

## **Transport Affordability and Motorcycle Ownership in Low-income Households: Case of Yogyakarta Urbanised Area, Indonesia**

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**Abstract:** The sprawling urban form and low quality public transport services are proven to affect the use of private vehicles. Most low-income people who live in this kind of area are forced to have private vehicles to meet their mobility needs. Therefore one of the solutions is to improve public transport as a more affordable mode. In the case of developing countries such as Indonesia, this policy alone may not solve the problem. The growth of motorcycle causing public transport cost not necessarily more affordable than private vehicles. Based on the reasons, the purpose of this paper is to examine whether these presumption are valid using the case of the Yogyakarta Urbanized Area. Data are collected using questionnaire and interview. The result of this study is that transportation costs using motorcycles are considered cheaper than public transport. However, the cost of a motorcycle was apparently still causing low-income communities in hardship.

*Keywords:* transport cost, transport affordability, low-income people

### **1. INTRODUCTION**

The rapid growth of private vehicles, especially motorcycles is one of the transport problems faced by big cities in Indonesia. From 2000 to 2013, the growth of motorcycles in Indonesia increased by 600% and Yogyakarta as one of the big cities in Indonesia is also following the same pattern. The rapid growth of the motorcycle was allegedly due to economic growth and changing lifestyles. But there are also allegations that the use of private vehicles increased due to lack of transportation services that force people to use private vehicles. Increased necessity to use private vehicles not only occurs in middle to high income people, yet also occur in low-income communities.

In the cases in developed countries, the compulsion to use private vehicles caused more by a lack of public transport services (see for example: Delbosc and Currie, 2011). Some studies (Naess, 2005; Burke and Hayward, 2001), revealed that the availability of affordable housing for lower-income people forced them to live far away from the city center, where land prices are more affordable. Other studies also found that people with lower socioeconomic conditions tend to live in the region with poor access to the transportation services (Dodson, 2007). Mattioli and Colleoni (2016), categorized it as a B type city where the conditions of transport disadvantage experienced by low-income residents is not resolved by the availability of public transportation on the city suburb.

In developing countries, the failure of the city to respond to the rapid growth of travel demand led to the rapid growth of motorcycle ownership and use. As a result, motorcycle now dominates urban transport in those cities, such as Jakarta and Hanoi (Tuan, 2015). However, based on previous studies, low-income people realized that motorcycle is not an ideal choice of transportation mode due to its vulnerability and fatality of the accident (Herwangi *et al.*, 2015). They are forced to use motorcycle because of the lack of availability of transportation services, and their job characteristics that cannot be served by public transport (Herwangi *et al.*, 2015). In addition, there is an indication that the choice of using the motorcycle is also due to the perception that the cost of transportation for motorcycles is cheaper compared to public transport (Adriyana 2011; Novitasari 2011; Aritonang, 2007; Erli H. 2006).

Until now there is less attention regarding transport affordability than other technical aspects of transportation. In USA, there is little solid information about how much American in any income level spend for transportation (Agrawal, 2011). This is also the case in developing countries where the issue of transport expenditure has been less studied (Pettersen, 2005). In Indonesia the studies that compared the transport expenses incurred in low-income people when using motorbikes and public transportation is still limited. Nevertheless, motorcycle is widely used by low-income people to fulfill their mobility needs. Therefore the aim of this paper is to examine whether the presumption that the cost of using motorcycle is cheaper than public transport are valid using the case of the Yogyakarta Urbanized Areas (YUA), which is one of the cities that experienced a rapid increasing of motorcycles ownership in Indonesia.

## **2. VEHICLE OWNERSHIP AND TRANSPORT AFFORDABILITY OF LOW-INCOME PEOPLE**

### **2.1 Vehicle ownership and transport expenditure in low income people**

Private vehicle ownership for low-income communities have two sides. On the one hand a vehicle ownership is seen as a means to facilitate the movement so that it opens up various opportunities for low-income people to improve their quality of life (Ong, 2002; Social Exclusion Unit, 2003; Clifton and Lucas, 2004). Some initiatives even done to improve access to private vehicles as was done in Hereford Shire and Suffolk Community Councils, UK, with a program named "Wheels to Work" (Department of Transport UK, 2000). But on the other hand, vehicle ownership can also cause a financial burden for low-income people that led to the term "transport poverty" (Lucas *et al.*, 2016; Gleeson and Randolph, 2002) or "forced car ownership" (Jones 1987; Banister 1994 in Currie and Delbosc 2009). It can be implied that vehicle ownership for low-income people could increase their social inclusiveness, but also could make financial burden to the family.

Therefore research on transport costs and its impact on low-income people really need to be done. However, unfortunately, this research still has not been the focus of studies on transportation and public policy. One of them is because of the difficulty of getting the data needed due to the unwillingness of respondents to provide information in this regard (Agrawal *et al.*, 2011). As studied by Olvera (2015), there are particularly three type of difficulties in collecting transport expenditure data, especially in Africa where the study took place, which are: 1) difficulties in estimating income derived from informal activity and occasional work. In Indonesia, informal workers consist of 60.2% of total workers, so, this could also be the case in Indonesia; 2) some of the income derived not from professional

activities (grants, benefits, pension, gifts from friends, family, and relatives) and earned irregularly, particularly in the case of gifts; 3) members of the family do not always informed about the amount earned by other family members. This could be a problem if the survey is only collecting information from a single informant in each household to give data of a whole family.

Based on studies conducted by Agrawal, the majority of low-income people are concerned about their transportation cost. In order to survive, they "actively and strategically manage" their limited income to covering their transportation cost. Some strategies are undertaken and it sometimes create hardship. Some of the strategies are: buying old vehicles, doing self-maintenance of the vehicles, and reducing other expenditures, such as expenditure for food, clothes, and recreation. (Agrawal, 2011). Due to the transport difficulty, low-income people also take 20% fewer trips and travel 40% fewer miles than other income groups (Loveless, 1999 in Scholl, 2002).

## **2.2 Transport affordability of low-income people**

Some of the research regarding transport cost affordability has been done by Litman (2014), Venter (2011), dan Venter dan Behrens (2005). Transport affordability is defined as the ability to make necessary journey to access basic needs, such as work, school, health, shop, and other service (Venter, 2011; Litman, 2014). In term of the specific number that is used as a benchmark, there is no agreement between the researcher and policy maker. For example, in the South Africa National Transport Policy 1996 (Venter and Behrens, 2005) 10% of disposable income is taken as the benchmark. In one of the research done by Zahavi (1974) it is stated that the travel budget of a person is between 7% to 9% (Bocarejo dan Oviedo, 2012). Other resource stated that transport affordability means that households spend less than 20% on transport cost or 45% on transport and housing (Litman, 2014). In this regard, this study is intended to provide some insight into transport expenditure of low-income people in YUA and further, it will also discuss the comparison between transport cost using motorcycle and public transport of low-income people.

## **3. RESEARCH METHODOLOGY**

### **3.1 Study Area**

The study area of this research is Yogyakarta Urbanized Area (YUA), which consists of the core area covering the City of Yogyakarta and surrounding urban areas covering Bantul Regency and Sleman Regency. There are 23 districts included in YUA. YUA region covers an area of 186.87 square km. Core area of the City of Yogyakarta is a high density built-up area, while the surrounding urban area is suburban areas with medium and low density that is experiencing rapid development. In terms of public transport service, the core area is served with adequate public transport service, while the suburban area is still lack of this service. In this study the area with lack public transport service is referred as transport disadvantaged area (TDA). The area with good public transport service is referred as non-transport disadvantaged area (NTDA). The more comprehensive explanation about identifying TDA and NTDA can be found in earlier publication of Herwangi *et al.* (2015).

To represent the characteristic of TDA, selected two districts in the City of Yogyakarta were chosen, which are Ngampilan and Notoprajan. Two other districts namely Sendangadi and Panggunharjo were also chosen to represent NTDA. The characteristics of each area can be seen on the map below

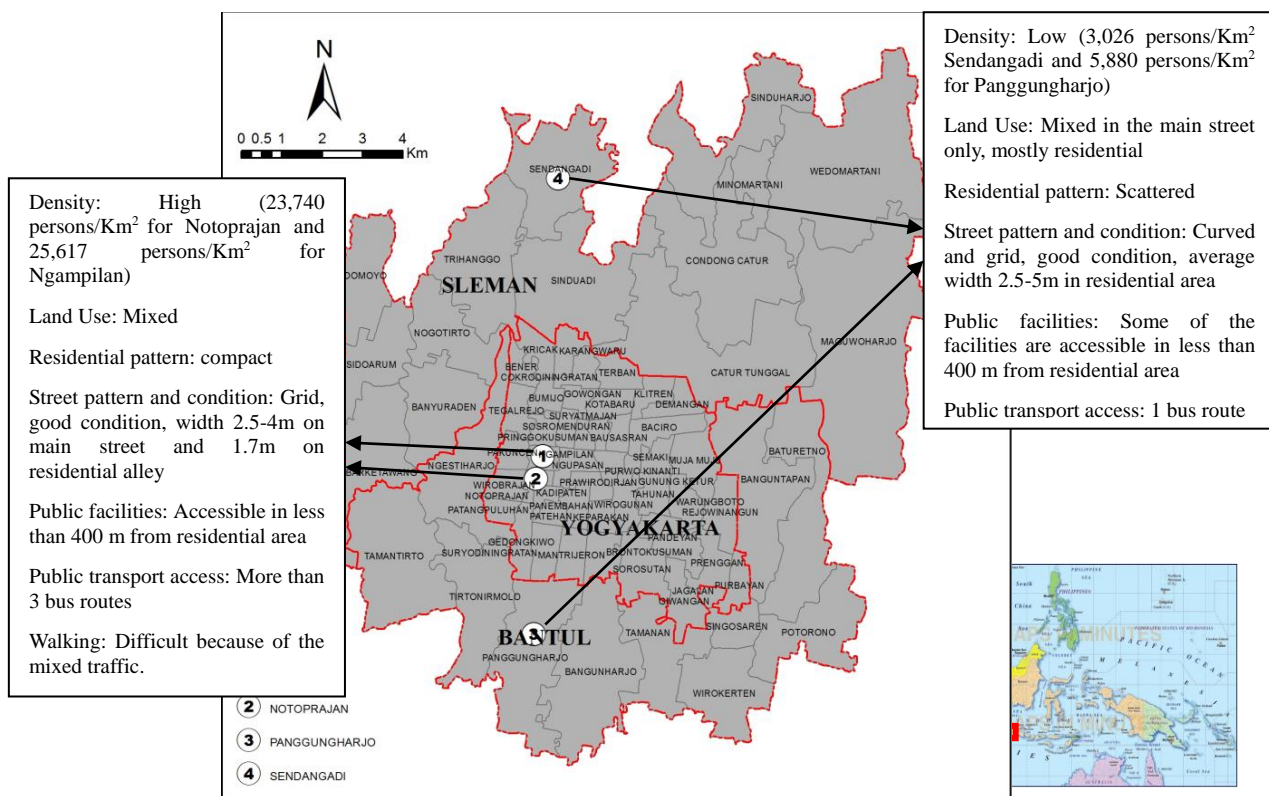


Figure 1. Study Area

### 3.2 Sampling Method

The sampling process is carried out in four selected districts. Respondents are low-income people who use motorcycles for their daily activities. Low-income people in this study is defined as a family whose daily consumption per family member is less than \$ 2 per day. This figure is adapted from ADB Standard of middle income people. According to the standard middle income people in developing countries is a person who consume more than \$2 per day. From that, the low-income people is assumed as people who consume less than \$2 per day.

The number of samples is calculated using the Cochran's formula (1977). Based on this formula, a total of 503 samples were selected using convenient sampling method. This method was chosen because not all households are willing to become respondents in this study. Data were collected from respondents using a questionnaire. Of the 503 questionnaires distributed, 437 (219 for the village Ngampilan and Notoprajan; 218 for sub Sendangadi and Panggungharjo) of it is declared valid. In addition to collecting data through questionnaires, an interview was also conducted to 40 respondents to deepen the data obtained from the questionnaire. Respondents for the interview were selected from the respondents that have been participated in questionnaire survey. Selection of the 40 respondents is based on the diversity of the data and willingness of respondents to be interviewed. Characteristics of the respondents can be seen in the following table:

Table 1. Characteristics of respondents in TDA and NTDA

	TDA	NTDA
Number of samples	219	218
Number of family members	3.61	3.61
Number of working family members	1.66	1.94
Monthly income (IDR)	1,251,803	1,299,862

### 3.2 Design of the Research

In accordance with the purpose of this study which is to examine whether the presumption that the cost of using motorcycle is cheaper than public transport are valid using the case of the Yogyakarta Urbanized Areas (YUA), the steps of this study are as follows:

1. Collecting trip data from respondents include: origin destination, purpose of travel, time, frequency, travel expenses and the vehicle cost of of motorcycle for work and school purpose. For that purposes, this study examined home-based trips, with regular travel destination, which are travel to work and school.
2. Identifying the daily travel route of respondents by using the Network Analysis from GIS software
3. Overlaying daily travel route of the respondents with the public transport route to determine the length of the trip that can be served by the existing public transport service.
4. Calculating the transportation costs incurred when using public transport, and compare it with the cost of transport by motorcycle
5. Analyzing the respondents' perceptions of the costs incurred, strategy undertaken to address these costs, and its impact on family spending

Travel data, transportation costs, and income data are analyzed in household scale. Data from each adult family members were aggregated to obtain household data. These data are then processed using descriptive statistics and compared between categories of TDA and NTDA for motorcycle usage data and between motorcycle and public transport for transportation cost, by using ANNOVA test. Transportation cost data collected in this study include the fuel cost and maintenance cost per month as stated by the respondents.

## 4. RESULT

### 4.1 Motorcycle usage of low-income people

The number of motorcycles owned by low-income households in the study area on average is 1.46 for the the NTDA and 1.58 for the TDA. This means that each household has more than one motorcycle. Families who live in the TDA has more motorcycle than families who live in the NTDA. This is influenced in part by the distance to the work place. People living in NTDA has advantage in terms of availability of jobs closer to home (Herwangi *et al.*, 2015). As can be seen in Table 2 and Figure 2, there are significant differences between the people living in the NTDA and the TDA in terms of daily travel distance to the workplace. The same thing happened to the trip to educational facilities.

Table 2. Motorcycle usage in TDA and NTDA

Motorcycle usage for:	Area		t- value	p-value
	TDA	NTDA		
Daily travel distance to jobs* (km)	7.146	5.536	-2.379	0,018
Daily travel distance to school** (km)	6.307	4.000	-3,111	0,002
Daily travel distance to other activities (km)	1.421	1.971	1,588	0,115
Total daily travel distance** (km)	18.714	13.769	-3,423	0,001

\* significant at p=0.05

\*\* significant at p=0.01

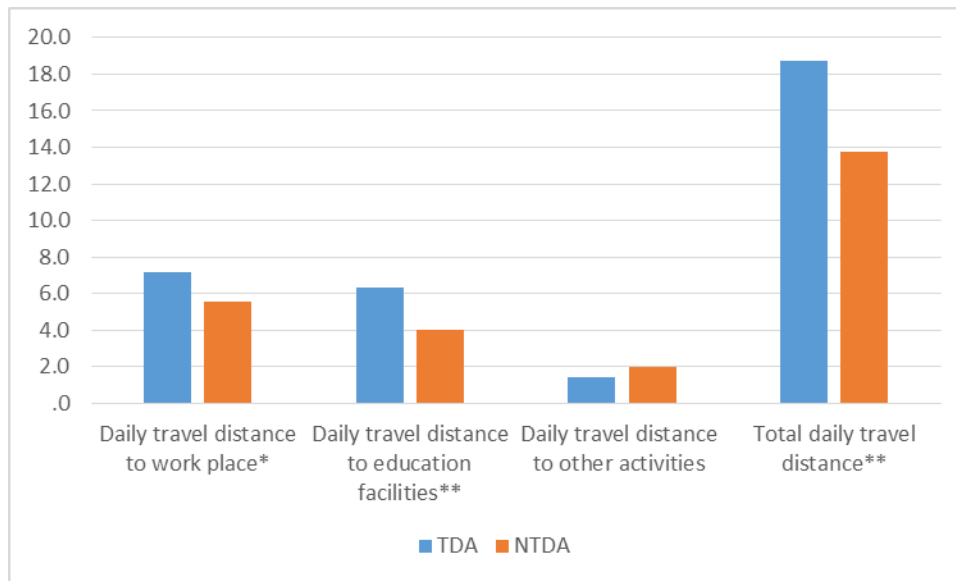


Figure 2 Daily travel distance to workplace and education facilities

More than 50% of respondents owned a motorcycle less than 10 years old. However, as much as 45% of motorcycles owned by low-income families in YUA has been used for more than 10 years. In fact there are 13% of motorcycles that have been used for more than 20 years.

#### 4.2 Motorcycle Expenditure

Most (58.4% of total) of the respondents obtain the motorcycle by buying new, either in cash or credit. Of these figure, 29.6% buy it on credit, while 33.3% of total buy a used motorcycle, and only about 8.2% get some support from their employer or from relatives. There are many low-income people who buy a new motorcycle on credit partly because it is relatively cheap and easy to buy a new motorcycle. For example, people just need to pay 1 million rupiah (74 USD) as a down payment to bring a new motorcycle home.

Table 3. How to get the motorcycle

How to get the motorcycle	%
Buy a new motorcycle on cash	28,8
Buy a new motorcycle on credit	29,6

Buy a used motorcycle on cash	27,5
Buy a used motorcycle on credit	5,8
Borrow a motorcycle from relatives or employer	8,2

To obtain a motorcycle on credit, respondent only have to pay IDR. 2,800,000 (250 USD) on average as a down payment. This amount is roughly equivalent to twice the average monthly income. Some respondents even be able to obtain a motorcycle with a down payment of less than IDR. 500,000 (35 USD). The amount of monthly installment to be paid is about IDR. 450,000 (33 USD), or more than 30% of the average income per month. With that amount, a motorcycle can be paid between 10 to 36 months.

In addition to the purchase cost, operating costs and maintenance costs are also taking a large portion of the income. Data shows that the average motorcycle expenditure in terms of operation cost reaches IDR. 198.698 per month (15 USD) while maintenance cost is IDR. 41 096 (3USD) per month. When compared with the total household expenditure, operational cost and maintenance cost reaches 18.35% and 20.90% for low-income reside in NTDA and TDA respectively. By using t-test, it is found that the percentage is differs significantly for low-income people reside in NTDA and TDA.

Table 4. Motorcycle Expenditure of Low-income People Live in NTDA and TDA

	NTDA	TDA	t-value	p-value
Average monthly purchasing expenditure (paid in 10-36 months)	IDR 527,532	IDR 601,946	0.389	.698
Average monthly operational expenditure	IDR 181,146	IDR 216,170	-1.576	.116
Average monthly maintenance expenditure	IDR 39,368	IDR 42,816	-0.539	.590
Percentage of operational and maintenance cost to total income	18.35	20.90	3.018	.003

### 4.3 Public transport expenditure

Public transport operating in the YUA consists of regular buses and BRT system called TransJogja. There are also paratransit, namely taxi, motorcycle taxi, and rickshaw. There are only small number of paratransit in YUA. In KPY there are 8 operating regular bus lines. At first there were 19 urban routes, operating in Yogyakarta, but that number dropped to 10 routes in 2010, and became the current amount, which is 8 routes in 2011 (Performance Measurement of Public Transport and Taxis, 2011). In addition to regular buses, there are also BRT system called TransJogja in which passengers can only get on and off from the bus at the provided bus stop. At the moment there are 6 routes TransJogja. In general, the performance of urban public transport in Yogyakarta continue to decline, which is characterized by reduced public transport route especially for regular bus transport; and the low load factor.

Calculation of the public transport cost is done to the respondent that 90%<sup>1</sup> of his/her travel route can be served by available route. Based on these criteria and the data collected, all

<sup>1</sup> The figure of 90% is obtained by calculating the distance that can still be reached by walking (walking distance). The average distance to place of work and into school is 7.9 km and 6.5 km. Based on the literature walking distance to public transport stops ranged only between 400-800m, which means the range between 5-10% of the average length of travel to work and school. Therefore, in this study the respondents who are more than 90% of the total distance traveled to work or school can be served by public transport, assumed as 'can be served by existing public transport service

the respondents who have been served by public transport for the purpose of work only came from low-income living in NTDA, ie only 51 out of 218 respondents NTDA, which means only about 23.34% of all NTDA respondents or only 11.37% of the total number of respondents. For school trips, there are fewer respondents who can be served by existing public transport service, only 17 respondents (all from NTDA) served by public transport, or about 7.8% of NTDA respondents. As for the overall length of daily trips of respondents in both TDA and NTDA, on average only 44.4% percent can be served by existing public transport routes.

Most respondents perceive the cost of public transport is bigger than using a motorcycle. However, because they owned motorcycle, they are not regular users of public transport. They cannot answer precisely when asked about how much it costs if they use public transport for daily activities. Therefore, in this study, the cost of using public transport is simulated with reference to the origin and destination of the respondents that they reported in the questionnaire.

Table 5. Average daily travel distance and travel cost for working trip and school trip

Average daily travel distance to work place	7.95 meter
Average daily cost of public transport for working trip	IDR. 11,460
Average monthly cost of public transport for working trip	IDR. 229,209
Average daily travel distance to education facilities	6.60 Km
Average daily cost of public transport for school trip	IDR. 7,533
Average monthly cost of public transport for school trip	IDR. 150,667

#### **4.4 Comparing public transport cost and motorcycle cost**

Simulation of transport cost using public transport made for respondents who have more than 90% of the daily trip distance to workplace can be served by available public transport route. Based on data collected, only respondents live in NTDA who meet this criteria, so that we can compare the cost with respondents from TDA. On average, respondents travel as far as 7.95 km (roundtrip) to travel to work and 6.60 km to (included in this category are parents who take their children to school). Of both types of the trip, the cost incurred by using public transport is greater than the cost incurred for the use of motorcycles. The gap between the cost reaches IDR. 172,659 (12.85 USD) per month. With that amount of money, low-income people can use it to pay for the installment of a new motorcycle. Thus it is understandable if the motorcycle become the mode of choice to meet the mobility needs of low-income people.

For school trips, the data obtained is not much different. Respondents who 90% of their daily travel distance can be served by public transport, the cost incurred when respondents used public transport is more expensive as much as IDR 105,896 (USD 7.88) per month when compared with the transport cost using a motorcycle.



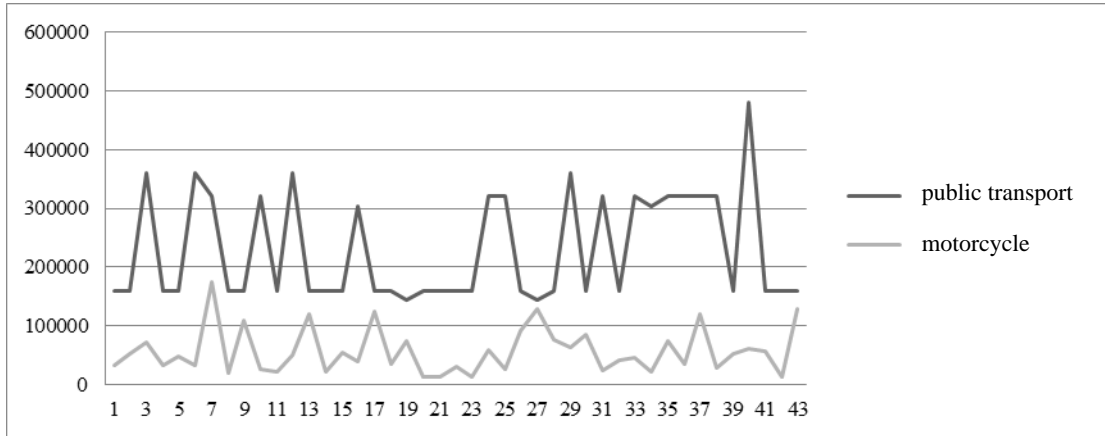


Figure 3. Motorcycle expenditure and public transport cost for trips to workplace

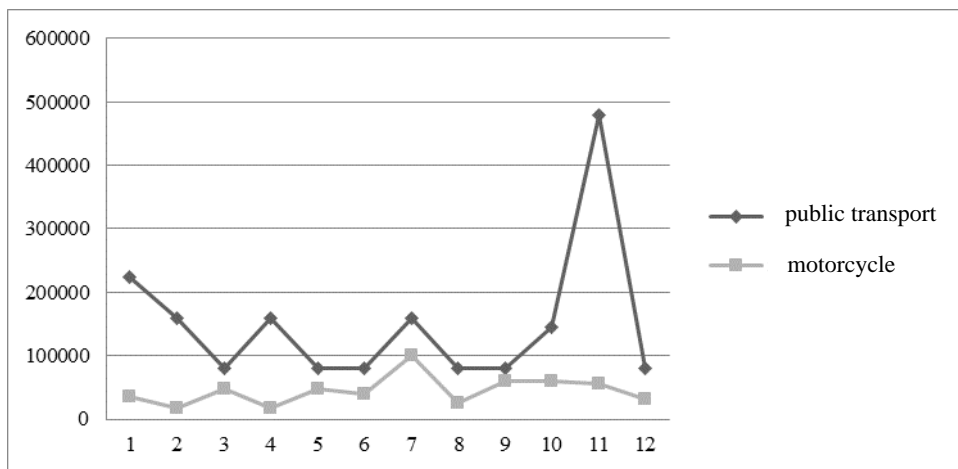


Figure 4 Motorcycle expenditure and public transport cost for trips to education facilities

Based on the sample data, the value of the population can be obtained by using confidence interval in inferential statistics. The 95% confidence interval for the motorcycle expenditure and public transport expenditure can be seen in Table 6

Table 6. Simulation of transportation cost for work and school trips

	Statistic	Parameter (95% confidence interval)
Public transport cost for work trips(IDR)	229,209	200,939 – 257,480
Motorcycle cost for work trips (IDR)	56,550	44,618 – 68,482
Gap between PT cost and motorcycle cost for work trips (IDR)	172,659	141,796 – 203,522
Public transport cost for school trips(IDR)	150,667	77,944 – 223,390
Motorcycle cost for school trips (IDR)	44,770	30,196 – 59,344
Gap between PT cost and motorcycle cost for school trips (IDR)	105,897	33,602 – 178,192

## 5. DISCUSSION

## 5.1 Perception of low-income people in transport costs

By the current fuel and maintenance cost, the operational cost of transportation with motorcycles ranging from an average of between 17.5 to 21.5 percent of their total income, while the cost of public transport is even bigger than the cost of motorcycle. This is line with the finding in Sub-Saharan Africa, where transport is a major component of poor household expenditure and daily use of public transport is unaffordable for the poor population (Olvera et.al, 2008). When compared to the affordability standard studied by Litman (2014), Venter (2011), and Venter and Behrens (2005), the low-income groups in YUA using motorcycles already belong to a group experiencing transport poverty. They are belong to the group that experience transport disadvantage. However, based on their perception, the majority of respondents (66.1% of all respondents either living in NTDA or TDA) do not consider the cost as a burden. This is because low-income people are already accustomed with large transportation costs, the absence of limited alternative modes of transportation, as well as the perception that by using public transport the cost will be greater, which is based on this study has proven to be true.

By comparing data between respondents who live in the TDA and NTDA, it is found that more respondents in TDA which states that transport costs by using a motorcycle burdensome. This is in line with the larger percentage of transport costs of people who live in the TDA. It is also related to the more distance that must be taken to get to a workplace than those who live in NTDA.

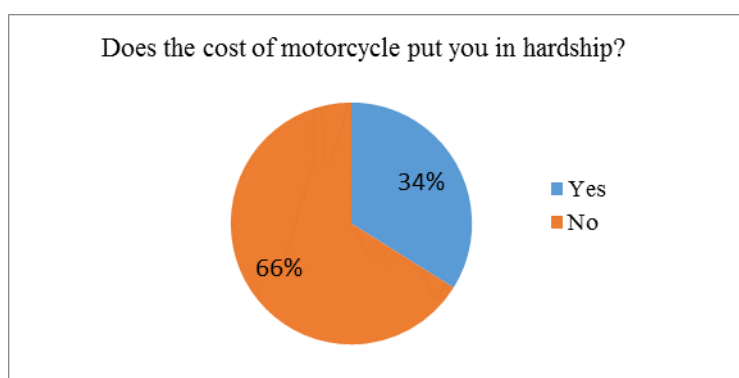


Figure 5. Respondents perception on the transportation cost

## 5.2 The strategies to deal with the high cost of transportation

The interview of data revealed that low-income households manage the cost of transportation using one or more of the following strategies:

1. Managing their income
2. Reducing non-transport spending
3. Modification their travel behavior
4. Managing their transport expenditure

Summary of the above strategies is in the Table 7

Table 7. Strategies of low-income households to manage their transport cost

Strategies	Examples	% of households adapting the strategies
Managing income	Borrowing some money from friends and relatives	25,9%

Reducing non-transport spending	Reducing discretionary spending (e.g. recreation, eating out)	23.8%
Modifying travel behaviour	Reducing non-discretionary spending	25,2%
	Reducing non-mandatory travel (e.g. recreational trips)	
Managing transport expenditure	Arranging trip-chaining to reduce the distance travelled	25,2%
	Fixing the motorcycle by themselves	
	Doing self maintenance of the vehicle	
	Buy second-hand motorcycle	

The number of households that chose each strategy are fairly balanced so that it can be said that there is no strategy that is most preferred compared to other strategies.

### 5.3 The rising of fuel price and motorcycle usage

The policy to dismiss fuel subsidy lead to a rise in fuel prices in Indonesia. To determine the willingness to pay of low-income people, a question is raised to the respondents: "How big is the increase in fuel prices per liter you can afford to continue to use the motorcycle?". This question was posed in the interview to obtain a more comprehensive answer. Most respondents feel they are able to bear the increase in fuel prices in order to remain able to use the motorcycle. They mentioned a nominal between IDR. 500 up to IDR. 2000 (USD 0.04 to 0.15) of increased cost per liter of fuel. When calculated with their daily fuel needs, this figure will increase 6.7% to 10% of transport expenditure taken from their income. This figure is quite similar with the amount they would have to spend if they use public transport. Of course there are other costs that have not been taken into account with the motorcycle ownership, such as the cost of purchasing a motorcycle. However, by consider it as an investment, and the calculation of benefit which is greater than the perceived value, they prefer to use motorcycle than public transport evethough the cost of using motorcycle will become higher after fuel subsidy abolition.

To encourage mode shift from motorcycle to public transport in low-income people a more significant policy may be needed. One example that can be done is to implement free train policy for low-income people as applied in Thailand. Based on research of Tansawat *et.al* (2015), free train policy has increased 32.65% of trip frequency for social purposes. Although this study did not examine how many mode shifts that occur from other modes of transportation, but the results of this study can give an insight of the great demand from low-income people to public transport that can be encouraged by the elimination of cost.

## 6. CONCLUSION

One of the obstacles in the shifting the mode from the motorcycle to public transport is a matter of transportation costs. Transportation costs using motorcycles are considered cheaper than the cost of using public transport. This study proves it. However, the cost of a motorcycle that was cheaper was apparently still causing low-income communities in hardship. The percentage of transport expenditure compared to total income of low-income people now exceed the standard of transport affordability. Moreover, when there is an increase in fuel prices that are very likely to occur. With that condition, the low-income people have no other option but to continue to use the motorcycle for their mobility needs, especially for routine activities such as going to work and school. To overcome the cost various strategies carried out by low-income communities, such as borrowing money from friends and relatives, buying

old vehicles, or reduce spending for other needs. Sometimes they even have to reduce important spending (non-discretionary spending), such as food, clothes, or school supply for the children. This leads to low-income people experiencing transport disadvantage, which is a condition where low-income people experiencing difficulty to perform daily activities caused by transportation. Nevertheless, based on the survey, most of the low-income people claim that they find no difficulty with the cost of transport which they bear today. It is because low-income people have been too long being in this condition so that they feel it as a normal circumstances.

One solution to overcome this problem is to provide affordable public transport that is capable of serving the needs of low-income communities. Public transport costs have to be lower than the cost of using a motorcycle to increase the chances of low-income people want to shifting modes. At the same time efforts to inhibit the increasing number of motorcycles also needs to be done. It should be noted that low-income people is now very dependent on the motorcycle in meeting their mobility needs so that the effort to restrict motorcycle must be done gradually. Furthermore, the provision of public transport should be adjusted to the mobility needs of low-income community because, according to our study (Herwangi *et al.*, 2015), low-income communities have distinctive travel patterns that is closely related to the characteristics of their work. By providing affordable public transport and accommodate their specific needs, it is expected that low-income people can switch to public transport as their chosen mode.

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