Study on Motorcycle Dependency of Factory Workers in Low-Income Cities:
Case Study of Sukabumi Regency, Indonesia

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Abstract

The development of the industrial sector in the Sukabumi Regency has caused severe transport problems along the main road. Since the factories are concentrated there, the commuters who work in the factories increase the load of the traffic, which is already significant. Angkot and private motorcycles often occupy the road as well, which is the main access during peak commuting times. If this traffic is not managed properly, the disastrous urban transport system could lead the Sukabumi Regency to fall apart because the lack of mobility and accessibility will not allow the regency to function in terms of supporting economic and social development. The objective of this study is to understand the motorcycle dependency of factory workers, including their commuting behaviors in low-income city. Quantitative research on factory workers in Sukabumi Regency was used to achieve the objectives. Based on this research, the dependency on motorcycles among factory workers is higher than the average in the regency. There are several variables that affecting commute behavior and mode choice among factory workers, particularly respondent and household background.

Keywords: motorcycle dependency, factory worker, low-income city, commuting behaviors

1. Introduction

For developing countries, manufacture sector still believed as the main engine for economic development. While the economic sector tends to shift into more service-oriented sector, the locational distribution of the factories began shifted into more peripheral areas, as the urban center changed into more service-oriented areas. Same goes with Sukabumi Regency as the biggest regency in West Java. Basic manufacture such as textile, garment and footwear industries moved their factories to the corridor of the national road that connected Sukabumi with Bogor and Cianjur Regency. Supported by abundance of low-skilled labor and the proximity advantage to the capital of Indonesia, manufacture sector in Sukabumi Regency has become the second highest contributor to the regional income and employment sector.

Although it can improve regional income and provide job opportunity for low-skilled labor, factory location is not managed and regulated properly, and causing the traffic disaster along the corridor. The mobility in the region increases due to the worker and goods movement, yet there is no significant improvement of the road infrastructure. As the main access that connected Sukabumi with other region, the road on the corridor has become the most

prone of road segment to the traffic jam. Insufficient public transport service also contributing to the traffic disaster considering many of the factory worker choose private motorcycle for their commuting mode. The over-reliance of transportation in Sukabumi Regency to road transportation also make it worse. As the result, road congestion of the corridor become daily problem in Sukabumi Regency, and often labelled as traffic jam disaster. This condition of course far from ideal, particularly for low-income cities that trying to catch-up the economic and regional development through manufacture sector. Because of this traffic congestion disaster, Sukabumi Regency lost its comparative advantage related to the proximity to the capital of Indonesia.

Through this study, the motorcycle dependency phenomenon in Sukabumi Regency was examined. Unlike big or metro cities that have quite significant amount of research related to the motorcycle dependency, the similar literature for low-income cities such as Sukabumi is very limited. The objective of this study is to increase the understanding about motorcycle dependency in low-income city of Sukabumi Regency, particularly among factory worker that concentrated along the corridor. By doing so, it will enhance the existing literature related to the urban transport in developing countries.

2. Literature Review

2. 1. Motorcycle Dependency in Developing Countries

Rapid motorization become one of the biggest problem for urban transport in developing countries. While it is less developed and economically lagging behind, the number of vehicle growth in developing countries, particularly in Asian region, often surpass the counterpart in well-developed countries. There is common pattern related to rapid motorization phenomenon in developing countries. The absence of proper regulation to manage the pace of rapid motorization is the most notable common pattern of motorization in developing countries. Uncontrolled rapid motorization could lead developing cities into severe transport problem considering the effect on sustainability and livability (Kenworthy, 2011). Developing countries also need to deal the mismatches between land use pattern that promoting motorization with the limited transport infrastructure. The sprawl pattern of land use usually lead into vehicle ownership because of the high cost and insufficient service of public transport. However, the transport infrastructure most likely fails to match the growth of mobility. Several previous study found that land use which imprinted through urban form and transport infrastructure as one important factor in determining the pace of motorization (Barter, 1999; Cervero, 2013; Gakenheimer, 2011; Kenworthy, 2011).

Other problem is unlike developed countries, the developing countries particularly in Asia and Africa also need to deal with the growth of motorcycle which is more significant compared to 4-wheeled vehicle. The characteristic of motorcycle which able to travel in congested traffic make it is more reasonable for low-income household to improve their mobility, considering the motorcycle is more affordable compared to 4-wheeled vehicle. However, for the cities, high rate of motorcycle growth increase the traffic burden and make transport problem more complicated (Nagai, Fukuda, Okada, & Hashino, 2003). Based on previous literatures, beside land use, household characteristics such as size, income, number of worker in household and number of motorcycle driving license holder in the household level become the main factor that influence the motorcycle ownership (Anh & Mateo-babiano, 2013; Leong, 2007; Senbil, Zhang, & Fujiwara, 2006). This is understandable considering the decision to own vehicle usually determined by household decision. It is highly possible that single motorcycle is used by almost all member of household, since they can use it alternately. Other factors such as travel pattern, characteristic of engine and vehicle price also become considerations to own the motorcycle (Anastasopoulos, Karlaftis, Haddock, & Mannering, 2012; Burge, Fox,

Kouwenhoven, Rohr, & Wigan, 2007).

It is important to note that the vehicle dependency is not only measured by the ownership of the vehicle, but also the usage rate of the vehicle (Rodrigue, Comtois, & Slack, 2013). For many cities with limited public transport service, the emergence of informal public transport such as motorcycle taxi has add the complexity of urban transport problems (Anh & Mateo-babiano, 2013; Cervero & Golub, 2007; Dimitriou, 1995; Dimitriou & Gakenheimer, 2011; Guillen, Ishida, & Okamoto, 2013; Hadi & Yoshida, 2017). However, not many study that view motorcycle ownership and motorcycle usage (including motorcycle taxi) as integral part in defining motorcycle dependency (Dinye, 2013; Guillen et al., 2013).

2. 2. Commute in Developing Countries

As mentioned earlier, land use pattern in developing countries usually promoting high use of automobile, yet the transport infrastructure and public transport most likely fails to meet the mobility demand. This condition will encourage people to choose private vehicle over public transport and affecting their commuting pattern. Change in the land use of the cities also believed will greatly affect the commuting pattern for urban residents. Previous study found that urban expansion which mainly caused by industrialization claimed as major factor in changing the commuting pattern (Zhao, Luë, & de Roo, 2010). Sprawling expansion through industrialization will increase travel needed through the emergence of new center of activities and new employer that work on industrial areas. The problem arises for fast growing cities in developing countries as they often overlook the commuting issues when they formulating spatial plans or masterplan (Alpkokin, Cheung, Black, & Hayashi, 2008).

Industrialization not only affect the commuting pattern through the distribution of the location (Deichmann, Lall, Redding, & Venables, 2008; Lee, 1992). Industrial type also contributes in shaping the commute pattern of the urban residents (Fragkias & Geoghegan, 2009; Henderson, 2002). Different type of industries will require different type of workers. For basic industries which require many female workers for their employment, urban and transport planner need a careful consideration in managing commuters considering different nature of commute pattern between male and female workers (Roy, 2009). Several studies related with the female workers commute already been conducted to understand the pattern. The tendency of shorter travel time and using public transport become the main character of female worker's commute (Crane, 2007; Haley-Lock, Berman, & Timberlake, 2013; MacDonald, 1999). Moreover, despite showing different in the term of accessibility, travel pattern, and more influenced by fear of attack or harassment, women's commute issues usually have little traction and often overlooked by policy maker (Rosenbloom & Plessis-Fraissard, 2009).

Commuting pattern and rapid motorization in developing countries has been studied thoroughly studied by many scholars. However, most of the studies are focused on big or metro cities in developing countries, which supported by abundance resource in the term of finance and human resource. The number of the literature that studied commuting pattern and motorization in low-income cities with limited finance and human resource support is quite limited. Providing literature related with commuting pattern and rapid motorization in low-income cities will provide better understanding about regional development in developing countries. The study particularly on manufacture worker as it believed that manufacture sector as the main engine of development. There are several research questions arise in this research:

1. Is there any different commute behavior between factory worker that own motorcycle and worker who do not own it?

2. What factors that affecting the motorcycle ownership among the factory worker?

3. What factors that affecting the worker to choose their commuting mode?

This paper divided into five sections. The third section of this paper described Sukabumi as the locus of the research, while the fourth section will explain research method and data collection. The last section is explaining the finding and discussion, while the last section is conclusion.

3. Characteristic of Sukabumi District

Sukabumi is the largest district in the West Java Province, with a total population of approximately 2.5 million people and with an annual growth rate of around 0.5%.[i] Approximately 5.21% of the total population in West Java Province, with the population density around 585 person/km^2. In the term of natural resource, Sukabumi Regency become one of the richest region in West Java Province, which is surrounded by long coastal line in the south part of the regency and mountainous areas in the north part. However, it is completely different for the infrastructure available, which is very limited compared to the vast area of Sukabumi Regency. There is imbalance development between northern part and the southern part of the regency. The development and population tend to concentrate in the northern part of the district due to the main road access that connecting the district to the capital of Indonesia.

The main access point that connects Sukabumi District with other regions runs around the hillside in the northern part of regency. The urban areas of the regency are mainly concentrated in this area, forming sprawl pattern along the corridor that been established in spatial regulation as the corridor of the strategic area of sustainable economic development of the regency. It is located along the national road from the Cicurug district at the west part to the Sukalarang district at the east (Hadi & Yoshida, 2017).[ii] It consists of 9 districts, with 5 being determined as urban areas in Sukabumi Regency.[iii] This corridor has become one of the most prone areas to the traffic jams, and labelled as a traffic congestion disaster area by the people who pass through the area. This is understandable, considering the fact that there are limited roads available, while the population in the area is always increasing, and the developments are concentrated along the road. An urban sprawl pattern with several town centers marked by traditional markets has spread along the access, which also contributes to this traffic disaster situation.

3. 1. Sukabumi Employment Sector

As a part of Indonesia that has a huge demographic bonus, Sukabumi population is also showing the same trend. There are more than 57% of Sukabumi's population (male and female) at the age in which they will be the most productive as workers (20-50 years old).[iv] The Sukabumi Regency relies heavily on natural resources as its main source of income. The three biggest employment sectors in the Sukabumi Regency consist of agriculture (29.14%), manufacturing (21.38%), and the trade sector (21.01%).[v] While it can absorb many employees, the growth rate of the agriculture sector is only 8%, far below that of the trade sector (15%) and the industrial sector (14%).[vi] However, unlike the agriculture and trade sectors that employ more male workers over female workers, the manufacturing sector shows different trends with more than 70% of its work force consisting of female workers.

Based on figure 1, the worker distribution in the Sukabumi Regency is concentrated in the northern part of the regency, since all of the manufacturing factories are located there. The picture above also shows several of industrial cluster planning of the regency. According to the Sukabumi Regency Spatial Plan, the industrial clustering areas are concentrated in several places spread out in the regency area. The clustering of manufacture industries is planned to concentrate in Ciambar and the Cikembar district. While the Cikembar district is located far enough from the corridor of sustainable economy (figure 1), the Ciambar district industrial clustering area is planned to be located
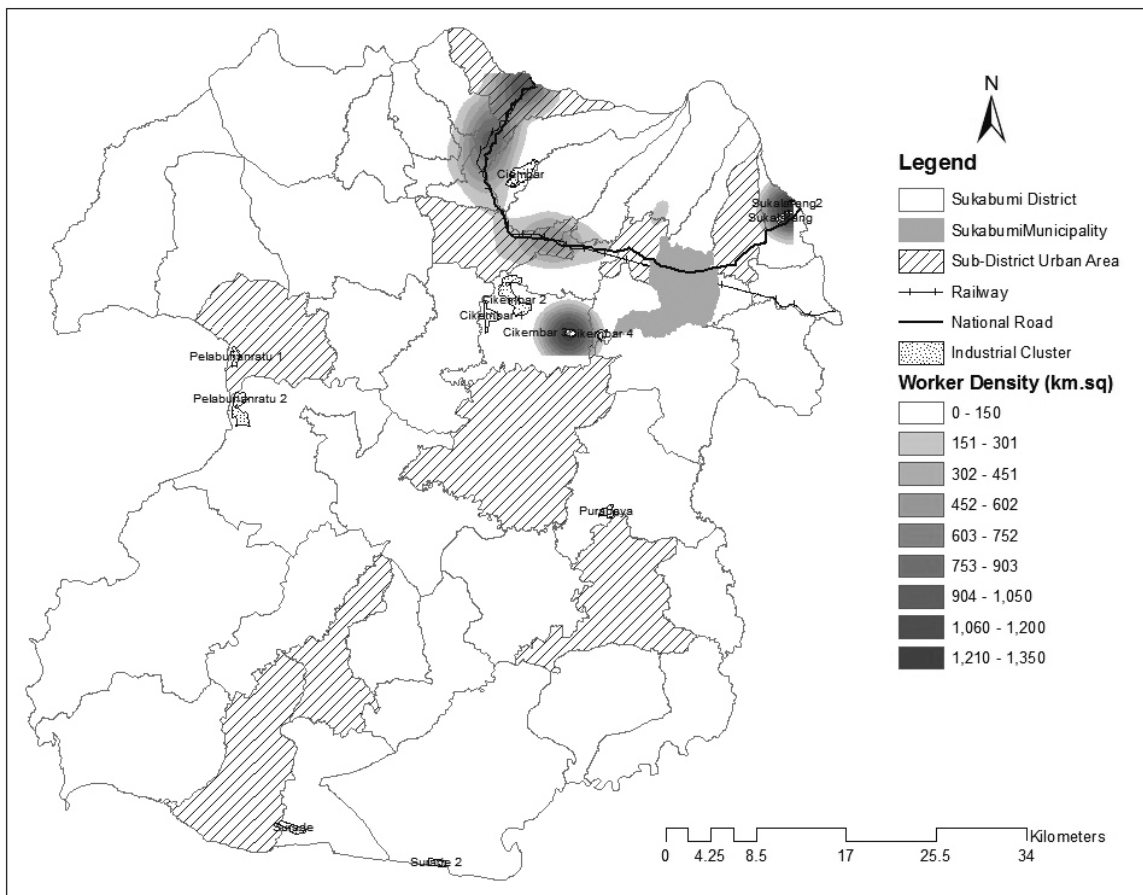
Figure 1. Spatial Plan and Distribution of Factory Worker

（Source: Employment and Transmigration Agency of Sukabumi Regency and authors）

in the corridor. Based on the transportation masterplan of the Sukabumi Regency, this part of the corridor is the most prone road segments for traffic congestion, particularly during the primary commuting times. This condition is understandable, considering the concentrated distribution of the factory workers that has been shown on the picture.

3. 2. Sukabumi Urban Transport

Like other regions on the island of Java, Sukabumi relies only on land transportation, and there are only two kinds of public transportation available in Sukabumi Regency: road-based transportation and a very small rail sector, which began operation only around 2012 and connects Sukabumi to the neighboring regions of Bogor and Cianjur Regency. All road-based modes—whether public, private, company, four-wheel, or two-wheel, motorized or non-motorized, formal or informal—operate on the same roads, making the road-based modal mix very high, significantly reducing efficiency. Roads—especially the national road—are quickly saturated, and the congestion level is high, especially during commute times.

The total road length in Sukabumi Regency is less than 1,800 km, which has been at the same length for past 8 years, without any improvements being made.[vii] All roads are classified as III C roads, with a maximum vehicle load of 8 tons.[viii] Compared to the total area—which is about 4,200 km²—these roads fulfill only about 10% of the total road needs, according to the Public Works Ministry.[ix] Two-wheeled private vehicles are the most common mobility choice,
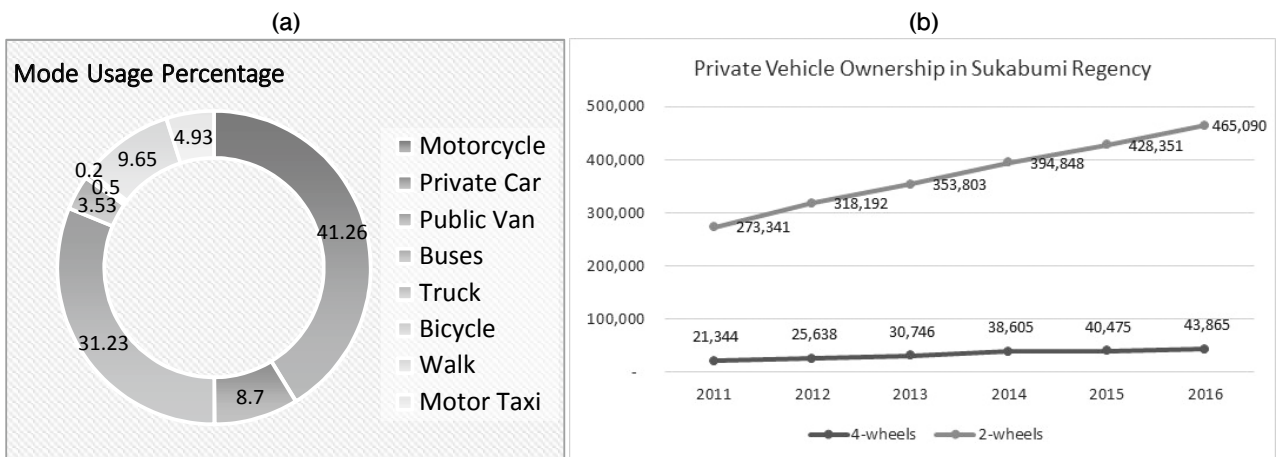
(a)

Mode Usage Percentage

- Motorcycle
- Private Car
- Public Van
- Buses
- Truck
- Bicycle
- Walk
- Motor Taxi

4.93
0.2
0.5
9.65
3.53
41.26
31.23
8.7

(b)

Private Vehicle Ownership in Sukabumi Regency

273,341 318,192 353,803 394,848 428,351 465,090
21,344 25,638 30,746 38,605 40,475 43,865

Figure 2(a). Mode Usage for Movement in Sukabumi Regency (Hadi & Yoshida, 2017);
(b). Private vehicle growth in Sukabumi Regency 2011-2016

(Source: Sukabumi Regency statistical Bureau)

with public-van (Angkot) as the second choice.[x] Non-motorized choices, including cycling and walking, make up less than 10% of total trips, according to the same source. Figure 2(a) shows Sukabumi residents'modal choice.

While the infrastructure is in a stagnant condition without improvement, the number of vehicles continuously grow every year. Many available vehicle ownership options with reliable back-up from financial institutions through the easy process of taking out loans, combining with the transport policy that encourages motorization, make the vehicle ownership unstoppable. Each year, more than 3,000 cars and 30,000 motorcycles are added to the traffic load (Figure 2(b)), while the amount of available roadway remains the same. In addition, the amount of public transportation remains nearly the same year after year (Figure 3).

Inevitably, road-based transportation dependency result in the public transportation system's low quality of service. Similarly to other regencies, all of the formal, road-based public transportation in Sukabumi Regency operates on fixed routes without fixed transit locations or scheduled service. A high level of reliance on road transportation make the roads over-saturated and easily congested. This proneness to congestion has reduced the service rate of public transportation, which is already inconvenient enough, considering that it operates with semi-transit systems without exact schedules. Average speeds of public transportation systems are far lower than those of private vehicles,
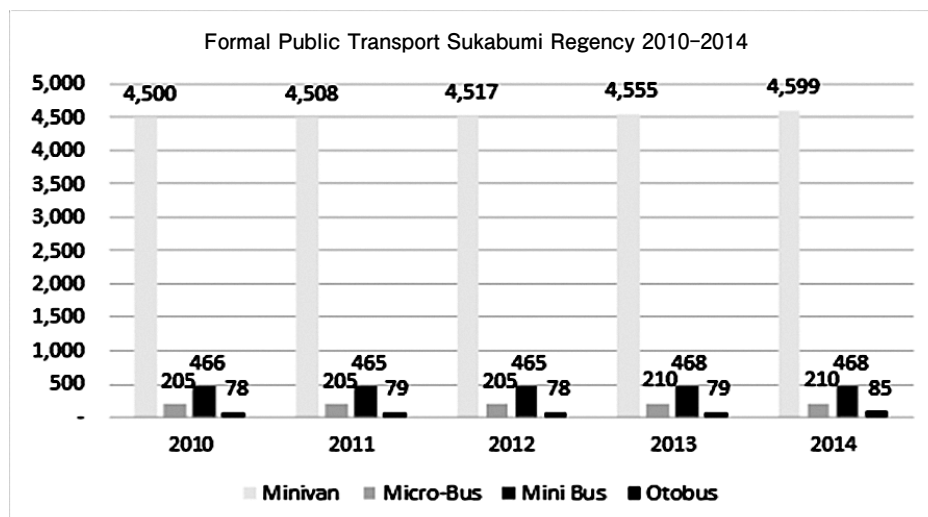

Figure 3. Public Transport Available in Sukabumi Regency (Source: Sukabumi Transport Masterplan)

especially when compared to motorcycles that can slice through congestion because of their smaller size.

The concentration of the manufacturing factory location, the poor public transport available, and rapid motorization have all caused the corridor to have severe traffic problems, particularly at the peak of commuting time. Angkot and private motorcycles that are used for workers' commuting often occupy whole roads in certain times, creating traffic jam chains all the way to the factory location. To solve this problem, the government built a highway road as an alternative to connect Sukabumi District with other regions. This highway road has several intersections along main road in the corridor. This project was begun in 2016, but there are several problems related to land acquisition in the Sukabumi section.

4. Research Method and Analysis

In this research, a quantitative method using a statistical approach was conducted to achieve the objective above. The questionnaire about mobility survey was conducted by purposive random sampling in 10 big factories along the study area. The factory was chosen based on the number of worker and the location, as the survey of the two factories that located near each other was avoided.[xi] Around 10 respondents were surveyed on each factory. Based on the calculation of the total manufacturing workers being around 123,000 people, the minimum sample size is 96, with the confidence level 95% and confidence interval 10. The questionnaire was divided into two different parts, the first being about the respondent's mobility behavior. This section emphasized the respondent and their household commuting behavior. The second part was related to the respondent's opinion about two public transport modes in the Sukabumi Regency as the most common public transport modes available. Those two modes are Angkot and Ojek[xii].

There is a total of 98 respondents participating in this research, with 78 out of 98 (80%) being female respondents, and 20 of the rest (20%) being male respondents. This number only slightly more than minimum sample required, which might lead some doubt for the data reliability. However, authors feel confident that the dataset built in this research is reliable for some reasons: The homogeneity of the respondents in the term of economic background and the site choice that chosen along the corridor. The objective to study about factory worker's commute behavior make the scope of the study narrower compared to the other similar studies. The respondents are believed have same economic background as it is become common knowledge in the study area, that factory worker in Sukabumi usually come from low-income household considering the minimum payment they received. In the term of site chosen, beside the worker's number, the factory chosen is not concentrated in some certain areas but spread along the corridor to increase the geographic representation.

The gender distribution represents the overall manufacture gender distribution in the district, that female worker's number dominated greatly over male worker.[xiii] The age of the respondents varied in the productive age range, with the minimum age being 19 years old and the maximum age being 40 years old. The average age of the respondents is 25.70 years old. The salary of the respondents varied between IDR[xiv] 1.25 million–IDR 4 million, with the average being around IDR 2.485 million, slightly higher than the minimum salary of the regency, which is around IDR 2.3 million. For their transportation, 51.2% are using the public transport service[xv]—mainly Angkot and a small fraction of Ojek—with the rest using private motorcycles as their primary mode for commuting. There are only less than 2% of the respondents who commute by walking. The distance to the workplace varied up to 41 km, and the average distance from work is 8.33 km, with the average commuting time being around 30 minutes and average commuting cost being around IDR 300.8 thousand.

Table 1. Tabulation of Questionnaire

	N	Minim um	Maxim um	Average	Unit
Age	98	19.00	40.00	25.70	years old
Income	98	1,250.00	4,000.00	2,485.67	Rp (x1,000)/month
Income (HH)	98	1,500.00	10,000.00	4,438.97	Rp (x1,000)/month
HH Member	98	1	10	4.54	people
Worker in HH	98	1	6	2.03	people
Student in HH	98	0	4	0.92	people
Car Owned	98	0	2	0.07	car(s)
Motor Owned	98	0	3	0.99	motor(s)
Bicycle Owned	98	0	2	0.24	bicycle(s)
Commuting Cost (HH)	98	−	840.00	300.80	Rp (x1,000)/month
Distance to Workplace	98	0.10	41.00	8.33	km
Commuting Time	98	5	90	29.66	minutes

In terms of household data, the average number of household members from the respondents was around 4.54 people/household, with 2.03 of them being working adults. The average number of the students is 0.92 student/ household. In terms of vehicle ownership, there are 73 out of 98 households that owned a private motorcycle, with the total number of motorcycles being 96. The ratio of motorcycle ownership is 248.7 motorcycles/1,000 people, much higher than the regency ratio of motorcycle ownership (163 motorcycles/1,000 people). For car ownership, there are only 5 households that owned a private car, with the ratio being only 15.7 cars/1,000 people, which is less slightly compared to regency ratio of 16 cars/1,000 people.[xvi]

The first analysis uses t-test analysis to get a better understanding of how the different respondents related to their commuting behaviors. Motorcycle ownership is used to grouping the variable into two different groups. Based on table 3, there are 4 different variables in the first grouping that have significant different meanings, with the significance level being 5%. This consists of the number of workers in the household, the number of students in the household, the individual commuting cost, and the distance of the commute.

Table 2. Explanatory Table of Variables

Term	Des cription	Unit
HH Member	Number of household member	(pers on(s)/hous ehold)
Workers in HH	Number of worker in household	(pers on(s)/hous ehold)
Students in HH	Number of student in household	(pers on(s)/hous ehold)
Car Ownership	Number of car owned by household	(car(s)/hous ehold)
Motorcycle Ownership	Number of motorbike owned by household	(m otorbike(s)/hous ehold)
Cycle Ownership	Number of bicycle owned by household	(bicycles(s)/hous ehold)
Working Transport Cost (HH)	Total trans portation cost for commute in household in a month	(IDR/m onth)
Individual Commute Cost	Commuting cost of the respondent in a month	(IDR/m onth)
Distance to Work Place	Distance between respondent's house and workplace	(km)
Commuting Time	Total time spending for commute from their living place into workplace	(m inutes)
Income of Respondent	Respondent's income	(IDR/m onth)
Housing Stat (1)	Housing status of the respondent, own (1) or rent (0)	−
HH Income	Total income of household	(IDR/m onth)
Motorcycle Ownership	Grouping variable based on household ownership of motorcycle(s) or not in household level	
Commuting Mode	Grouping variable based on commuting mode choice, whether it is private vehicle or public trans portation	
Motorcycle User	Grouping variable based on the motorcycle us age wether it is private or public (ojek) for commute or no	
Satisfied / Not Satisfied	Public perception about public trans ports ervice in the district (Angkot and Ojek). Their perception will be categorized as satisfied when the total scale mark of their answer in questionnaire is 3 or more. When it is less than 3, then it will be categorized as not satisfied	

Table 3. Motorcycle Ownership Individual T-Test

Motorcycle Ownership	Mean		Anova (F-Test)	t-value of t-test	Sig (2- tailed)
	Own (N= 73)	Not own (N=25)			
HH Member	4.63	4.28	1.517	0.77	0.443
Workers in HH	2.16	1.64	0.21	2.452	0.016**
Students in HH	0.81	1.24	5.745	−2.124	0.036**
Car Ownership	0.1	0	7.133	1.262	0.21
Cycle Ownership	0.27	0.16	4.474	0.986	0.327
Working Transport Cost (HH)	358,465.75	308,640.00	2.155	0.871	0.386
Individual Commute Cost	296,054.79	205,920.00	0.85	2.158	0.033**
Distance to Work Place	9.08	5.61	5.185	2.155	0.034**
Commuting Time	28.59	32.80	0.694	−0.98	0.33
Income of Respondent (IDR)	2,503,269.59	2,434,284.80	3.004	0.743	0.459
HH Income (IDR)	4,232,315.07	5,040,160.00	0.028*	−1.704	0.097
* Equal variance not assumed					
** Statistically significant at 5%					
*** Statistically significant at 1%					

To understand the determinant factor of household that influence the decision in obtaining motorcycle among the factory worker's household, binary logistic regression analysis using discrete model choice with cross-sectional data were used. As seen on table 4, the model is statistically significant, for Chi-square = 42.874, the value of $p < .05$. The model explained 47.2% (Nagelkerke R^2) of the variance in motorcycle ownership, and correctly classified 78.6% of the cases. The result shows by the partial test shows the consistency with the t-test in previous analysis. The motorcycle ownership will increase most likely 261% when the number of worker in household increase (significant level 1%). Other factors that significantly affect the decision of household to buy motorcycle are household income, and distance with 10% significance. Unlike variable of commuting distance that has positive influence in motorcycle ownership, household income variable shows that it has significant effect on the model, but it does not affect in motorcycle ownership.

Table 4. Model Summary

Step	−2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	92.983[a]	.354	.472

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Table 5. Variables in the Equation

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1[a]	HH Income	.000	.000	3.242	1	.072	1.000
	Distance	.091	.048	3.506	1	.061	1.095
	Student in HH	−.446	.275	2.638	1	.104	.640
	Worker in HH	.960	.316	9.215	1	.002	2.611
	Housing Stat (1)	.022	.711	.001	1	.976	1.022

a. Variable(s) entered on step 1: HH Income, Distance, Student in HH, Worker in HH, Housing Stat.

The next analysis is the mean difference between users and non-users of private vehicle in commuting to the workplace (table 6). Based on the questionnaire, all respondent that using private vehicle are using motorcycle for commute. The mean difference between users and non-users of public transportation are statistically significant in terms of motorcycle ownership and an individual's commuting cost, with a significance level of 1%. The other variable that has statistically significant means is the average number of students in the household (sig. 5%).

The third analysis with the t-test is user and non-user of motorcycle, whether use private motorcycle or public transportation option. The first group defined themselves as motorcycle users. Although they might be using multiple modes of transportation for commuting, if one of them is a motorcycle (either private or public), then they will be categorized as the first group. The second group is non-users of motorcycles, including those who walk to their workplace. Based on table 7, there are two variables that have a significant different of 1% and one variable that has a difference with a 5% significance. The first two are motorcycle ownership and commuting distance. The difference also means that the individual commuting cost has a 5% significance. The result shows consistent findings related to the previous test.

To form a better understanding of the relationship between non-parametric variables, descriptive statistics using cross-tabulation and chi-square analysis are employed. The satisfaction of public transportation and gender become the axis of this analysis. The satisfaction is measured subjectively based on questionnaire related to the fare, safety, and quality of service of the two most common transport modes in the district, Angkot and Ojek. Based on their answer, they will be categorized in two different groups, feel satisfied or not satisfied (table 8 & 9). There are several non-parametric variables that are examined, consisting of gender, private vehicle use, and motorcycle use.

Based on the analysis (table 8), there is a correlation between public transport (PT) satisfaction (Angkot), gender, and private vehicle use that is statistically significant (sig 5%). Most male respondents feel that the service level of PT is not satisfying (70%). Meanwhile, most of the female respondents feel satisfied with Angkot service (56%). However, different result shown by the satisfaction rate of Ojek. There is no variable that statistically significant related to the service of Ojek as part of public transport in Sukabumi Regency.

To provide more information about mode choice among factory workers, multinomial regression was used. In this

Table 6. Private Vehicle User Individual T-Test

Commuting Modes	Mean		Anova	t-value	Sig
	Private (N=47)	PT (N=51)	(F-Test)	of t-test	(2-tailed)
HH Member	4.45	4.63	1.384	0.454	0.651
Workers in HH	2.15	1.92	1.287	−1.191	0.237
Students in HH	0.72	1.10	2.51	2.112	0.037**
Car Ownership	0.11	0.04	3.92	−1.01	0.315
Motorcycle Ownership	1.40	0.61	0.532	−5.992	0***
Cycle Ownership	0.32	0.18	6.964	−1.422	0.158
Working Transport Cost (HH)	338,297.87	352,627.45	1.416	0.286	0.775
Individual COmmute Cost	325,531.91	224,705.88	2.007	−2.811	0.006***
Distance to Work Place	9.49	6.99	2.884	−1.765	0.081
Commuting Time	28.66	30.59	0.088	0.512	0.61
Income of Respondent (IDR)	2,467,662.13	2,502,268.24	0.141	0.426	0.671
HH Income (IDR)	4,139,553.19	4,713,803.92	0.023*	1.489	0.14
* Equal variance not assumed ** Statistically significant at 5% *** Statistically significant at 1%					

Table 7. Motorcycle Use Individual T-Test

Motorcycle Use	Mean		Anova (F-Test)	t-value of t-test	Sig (2-tailed)
	User (N= 62)	Non User (N=36)			
HH Member	4.56	4.50	0.277	−0.156	0.876
Workers in HH	2.03	2.03	0.048*	−0.023	0.982
Students in HH	0.85	1.03	0.129	0.924	0.358
Car Ownership	0.08	0.06	0.464	−0.362	0.718
Motorcycle Ownership	1.16	0.69	0.03*	−3.145	0.002***
Cycle Ownership	0.24	0.25	0.01*	0.077	0.939
Working Transport Cost（HH）	336,322.58	362,000.00	1.213	0.495	0.622
Individual Commute Cost	313,741.94	203,000.00	8.652	−2.994	0.003***
Distance to Work Place	9.30	6.28	12.958	−2.075	0.041**
Commuting Time	28.74	31.25	0.107	0.643	0.522
Income of Respondent (IDR)	2,499,365.81	2,462,086.67	0.001*	−0.428	0.67
HH Income (IDR)	4,297,338.71	4,681,333.33	0.089	0.954	0.342
* Equal variance not assumed					
** Statistically significant at 5%					
*** Statistically significant at 1%					

Table 8. Crosstab and Chi-Square Analysis for Public Transport (PT) Satisfaction (Angkot)

Public Transport Satisfaction	Satisfied	Not Satisfied	N	Chi-Square Test	
			Total	Value	A.Sym Sig (2-tailed)
Gender				4.443[a]	0,035*
Male	6(30%)	14(70%)	20(100%)		
Female	44(56%)	34(44%)	78(100%)		
Public Transport (PT) User				5.850[a]	0.016*
PT User	32(63%)	19(37%)	51(100%)		
Private Vehicle User	18(38%)	29(62%)	47(100%)		
Motorcycle User				2.319[a]	.128
Motorcycle User	28(45%)	34(55%)	62(100%)		
Motorcycle Non-User	22(61%)	14(39%)	36(100%)		

Table 9. Crosstab and Chi-Square Analysis for Public Transport (PT) Satisfaction (Ojek)

Public Transport Satisfaction	Satisfied	Not Satisfied	N	Chi-Square Test	
			Total	Value	A.Sym Sig (2-tailed)
Gender				3.247[a]	0,035*
Male	6(30%)	14(70%)	20(100%)		
Female	41(53%)	37(47%)	78(100%)		
Public Transport (PT) User				1.058[a]	0.016*
PT User	27(53%)	24(47%)	51(100%)		
Private Vehicle User	20(43%)	27(57%)	47(100%)		
Motorcycle User				.031[a]	.128
Motorcycle User	28(45%)	34(55%)	62(100%)		
Motorcycle Non-User	19(53%)	17(47%)	36(100%)		

analysis, the respondent that live near the factories and used to walk to commute are excluded as it is incomparable with others. There are 3 possibilities in mode choice for the factory workers in the Regency, mix mode user (usually ojek and angkot), angkot user and private motorcycle user. However, for the worker that using ojek only for commute, they analyzed as mix mode user, considering very small number of them (4). There are 91 respondent that could be analyzed on this method. Based on overall test (table 10), the value of Chi-square is 67.232 and the value of p < .05, which means the model is significant because there is minimum one independent variable that statistically significant affecting the dependent variable. Based on likelihood ratio test (table 11), variable of commuting distance, motorcycle owned, and respondent gender are variables that statistically significant in affecting mode choice for commute among the factory workers.

Tabel 10. Model Fitting Information

| Model | Model Fitting Criteria | Likelihood Ratio Tests | | |
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	173.218			
Final	105.986	67.232	12	.000

Tabel 11. Likelihood Ratio Tests

| Effect | Model Fitting Criteria | Likelihood Ratio Tests | | |
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	105.986[a]	.000	0	.
Income	107.848	1.862	2	.394
Distance	111.973	5.987	2	.050
Motorcycle Ownership	147.962	41.975	2	.000
Opinion of Angkot	109.159	3.173	2	.205
Opinion of Ojek	106.353	.366	2	.833
Respondent Gender	120.909	14.923	2	.001

In table 12, parameter estimates compared two different group of mode user relatively to the private motorcycle user as reference category. The first one is ojek and mix mode relative to private motorcycle user. Motorcycle ownership is the regression coefficient that statistically different for ojek and mix mode relative to private motorcycle user with significant level 0.01 (p = 0.000). Another regression coefficient that statistically different with less confidence level (p = 0.061) is distance regression variable. Based on this result, factory worker will 0.04 times more likely use private motorcycle for commute if they have it and other variables are constant. However, if the two subjects have identical regression variables other than distance, the subject with further distance will more likely use mix mode 1.165 times compared to private motorcycle. The second one is use angkot relative to private motorcycle. There are two regression coefficient that has significant level 5%, motorcycle ownership and respondent gender (p < 0.05). Based on the result, if other variables are constant, factory workers who has motorcycle 0.138 times more likely used it for commuting. For the respondent gender variable, given other variables constant, female workers 23.298 times more likely use angkot for commute compared to male workers.

Tabel 12. Parameter Estimates

Choice[a]		B	Std. Error	df	Sig.	Exp(B)
Ojek and mix mode user	Intercept	−5.615	4.860	1	.248	
	Income	.000	.000	1	.202	1.000
	Distance	.153	.082	1	.061	1.165
	MotorOwn	−5.419	1.420	1	.000	.004
	[Opinion of Angkot=.00]	−1.886	1.196	1	.115	.152
	[Opinion of Angkot=1.00]	0[b]		0		
	[Opinion of Ojek=.00]	.564	1.077	1	.601	1.758
	[Opinion of Ojek=1.00]	0[b]		0		
	[RespondenGender=.00]	1.697	1.791	1	.343	5.458
	[RespondenGender=1.00]	0[b]		0		
Angkot user	Intercept	.056	2.058	1	.978	
	Income	.000	.000	1	.855	1.000
	Distance	−.041	.048	1	.386	.959
	MotorOwn	−1.981	.603	1	.001	.138
	[Opinion of Angkot=.00]	−.845	.648	1	.193	.430
	[Opinion of Angkot=1.00]	0[b]		0		
	[Opinion of Ojek=.00]	.329	.643	1	.609	1.390
	[Opinion of Ojek=1.00]	0[b]		0		
	[RespondenGender=.00]	3.148	1.102	1	.004	23.298
	[RespondenGender=1.00]	0[b]		0		

a. The reference category is: 1.00. (private motorcycle user)
b. This parameter is set to zero because it is redundant.

5. Findings and Discussion

Based on this research, the employees of factories are highly dependent on two-wheeled vehicles, either public (motorcycle taxi) or private. This differs from the results for the use of four-wheeled vehicles, as there are no factory workers that commute by private cars. This condition is related to the homogeneity of the sample that was taken. The sample chosen is the factory workers that are paid the minimum salary determined by the district standard. The average household income of the respondents is IDR 4.43 million, which is less than IDR 1 million per capita, based on this survey. The ownership rate of cars is slightly below the car ownership rate on the district level, which averages 15.7 cars/1,000 people. The different condition is found with the motorcycle ownership rate, which surpasses the district's motorcycle average rate by more than 80 motorcycles/1,000 people. This mode of transportation is more affordable for the factory worker class, and the dimension of motorcycles that could slice through the traffic jam is more suitable to the poor transport infrastructure in Sukabumi District.

There are several key variables related to this motorcycle dependency. For motorcycle ownership, number of worker in household, number of student in household, individual commute cost and distance have significant means difference. Moreover, number of worker in household and commuting distance become the determinant in motorcycle ownership among factory workers. All means difference that shown in descriptive statistics about motorcycle ownership have shown the background of two different type of household based on motorcycle ownership. More workers in the household will require more mobility; hence, obtaining a motorcycle could add other available options for household mobility. This finding is confirmed by the next analysis that shown number of worker in household is one of the important consideration for household to own the motorcycle. Same goes with the number of student which correlates negatively with the motorcycle ownership, although it does not statistically significant on regression

result. If the household has children that attend the schools, the household have extra post for spending which is more important than buy motorcycle (e.g. for school). Another reason is that although it increases the mobility, school usually located relatively near and can reach only by walk.

For individual commute cost, the motorcycle owner has to spend more considering that they counted monthly fuel expenses into their commuting costs. It is very difficult for them to separate their commuting costs from other mobility costs, while the next respondent group who do not own motorcycles could easily determine their commuting cost simply based on daily commuting fare. However, this variable excluded in the regression analysis since it correlated with the distance. As for distance, the means difference is statistically significant, and it also significant in determining the motorcycle ownership (sig level 10%). Further distance will require more mobility, and by obtaining motorcycle, it could expand the mobility option of the household. Therefore, the commuting distance will not be less important issue for motorcycle owner, considering the fact that they have another option for mobility.

As for income, there are no significant different means among two groups of respondents, showing the homogeneity of the respondent group. However, this research has found the different result related to household income and motorcycle ownership. While all similar researches have shown the importance of household income to own motorcycle, the model of this research has shown that household income is significantly insignificant to determine the ownership of motorcycle. There are several reasons for this phenomenon. The first is data used to build the model, which is collected from the household with similar economic background. Unlike other similar researches that could capture many income group among the respondent, the range of household income is narrow so that the model cannot explain the relation between household income and motorcycle ownership. The next reason is that among factory worker group, mobility that explained by distance and number of worker in household variable become the most important variable in determining motorcycle ownership. Hence, by capturing particular group of factory workers, the research has shown that mobility needed have more importance compared to household income.

For mode choice, means difference among two different group that categorized by private vehicle user and motorcycle user have confirmed that motorcycle ownership encourages people to use it (Vu & Shimizu, 2005). While individual commuting cost and number of student in household have significant different means for the same reason, the commuting distance variable also shown the means difference between motorcycle user and non-user group in factory workers. This finding confirms the previous result about the relation of motorcycle ownership and distance. However, unlike the commuting pattern for general in the region, the number of public transport user is highest compared with other modes, more than 50% of the respondent is public transport user (Angkot). This finding mainly because of the homogeneity of the respondents that dominated by female workers.

The regression analysis about mode choice provide further confirmation about the finding. Commuting distance, the ownership of motorcycle and the respondent gender become the important variable that determine the commuting mode used by the respondents. While the ownership of motorcycle definitely affecting the decision in mode choice, the distance variable become important consideration in mode choice, particularly when the use of mix mode (usually ojek and angkot) relatively compared to use private motorcycle which less safe and secure. This is mainly because the respondent group that dominated by female worker which have different commuting pattern with their counterpart. They tend to use more safe and secure mode, with slower speed. The next explanation will confirm the importance of gender in commuting pattern as female worker tends to use public transportation more than male worker. This finding also confirmed by the descriptive analysis on this paper. Only 15% of male workers (3 out of 20) are using the public transport services. This number is so small compared to the amount of PT users in female workers, which consist of 48 respondents (62%).

There are several things local government could do to reduce the traffic load along the corridor of sustainable

economy in Sukabumi Regency. The first one is providing affordable vertical housing around the industrial area to reduce the commuting load from the factory workers. By providing it, the negative impact of commuting distance as critical variable in motorcycle ownership and mode choice could be reduce, hence it will increase the service ability along the corridor road. The second one is that government needs to improve the quality and availability of public transport services. In this research, the respondents' opinion about public transport showing insignificant variable for mode choice, yet it reveals more dissatisfaction than contentment. Improving the service particularly for female passenger become important, considering that they tend to use public transport compared to private vehicle. Providing proper transit places near the factories could improve the service ability of Angkot for female workers, and it would also help in traffic management by reducing potential conflicts. Same goes with Ojek as part of common public transport for the worker. They also need service improvement particularly related to safety and security issue. Registration of the driver, standardization of the service and the arrangement of transit place could do by local government to increase their service level. The last one is related to manage the abundance of motorcycle on the road around the corridor. The traffic load on national roads is in a heavy mixed-mode condition. Separating between 2-wheeled and 4-wheeled vehicles will increase the safety of bike riders, especially considering the fact that the number of motorcycles is constantly increasing. This of course needs a careful and comprehensive approach, considering the many limitations faced by the government. However, if executed properly, this could increase the safety of motorcycle users by reducing potential conflicts of the vehicle on mixed-mode roads.

Acknowledgement

Notes

i Sukabumi District latest population based on Data from local government is 2.516.461 person. The growth rate based on year 2015, taken from West Java in Figures 2016

ii Sukabumi Spatial Regulation no 22 year 2012

iii Sukabumi Spatial Regulation no 22 year 2012

iv Sukabumi in Figures 2016

v West Java in Figures 2016

vi This economic annual growth rate compiled from West Java in Figures 2009 - 2015

vii Compiled from West Java in Figures 2009 - 2015

viii West Java in Figures 2016

ix Road standard minimum of service according to the Standard of Public Works Ministry on Government Regulation no. 34 year 2006 about Road Transportation

x Sukabumi Regency Transportation Master Plan

xi The factories that been chosen employ more than 1,000 workers as it categorized as big factory.

xii Ojek (motorcycle taxi) is an informal public transport mode, motorcycles that carry passenger on the back seat and operate like a taxi, a motorcycle taxi.

xiii The data from The Employment and Transmigration Agency of Sukabumi District shows that the female worker that work in factory (1,000 worker or more) are more than 81%. This condition mainly supported by the kind of factory that operates in Sukabumi Regency which mainly is basic industries such as textile, garment and footwear.

xiv IDR: Indonesian Rupiah, Indonesian currency.

xv This percentage is relatively high compared to general commuters which only used by 31.8% of them.

xvi The ratio of vehicle ownership (motorcycle and car) is compared to the total of household member of the respondents. In this research, there are total 390 household members.

References

Alpkokin, P., Cheung, C., Black, J., & Hayashi, Y. (2008). Dynamics of clustered employment growth and its impacts on commuting patterns in rapidly developing cities, *42*, 427-444. https://doi.org/10.1016/j.tra.2007.11.002

Anastasopoulos, P., Karlaftis, M., Haddock, J., & Mannering, F. (2012). Household Automobile and Motorcycle Ownership Analyzed with Random Parameters Bivariate Ordered Probit Model. *Transportation Research Record: Journal of the Transportation Research Board*, *2279*, 12-20. https://doi.org/10.3141/2279-02

Anh, V., & Mateo-babiano, I. B. (2013). Motorcycle Taxi Service in Vietnam – Its Socioeconomic Impacts and Policy Considerations. In *Eastern Asia Society for Transportation Studies* (Vol. 9).

Barter, P. (1999). *An International Comparative Perspective on Urban Transport and Urban Form in Pacific Asia: The Challenge of Rapid Motorisation in Dense Cities*. Murdoch University. Retrieved from http://researchrepository.murdoch.edu.au/3332/

Burge, P., Fox, J., Kouwenhoven, M., Rohr, C., & Wigan, M. R. (2007). Modeling of Motorcycle Ownership and Commuter Usage: A UK Study. *Transportation Research Record*, *2031* (2031), 59-68. https://doi.org/http://dx.doi.org/10.3141/2031-08

Cervero, R. (2013). Linking urban transport and land use in developing countries. *The Journal of Transport and Land Use*, *6* (1), 7-24. https://doi.org/http://dx.doi.org/10.5198/jtlu.v1.425

Cervero, R., & Golub, A. (2007). Informal transport: A global perspective. *Transport Papers*, *14*, 445-457. https://doi.org/10.1016/j.tranpol.2007.04.011

Crane, R. (2007). Revolution in Women's Gender Gap in Commuting, (August 2013), 37-41. https://doi.org/10.1080/01944360708977979

Deichmann, U., Lall, S. V, Redding, S. J., & Venables, A. J. (2008). Industrial Location in Developing Countries, 219-246. https://doi.org/10.1093/wbro/lkn007

Dimitriou, H. T. (1995). *A Developmental Approach to Urban Transport Planning; Indonesian Illustration*. London: Avebury.

Dimitriou, H. T., & Gakenheimer, R. (2011). Transport and city development: Understanding the fundamentals. In H. T. Dimitriou & R. Gakenheimer (Eds.), *Urban Transport in Developing World*. Northampton: Edward Elgar Publishing.

Dinye, R. D. (2013). The significance and issues of motorcycle transport in the Urban areas in northern Ghana. *Scientific Journal of Review*, *2*, 256-272. https://doi.org/10.14196/sjas.v2i10.1032

Fragkias, M., & Geoghegan, J. (2009). Commercial and industrial land use change, job decentralization and growth controls: a spatially explicit analysis. *Journal of Land Use Science*, *5* (1), 45-66. https://doi.org/10.1080/17474230903437162

Gakenheimer, R. (2011). Land Use and Transport in Rapidly Motorizing Cities: Context and Controversy. In H. T. Dimitriou & R. Gakenheimer (Eds.), *Urban Transport in Developing World* (pp. 40-68). Northampton: Edward Elgar Publishing Inc.

Guillen, M. D., Ishida, H., & Okamoto, N. (2013). Is the use of informal public transport modes in developing countries habitual? An empirical study in Davao City, Philippines. *Transport Policy*, *26*, 31-42. https://doi.org/10.1016/j.tranpol.2012.03.008

Hadi, R. P., & Yoshida, T. (2017). Analyzing Motorcycle Taxis as an Informal Mode of Urban Transportation through the Land Use Approach-A Case Study of Urban Areas in Sukabumi Regency, Indonesia. *Policy Science*, *24* (2), 101-116.

Haley-Lock, a, Berman, D., & Timberlake, J. M. (2013). Accounting for Job Quality in Women's and Men's Commute Time to Work: An Update to the "Household Responsibility" Thesis. *Social Service Review*, *87* (March), 70-97. https://doi.org/10.1086/669241

Henderson, V. (2002). Urbanization in Developing Countries, *17* (1), 89-112.

Kenworthy, J. (2011). An International Comparative Perspective on Fast-rising Motorization and Automobile Dependence. In H. T. Dimitriou & R. Gakenheimer (Eds.), *Urban Transport in Developing World* (pp. 71-111). Northampton: Edward Elgar Publishing Inc.

Lee, K. S. (1992). Spatial Policy and Infrastructure Constraints on Industrial Growth in Thailand. *Review of Urban & Regional Development Studies*, *4* (1), 17-31. https://doi.org/10.1111/j.1467-940X.1992.tb00031.x

Leong, L. V. (2007). A STUDY ON THE MOTORCYCLE OWNERSHIP : A CASE STUDY IN PENANG STATE , MALAYSIA, *7* (2004), 528-539.

MacDonald, H. I. (1999). Women's Employment and Commuting: Explaining the Links. *Journal of Planning Literature*, *13* (3), 267-283. https://doi.org/10.1177/08854129922092397

Nagai, Y., Fukuda, A., Okada, Y., & Hashino, Y. (2003). Two-Wheeled Vehicle Ownership Trends and Issues in the Asian Region. *Journal of the Eastern Asia Society for Transportation Studies*, *5*, 135-146.

Rodrigue, J.-P. ;, Comtois, C., & Slack, B. (2013). *The Geography of Transport System* (3rd ed.). New York: Routledge.

Rosenbloom, S., & Plessis-Fraissard, M. (2009). Women's Travel in Developed and Developing Countries Two Versions of the Same Story? Sandra. In *Women's Issues in Transportation* (pp. 63-77). California: The National Academic Press. https://doi.org/10.17226/22901

Roy, A. (2009). Gender, Poverty, and Transportation in the Developing World. In *Women's Issues in Transportation* (pp. 50-62). California: The National Academic Press. https://doi.org/10.17226/22901

Senbil, M., Zhang, J., & Fujiwara, A. (2006). *Motorcycle Ownership and Use in Jabotabek (Indonesia) Metropolitan Area* (Vol.2006-3). *Discussion Paper Series Vol.2006-3* (Vol. 2006).

Vu, T. a., & Shimizu, T. (2005). Modeling of Household Motorcycle Ownership. *Journal of the Eastern Asia Society for Transportation Studies*, *6*, 1751-1765.

Zhao, P., Luë, B., & de Roo, G. (2010). Urban expansion and transportation: The impact of urban form on commuting patterns on the city fringe of Beijing. *Environment and Planning A*, *42* (10), 2467-2486. https://doi.org/10.1068/a4350