Doctoral Dissertation

Policy Analysis of MRT Development Impacts on Commuting Mode Choice

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ABSTRACT

Jakarta as one the most congested cities in the world has modestly estimated to loss 5.6 billion USD a year, which accounts for approximately 5% of GRDP of Jakarta. The growth rate of vehicles continues to be much greater than that of transport infrastructure provisions. To mitigate the congestion while addressing both the travel demand and supply in Jakarta, Mass Rapid Transit (MRT) has been constructed and it is expected to be operated in 2020. MRT as a mass public transport has a big capacity and railway based system that gives some benefits such as not facing congestion, and environmental friendly since using the electricity as the energy source. The main target of MRT is to attract the private commuters to shift to MRT.

The main objective of this research is to provide analytical results of commuters' behaviors and preferences on transportation mode choices, if the development of MRT would be successfully completed, and its benefits to the economic and environmental improvement. The choice experiment approach to analyzing the travel behavior change in response to hypothetical choice experiment is the method. Repeated choice experiments for private vehicle commuters in Jakarta on preferences if they would be willing to shift to the MRT once it becomes available, have been conducted before and after removal of the fuel subsidy. The main target respondents are the commuters who use private vehicles as the main transport for daily commuting.

Before knowing the future commuters' behaviors, the research is started by understanding the current commuters' behaviors and attitudes in choosing the transport modes for daily commuting. By knowing current behaviors and attitudes, it can reflect the result in future and it can affect the future commuters' behaviors. The method used is descriptive analysis through tabulation and chi-square test and multinomial logit model to know the determinant factors in choosing current transport mode. The main findings of first chapter are the characteristics of commuters in Jakarta have been changed within the last six years in term of education, income and the distance in commute. The higher the income, cars are preferable and surprisingly motorcycles are chosen by commuters in all the income ranges. The main reasons for using cars and motorcycles are more comfortable, more flexible and could save the time especially for motorcycles. However, the commuters will avoid using cars or motorcycles if the traffic congestion is getting worse and the parking space is limited and also put high charge.

To analyze the future commuters' preferences on transport mode choices once MRT successfully completed under different policy scenarios is the main objective. Balancing conflicting policies are important. Fuel subsidy is such policy that hampers potential impacts of MRT being currently under construction. The mixed logit models revealed that scale of impacts on probability to shift to MRT due to the subsidy removal is significantly large compared to that of the best available feasible options for MRT service improvements. Moreover, this effect is leveraged by joint implementation with road pricing and more the impact is expected for car commuters than motorcycle commuters. However, after the actual implementation of fuel subsidy removal, more motorcycle commuters are willing to shift compared to the hypothetical scenario of the fuel subsidy removal.

In addition, by providing MRT it can give the economic and environmental benefits. The total economic value that can be generated from car and motorcycle is maximum 0.9 million USD and it is increased after the fuel subsidy was removed to be 1 million USD. Shifting from cars or motorcycles to use MRT also can reduce the CO_2 emission. Under the assumptions that MRT will be operated electric based and the CO_2 emission is negligible, the shifting of commuters from cars and motorcycles can reduce the CO_2 emission by 10.67% per year and using the year 2013 as the base year. Morover, because of fuel subsidy removal, the reduction of CO2 emission will be 13.28% per year.

LIST OF ABBREVATION

Bodetabek	Bogor Depok Tangerang Bekasi
BRT	Bus Rapit Transit
CBD	Central Business District
CO2	Corbon Dioxide
CS	Consumer Surplus
DKI	Daerah Khusus Ibukota (Special Capital Region)
FGD	Focus Group Discussion
FS	Fuel subsidy removal under Scenario
FSR	Fuel Subsidy Removal
GHG	Green House Gas
GoI	Government of Indonesia
GRDP	Gross Regional Domestic Product
IIA	Independent from Irrelevant Alternative
ITDP	The Institute for Transportation and Development Policy
ITS	Intelligent Transport System
Jabodetabek	Jakarta Bogor Depok Tangerang Bekasi
JICA	Japan International Cooperation Agency
JP	Joint Policy between Road Pricing and Fuel Subsidy removal
LCGC	Low Cost Green Car
LRT	Light Rapit Transit
ML	Mixed Logit
MNL	Multinomial Logit
MoT	Ministry of Transportation, Republic Indonesia
MRT	Mass Rapit Transit
NLFS	National Labor Force Survey
NSS	National Socio-economic Survey
RP	Road Pricing
TDM	Transport Demand Management
TSM	Transport Supply Management
TT	Travel time
WTP	Willingness to Pay

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Chapter 1 Introduction

1.1 Background

The rapid increase of travel demand in Jakarta is not surprising since Jakarta is the capital city of Indonesia as well as the center of economic activities. Current total travel demand in Jakarta has reached 21.9 million trips per day and 15.3 million trips use vehicles (Japan International Cooperation Agency, 2012). The travel demand is generated not only by people who live in Jakarta but also by people who live in buffer areas of Jakarta namely Bogor, Depok, Tangerang and Bekasi (Bodetabek). Based on the Statistics Indonesia data, the population number in Jakarta during the day is increased by 2 million people and becomes 12 million people. The data collected by JICA (2012) show that the increament of commuter traffic trips from 2002 to 2010 was about 1.4 times from south and west areas of Jakarta. The south areas are Depok and Bogor, while the west areas include Tangerang and South Tangerang. Moreover, the increase of traffic trip from east areas is higher, 1.6 times compared to south areas.

Having high economic growth and being the largest GRDP (Gross Regional Domestic Product) in Indonesia give implications to the region for having the high growth rate of vehicles especially cars and motorcycles. The vehicle growth rates from 2011 to 2013 are 18.5% and 21.2% for cars and motorcycles respectively (Zhao, Johnston, & Schultz, 2013). The high growth rate of motorcycles does not only happen in Indonesia, but also in some developing Asian countries such as China, Thailand, Malaysia, Taiwan and Vietnam because probably motorcycles have been considered as a temporary mode (Tuan & Shimizu, 2005). Also, in Jakarta, a number of households having a car are approximately about 20.7% and the average number of car owning per household is about 1.2 which is same or little bit higher than developed countries (Susilo, Santosa, Joewono, & Parikesit, 2007). Though, the growth rate of length of road is 0.14% from 2011 to 2013 (Statistics of Jakarta Province, 2014). The ratio of length of roads to the total areas of Jakarta in 2013 reached 7.2%. Some big cities in the world have ratio about 12%. Meaning that, the total length of road in Jakarta is still shortage. This situation is commonly happened in developing stages where the growth rate of vehicles continues to be much greater than that of transport infrastructure provisions (Santos, Behrendt, Maconi, Shirvani, & Teytelboym, 2010).

Lack of public transport provision as well as low services of public transport make people reluctant to use it. The share of public transport is less than 2% and the rest is dominated by private vehicles either cars or motorcycles. The current mass public transports in Jakarta such as Bus Rapid Transit (BRT), well known to be named Transjakarta, only can accommodate 400,000 passengers per day and it is expected to be double if all the corridors are operated. The Jabodetabek railway can accommodate about 700,000 passangers per day. If it is compared with the total travel demand, it is only about 7% in total. Although still there are other types of public transports but the

numbers and capacities are also low. The other liability deterring to utilize the exisitng public transports is that among them are not well integrated.

Consequently Jakarta has been known as one of the most congested cities in the world (Cunningham & Cunningham, 2010) because private vehicles, either cars or motorcycles become the favorite transports to use for daily actitivies. If in the few years ago, the congestion is only happened during the peak hours, morning and after office hours, but recently the congestion is happened all days, including weekend. The economic cost only for time losses of the congestion was modestly estimated to be 5.6 billion USD a year (Japan International Cooperation Agency, 2012), which accounts for approximately 5% of GRDP of Jakarta (Statistics Indonesia, 2014a).

Moreover, transportation sector become the second largest GHG emissions in Jakarta after industry sectors. Based on the SITRAM (2004), the slow traffic in congested roads leads to additional carbon emissions as emission factor is sharply and exponentially increased with slowdown of average speed after about 40 km per hour. Currently the average speed of road transports is less than 20 kilometer per hour (UKP4, 2012) and for Bodetabek the average speed is 20 kilometer per hour (Ministry of Transportation Indonesia, 2013). The total CO_2 emissions from transportation sectors in 2013 are about 10.7 million ton and road transportation is placed as the largest contribution with 76.1% from total CO_2 emissions in transportation sector (Environmental Management Agency of Jakarta Province, 2013)

Various efforts have been made mainly by Ministry of Transportation to mitigate the congestion while addressing both the travel demand and supply in Jakarta. The examples are of travel demand management (TDM) are "3-in-1" system where only cars occupied by three persons or more can enter the central business district (CBD) (Jakarta Province, 2003). The "3-in-1" system has been introduced in 2002 when the BRT started to operate. The other types of TDM is relocating the parking areas, no on-street parking, increase the parking charge, etc. In term of travel supply management (TSM), developing mass public transports and increase the capacities of current mass public transport such as BRT and Jabodetabek railway. Developing other new public transports have been started, such as mass rapid transit (MRT) and monorail. This research will focus on the impacts of MRT development once it is operated.

1.2 Research Motivation

Improving the public transportation provision by developing MRT is one of the solutions to reduce the travel demand of private vehicle commuters. MRT as a mass public transport has a big capacity and railway based system that gives some benefits such as not facing congestion, environmental friendly since using the electricity as the energy source. Based on the Jakarta master-plan, MRT will be develop to connect south and north parts of Jakarta as the first route and the second route, it is planned to connect the east and west parts of Jakarta.

The main objective by providing MRT is to reduce the congestion by attracting private vehicle commuters, both cars and motorcycles, to shift to use MRT for daily commute. However, it is not easy to make public transport, especially MRT, attractive for car and motorcycle commuters. Jakarta's government should learn from the previous, the development of BRT. Firstly, the main objective by providing MRT is to attract the private vehicle users. In fact, the passengers who shifted using BRT are about 24.9% and 10.3% from motorcycles users and private car users respectively. Most of them just shifted from other public transports.

Why public transportation is not so attractive? There are many reasons that people reluctant to use it, for example insecurity, unsafety, unscheduled, difficult accessibility, inconnectivity etc. In addition, the cost by using private vehicles is very cheap in Indonesia, especially for motorcycle users. The fuel price in Indonesia until end of last year is still subsidized by government and the price can be a half from other countries. Huge government budget spent on fuel subsidy. Based on the data survey in 2013, with the cheap price of fuel and the efficient consumption of fuel, the cost by using private vehicles are not so significant different to public transport cost. Even the cost by using motorcycles can be cheaper than by using public transports.

The implemented policies to encourage people to use public transports should be appropriate. In point of facts, by only providing the better services of public transport, it is not enough. Other policies that can discourage people to shift from private vehicles are also needed. The policies should be from both sides, and it is called "push and pull" policies. Many previous studies focusing on the transportation sector suggested some instruments or approaches on how to encourage people to use public transport or to discourage from private vehicles, such as the area pricing scheme, congestion charge, toll scheme, car ownership control, incentives to reduce drive behavior, car ownership control (Cullinane, 2003; Yagi & Mohammadian, 2008). A different approach has been studied by Zheng Zhang, et al (2014) by introducing flexible work schedule also can be the alternative way to reduce the congestion during rush hour. The economic instruments related to price of motor fuel to reduce traffic volume, discourage rush hour driving, discourage in driving speed, and reduce their driving distance have been studied by Elvik & Ramjerdi (2014).

1.3 Research Objective

Introducing MRT without sufficient simultaneous countermeasures to discourage vehicle commuters such as electronic road pricing (Yagi & Mohammadian, 2008), increasing fuel price or fuel subsidy removal (Elvik & Ramjerdi, 2014) would result in failure for solving the congestion. Empirical evidence to quantify the scale of impacts of mixed policies to discourage vehicle commuters on the relative utilities is significant for better policy planning and implementation. Because of that, this research is mainly to provide analytical results of current commuters' behaviors and preferences on willingness to shift to MRT, if the development of MRT would be successfully completed, and its benefits to the economic and environmental improvement, if external policy scenarios have been implemented coincidently.

The following research questions are delivered by this research, namely:

1. Why the commuters are robustly use private vehicles? What are the barrier of them to shift to current public transport?
2. How much private vehicle commuters are willingness to shift to MRT under different policy scenarios?
3. How does the recent implementation of conflicting policy (fuel subsidy removal) affect the future private vehicle commuters' willingness to shift to MRT?
4. How much can the potential benefits of MRT development by realizing modal shift from existing transport mode choices?

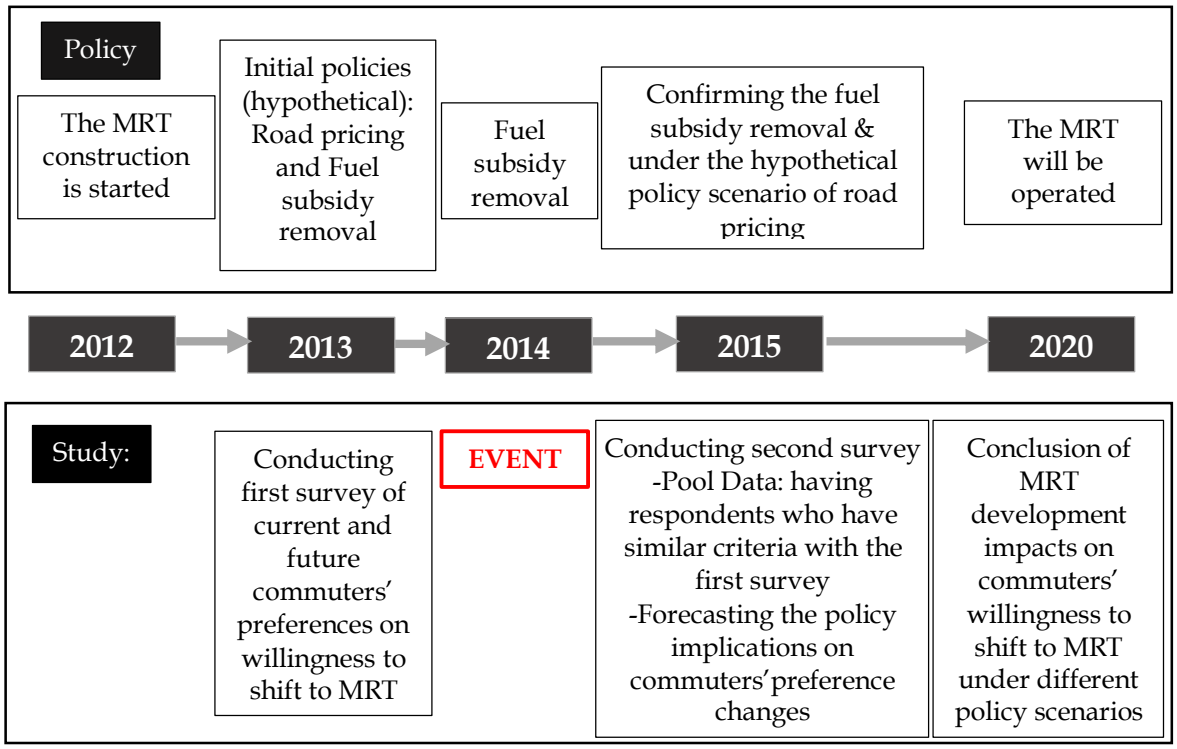
1.4 Research Timeframe

The research timeframe of this study describes on figure 1.1. The research has been started when the MRT construction has been started in 2012. Providing an

alternative mass public transport in Jakarta is expected to reduce the traffic congestion. To find out whether the MRT development would have impacts on commuter's preference to shift to MRT during and after the launch, this research conducts two surveys for the different periods in the respected region as a base to test the hypothesis. The main target of respondents are commuters who use private vehicles, either cars or motorcycles, and also work along the main roads where MRT will be operated.

The first survey was conducting in 2013 by implementing hypothetical scenarios. The scenarios are implemented road pricing, fuel subsidy removal and joint policy of road pricing and fuel subsidy removal. The main objectives of this survey is to understand current and future commuters' preferences on willingness to shift to MRT, including how the provision of MRT affects their behaviors to commute or not, and how both single and joint policy scenarios impacts to the transportation costs of private vehicles.

At the end of 2014, Government of Indonesia (GoI) has removed the fuel subsidy because the spending on this subsidy was very high. The government committed to reallocate the subsidy to develop the infrastructure. This event could change the commuters' behaviors due to the transportation cost becomes expensive. To estimate the implications of the policy on fuel subsidy removal to the commuters' preference changes, the second survey has been conducted in 2015 with the similar respondent target in the respectived area with the first survey. The method used is also similar to the first survey.



Source: Author, 2015

Figure 1. 1 Research timeframe

From the research timeframe, it also can be concluded the potential impacts of MRT development on commuters' willingness to shift to MRT under different policy scenarios. Since one policy, fuel subsidy removal, has been implemented, it becomes one of the interesting issue to reconfirm the analysis.

However, the research is also followed by analyze the commuters' behavior changes that give benefits in term of economic value under the hypothetical scenarios as well as the environmental benefits. By shifting in using MRT for daily commuting from private vehicles, either cars or motorcycles, it can reduce emissions from transportation sectors especially Carbon Dioxide (CO_2). How MRT development contributes to the climate change policy in urban transportation.

1.5 Research Boundary

The scope of analysis in this research is the behavior changes of commuters who use private vehicles either cars or motorcycles as the main transports to commute to Jakarta CBD where MRT will be operated. The current public transport users or other types of transport modes used are not included in the analysis. It is focused on the private vehicle users since the numbers of private vehicle users are increasing and make the traffic congestion to be chronic. Introducing other types of public transport, MRT, either can affect their preference changes or not is the main objective of this research. However, it is also analyzed the impacts of policy scenarios to private vehicle user behaviors.

Due to the research area is in the CBD where most of offices located, the population numbers within next 5 years is assumed not to be increased significantly as long as the CBD is not expanded. Because the current condition in CBD has high density, it seems difficult to add numbers of buildings in this areas.

1.6 Outline of Dissertation Report

This section outlines the whole research framework as shown on figure 1.2. The research begins by writing the basic problems behind the research by explaining the current situation related to traffic congestion in Jakarta. The first chapter will contain introduction and background of the study. Research motivation is introduced separately to emphasize the importance of this research. Delivering the clear messages of this research on the research objective and make it clear by rising research questions that are related to the each chapter of analysis. The research boundary tried to show the limitation of study is also part of the introduction. The last part of this chapter is the outline of dissertation report.

The second chapter contains the review of current positioning of transportation policies in Jakarta and theoretical framework. This chapter will explain in detail, the current policies in transportation sector in Jakarta as well as the master plan up to 2020 and 2030. By knowing the current and future policies in transportation sector in Jakarta, it can help in the analysis to justify and later to formulate the policy recommendations from the research findings. In addition, the theoretical framework that will be used in the analysis is also explained in this chapter.

There are four analysis chapters from this research that it is started from chapter three to chapter six. This first analysis chapter is discussing about the current commuters' behaviors in choosing the transport modes for daily commuting. It also will analyze private vehicle users' attitudes toward current transport mode used. By knowing current behaviors and attitudes, it can reflect their behavior and attitudes in the future.

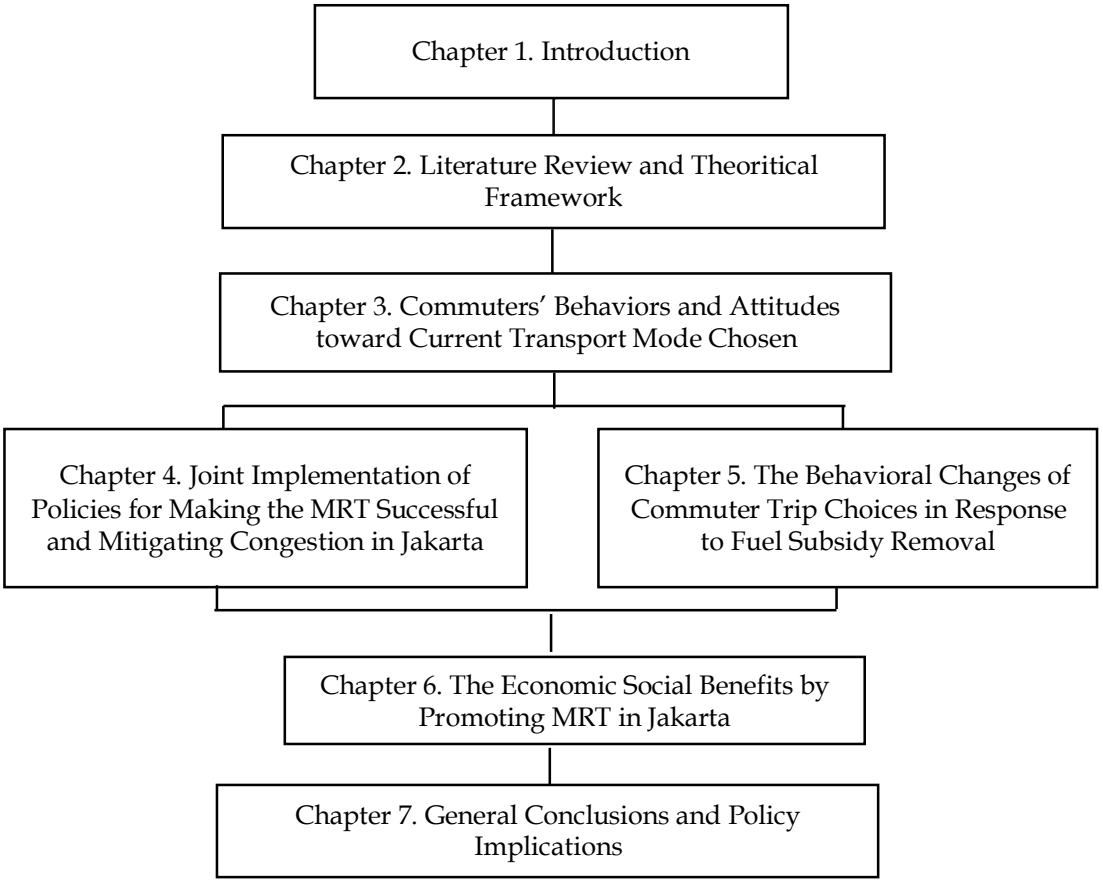


Figure 1. 2 Dissertation framework

The second analysis chapter, chapter four, is the empirical analysis to quantify the scale of impacts of such policies to discourage vehicle commuters on the relative utilities for better policy making. The choice experiment method is applied in this chapter to measure the impact based on the stated preference.

The chapter five as the third analysis chapter will compare the commuters' behavior changes in choosing transport mode and their willingness to use MRT once operated after the fuel subsidy removal has been implemented since at the end of 2014. The research method used is choice experiment method which is similar to the previous analysis, but for this chapter, since one of policy scenario has been implemented, the expected result is to reconfirm the impact of the policy. The commuters' preference changes are predicted not only come from the implementation of policy but also there is socio-demographic changes of commuters related to the income, travel time and other factors. For the chapter four and five, the analysis will be based on the sample data from the survey.

The last analysis chapter analysis is chapter six. In this chapter, it is to estimate the total economic value as well as how much the potential CO_2 emissions can be reduced after MRT operated by realizing "modal shift" from existing transport system. To calculate the benefits of the chapter six, it is scaled up into the number of commuter population who use cars and motorcycles and through the MRT route for daily activities.

This report will be closed by chapter seven. It will conclude all the research findings and the policy implications from the research findings.

Chapter 2 Literature Review and Theoritical Framework

2.1 Review of Transportation Policies in Jakarta

Jakarta as the metropolitan city and 98% of commuters depend on the private vehicles either cars or motorcycles cause the traffic congestion at a whole day. The commuters are not only come from inside of Jakarta areas but also from surrounding cities, Bodetabek. The total numbers of commuters who come from the Bodetabek can reach two million people. It can be indicated from the total population of Jakarta when during the day, it will increase to approximately 12 million from the total Jakarta population about 10 million.

The Jakarta provincial government has been trying to solve this problems. The GoI also step in due to the chronic traffic congestion. Some policies have been implemented are:

1. Provision of mass public transports such as BRT and Jabodetabek Railway.
2. "3 in 1" system in the CBD has been implemented since 2003 based on the Jakarta Governor Decision number 4104, 2003.
3. Parking management related to the parking areas and charges, based on the Jakarta Governor Decision number 120, 2012.

The policies pose the transport demand and supply management. Transport demand management (TDM) such as parking management via the annual permit cost, parking fee per hour, limitation of parking space and location of parking lots greatly give impacts on mode choice to use public transport such as bus (Rotaris & Danielis, 2014). Rotaris and Danielis also argue that the provision of public transport with the fully subsidized would have a large effect on mode choice.

Regarding the provision of BRT, it deliberates in turn the role of Intelligent Transportation System (ITS) technology in prompting the operational efficiency, technical performance and cost issues of BRT. By this condition, it give the impacts of BRT on travel behavior change, traffic environment and property development (Deng & Nelson, 2013). BRT is also one of the key measures for promoting sustainable mobility.

2.1.1 Provision of mass public transports

Bus rapid transit (BRT)

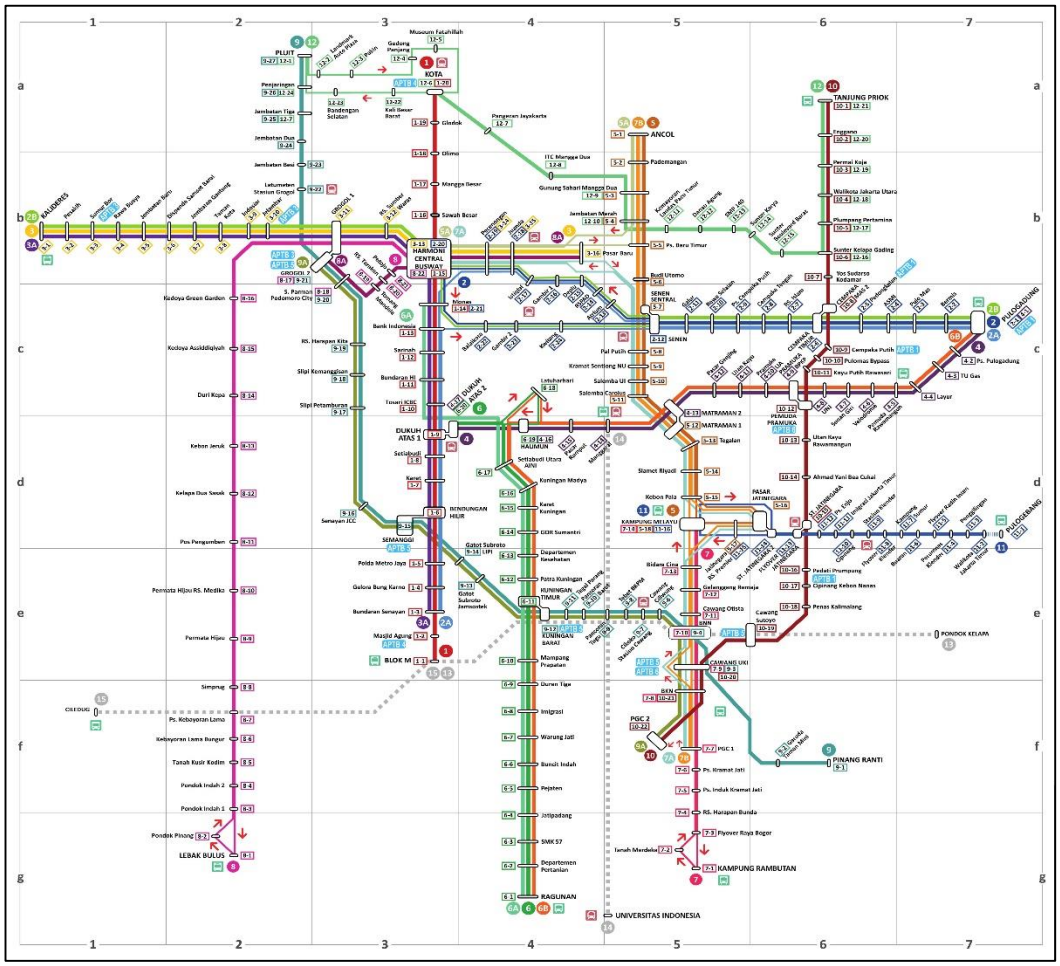
Bus Rapid Transit, BRT, has been known and operating in many big cities of emerging economy countries around the world. The BRT offers better services compared to other public transports. The BRT is fast and reliable services for a range of requirements. In Indonesia, BRT, or it is well known to be called Transjakarta, has been operated since 2004 with only one corridor. Until 2014, there are 12 corridors out of 15

corridors in a plan have been operated. The BRT map and also the name of corridors and routes are described on figure 2.1.

Current status, the BRT can accommodate around 400,000 passengers per day and it is expected to be double once all the corridors operated and also increase the numbers of buses. The BRT use the special lane to avoid the congestion and also give 24 hour-services for certain corridors. However, the headway is still low within 15-30 minutes. The total passengers of BRT always had experienced to increase from 2004 to 2011, but since 2012 to 2014 the total passengers of BRT are decreasing (Transjakarta, 2014).

The main factor that cause the decrease of total passengers are the long time of headway. This is because: 1) the exclusive lane for BRT are not sterile anymore (many other types of vehicles are also occupied the BRT lanes); 2) numbers of buses are not enough; 3) only few gasoline stations provide the gas fuel. In addition, the decreasing of service quality is also the cause in decreasing the number of passengers. Lindau, Hidalgo, & de Almeida Lobo (2014) mentioned that institutional complexities and lack of technical capacity could be the causes of the unsuccessful of BRT development.

The capacities and quality of services are important to keep the number of BRT passengers. Law enforcement regarding the use of BRT lane is also needed to improve. The guarantee of passengers in term of safety, security, punctually and other types of services as the indicators of good services is very important.



Source: http://www.transjakarta.co.id

Figure 2. 1 The BRT map

Table 2. 1 The routes of BRT corridors

No	Corridor	Route
Operated		
1	Corridor 1	Kota – Blok M
2	Corridor 2	Harmoni – Pulo Gadung
3	Corridor 3	Kali Deres – Pasar Baru
4	Corridor 4	Pulo Gadung – Dukuh Atas 2
5	Corridor 5	Ancol – Kampung Melayu
6	Corridor 6	Halimun – Ragunan
7	Corridor 7	Kampung Melayu – Kampung Rambutan
8	Corridor 8	Harmoni – Lebak Bulus
9	Corridor 9	Pluit – Pinang Ranti
10	Corridor 10	Tanjung Priok – Cililitan
11	Corridor 11	Kampung Melayu – Pulo Gebang
12	Corridor 12	Pluit – Tanjung Priok
Future plan		
13	Corridor 13	Blok M – Pondok Kelapa
14	Corridor 14	Manggarai – Universitas Indonesia
15	Corridor 15	Ciledug – Blok M

Source: http://www.transjakarta.co.id

To increase the numbers of passengers, now the BRT offer an additional service that is the integrated border transports. This border transport will connect the passengers from outside of Jakarta and bring them to the closest BRT stations. The ticket is also integrated. The gas fuel stations are also added to cut the headway time.

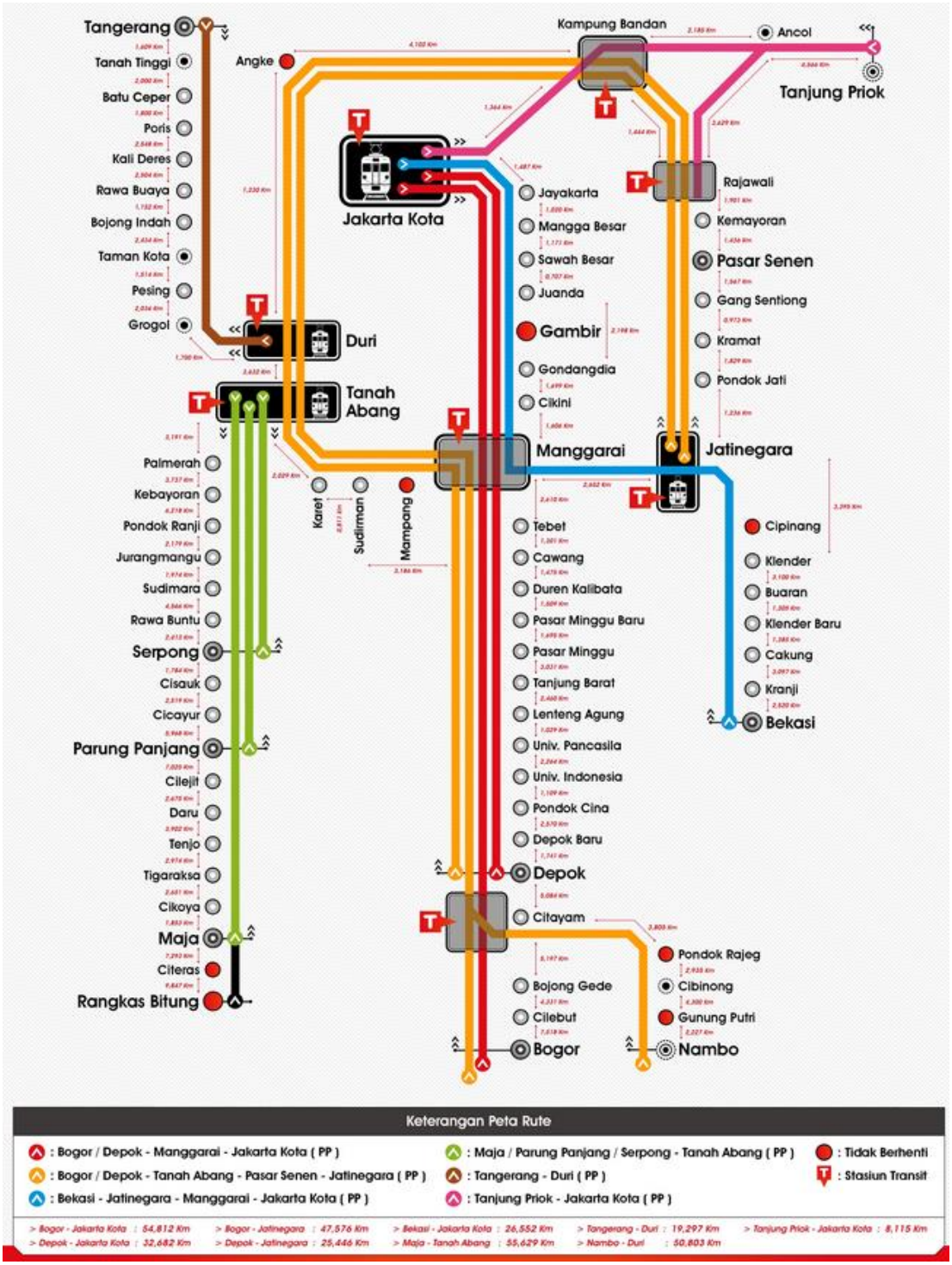
Jabodetabek Railway

Another mass public transport in Jakarta is Jabodetabek Railway. It is called the Jabodetabek Railway because this transports connect Jakarta, Bogor, Depok, Tangerang and Bekasi. The Jabodetabek Railway continue to improve services to users by adding facilities as well as a variety of innovations in the field of services for passengers. The result, for the first time in history, the number of Jabodetabek Railway passengers exceeded 200 million people a year with an average of 700,000 passengers per day (PT KCJ, 2015). The map of the Jabodetabek Railway to show the routes is depicted on figure 2.2.

Throughout 2014, the Jabodetabek Railway has added 32 percent frequency of trips that were previously only 560 trips per day in 2013 to 739 trips per day by the end of 2014. Overall the trip accommodated by operating the 65 series per day in the Greater Jakarta area. In addition to adding the trip, part of a series that has been purchased in 2013 and 2014 are also used to replace the circuit KRL that require care in a long time. The treatment strategy is one of the steps to do to reduce the number of nuisance trips caused by means of the trains.

Not only increasing the capacities, the Jabodetabek Railway also improves the services by developing e-ticketing through cooperation programs with four top banks regarding the use of prepaid cards. Development of information systems through the installation of information screens at several stations KRL (Big Screen) and circuit of trains has also been implemented. The move was made to continue to meet the information needs of service users as well the trains through oral information given by the Jabodetabek Railway officers. The Jabodetabek Railway is targeted to have 1.2 million passengers per day in 2019.

Jabodetabek railway can be the most favorite public transport mode for commuters especially who live in the buffer areas of Jakarta namely Bodetabek. As predicted the number of commuters who live in Bodetabek has been increased.



Source: http://www.krl.co.id/ accessed 2015

Figure 2. 2 The Jabodetabek railway map

2.1.2 "3 in 1" system

The "3 in 1" system has been implemented since 2003. This regulation is the establishment of traffic control areas and liability carrying at least three passengers per vehicle on certain road segments in Jakarta. This regulation made to support the BRT operation. The traffic control areas included in this regulation are:

1. Sisingamaharaja road
2. Sudirman road
3. MH. Thamrin road
4. Medan merdeka Barat road
5. Majapahit road
6. Gajahmada road
7. Pintu Besar Selatan road
8. Pintu Besar Utara road
9. Hayamwuruk road
10. Part of Gatot Subroto road

The regulation applies in two different time, in the morning from 7 a.m. to 10 a.m. and afternoon from 4 p.m. to 7 p.m. By implemented this regulation, it is expected to discourage commuters to use cars for daily commuting and shift to BRT once it is operated.

However, this system seems not successful since there are many "jockeys" who offer services to get in to the cars to reach the minimum capacity of the cars. The "jockeyes" will be paid about 1 USD per person. So, restriction by using "3 in 1" system is not working well. This condition is also happened in Beijing China where government implemented a driving restriction which is one day per week. The estimates reveal that the restriction of car use policy in Beijing does not have significant influence on individuals' decisions to drive, as compared with the policy's influence on public transit (L. Wang, Li, Wu, & Bai, 2013).

2.1.3 Parking management

Parking management become very important since the high growth rate of the vehicle numbers and in contrast, the growth in parking suppy has always been slower. This condition has been experienced by almost big cities in the developing countries. A reform in parking management in order to promote sustainable urban transportation is a must. R. Wang & Yuan (2013) suggested to set criterias for on-street parking provision, using prices to achieve better utilization of public parking facilities, and setting maximum parking requirement in urban core.

For Jakarta case, the parking tariff has been increased to be double since 2013. The objective by implementing this policy is reduce the private vehicles numbers to enter the business areas in Jakarta. The tariff is progressive and it depends on the areas.

To encourage commuters to use BRT, now Jakarta Provincial Government is increasing the numbers of parking areas and facilities closed to the BRT stations. The commuters can park their cars or motorcycles at the BRT stations and shift to use BRT to reach their destination. This policy is just begun in 2014.

In addition, to improve the parking services, the Jakarta Provincial Government introduces the electronic parking card. By using the e-parking card, it is expected to reduce the illegal payment. Parking management is very crucial to improve the transportation system as well as to encourage people to use public transport.

2.1.4 The Macro Transportation Pattern

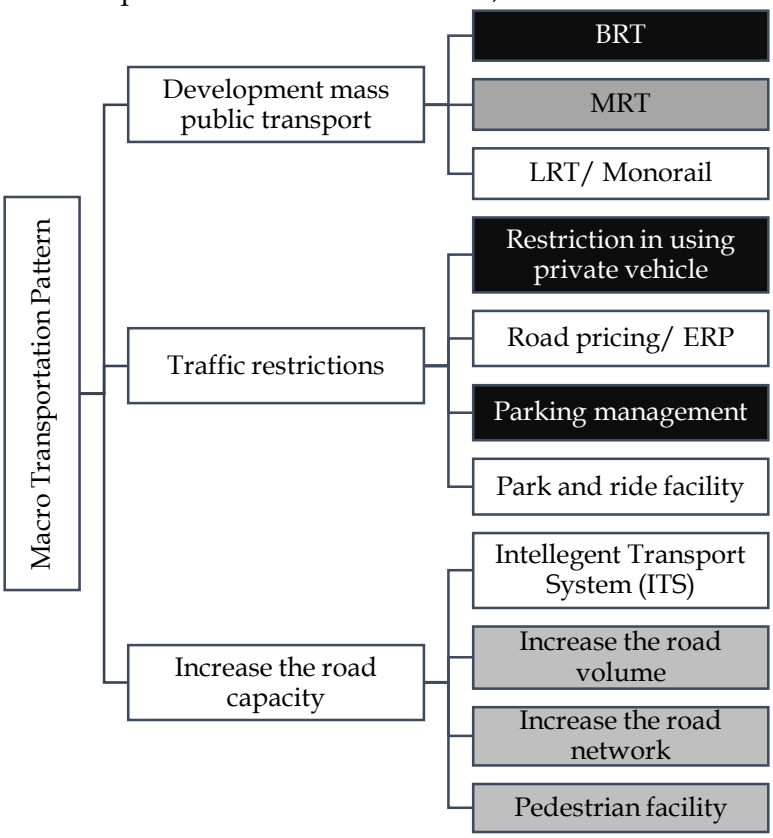
The macro transportation pattern (MTP) has been planned since 2004 under the Governor Decision number 84, but it seems some of the scenarios under this policies are not well implemented. As a plan, the direction of the development of transport system is for:

1. improve the accessibility in all regions of Jakarta and rearranging transport modes in an integrated manner;
2. promote mass transportation systems;
3. promoting the use of train;
4. reducing excessive private vehicles;
5. add the primary road network, bus priority, transit light rail (LRT) and Mass Rapid Transit (MRT);
6. increase the non-toll road network and build new roads.

The scenarios to realize that development direction are:

1. The development of bus public transport system;
2. The development of mass public transport system;
3. The development of road network system;
4. The development of railway transport system;
5. The development of alternative transport system;
6. The development of traffic restrictions.

This policies will be implemented started from 2007, 2010 and 2020.

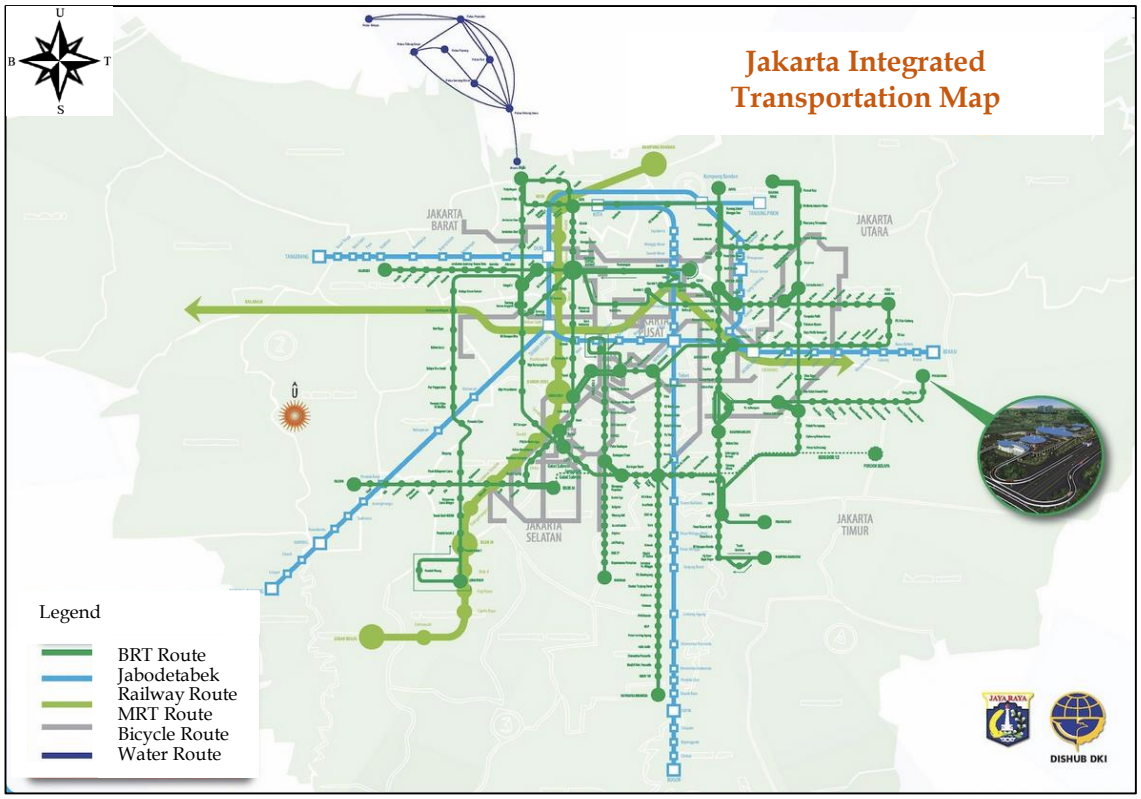


The policies have been implemented
The policies have been implemented but it is still not finished yet
The policies have not been implemented yet

Source: Author, 2015

Figure 2. 3 The strategy of macro transportation pattern of Jakarta

All the planned policies are needed the commitment from all stakeholders to realize it. However, to solve the transportation problems in Jakarta is also needed the cooperation with the buffer areas, Bodetabek, since the traffic demand from Bodetabek to Jakarta is also high. If all the planning has been implemented, the public transportations in Jakarta will be integrated and it describes on figure 2.4. In the figure 2.4, the mass public transports such as BRT, Jabodetabek Railway, and MRT will be integrated as well as the provision of bicycle lanes in certain areas.



Source: Transportation Agency of Jakarta Province, 2015

Figure 2. 4 The Jakarta integrated transportation map

To achieve the goal to have the efficiency transports depends on many factors, from the planning process, technology used, policies implemented by government, as well as the control strategies. The interaction among those factors are also not so easy in the implementation. Pro and contra of some policies could be happened. The planning process and real-time control strategies have been widely studied in recent years, and there are several practical implementations with promising results. Mixed policy scenarios also become an interesting study to know the impacts in developing transportation.

2.2 Theoritical Framework

2.2.1 Multinomial Logit Model

The behavior must adopt theoritically appropriate models of people choice among multiple alternatives. The multinomial logit (MNP) models fit this requirement as each may be derived from economic choice theories of utility maximization. The multinomial logit is the extension of the logit model. In model MNP can be represented as:

$$U_{ij} = \beta' X_{ij} + \alpha_j' Z_i + \varepsilon_{ij} \quad (2.1)$$

Where X_{ij} is a vector of attributes as observed by respondent i, and Z_i is a vector of respondent characteristics. β and α_j are the parameters that need to be estimated and ε_{ij} is the standard error.

Each respondent wants to get the maximum utility, so the probability that respondent i choose alternative 1 is:

$$P_{i1} = P[U_{i1} > U_{i2}, U_{i1} > U_{i3,}, \dots, U_{i1} > U_{ip}] \quad (2.2)$$

for any m in the set of *1, …. , p* attributes:

$$P\ (m) = P\left[\varepsilon_{im} - \varepsilon_{ij} < \left(\beta' X_{ij} + \alpha_j' Z_i\right) - \left(\beta' X_{im} + \alpha_m' Z_i\right), j \neq m\right] \quad (2.3)$$

In the multinomial logit, it is assumed that errors are independent, identically distributed (iid) with type I extreme value distribution. The probability that a respondent i choose alternative j is given by:

$$P\left(vote = j \middle| \beta, \alpha_j, X_{ij}, Z_i\right) = \frac{\exp \beta' X_{ij} + \alpha_j' Z_i}{\sum_{k=1}^{p} \beta' X_{ik} + \alpha_k' Z_i} \quad (2.4)$$

The equation (2.4) can be written into log-odds of each response follow a linear model:

$log \frac{P_{ij}}{P_{ik}} = \alpha_j + \beta_j X_i$, where α_i is a constant and β_j is a vector of regression coefficients, for $j = 1,2, \dots, J-1$.

The subscript *i*, designating individual observations, has been dropped for simplicity. In this case P_j, where j = 1, … , J – 1, indicates the probability that the *k*th choice will be made. There are J – 1 multinomial equations, instead of one, that contrast each category 1, 2, …, J – 1 with category J as a reference. Each equation assumes that the logarithm of the odds of one choice relative to a second choice is a linear function of the attribute *X*. These odds are dependent on the odds associated with the remaining two equations only in the sense that the system must be constrained so that the sum of the individual probabilities equal to 1. It is unnecessary to estimate each of the three equations separately. We can simplify by accounting for the fact that the choice of logit form forces constraints on the model that reduce the number of parameters to be estimated.

The estimated parameters will determine the effect of changes in *X* on the logarithm of the ratios of the probabilities. If actual magnitudes are needed, one must take into account the constraint that the estimated probabilities sum to 1. This can be done by renormalizing the estimated parameter value after the initial least squares regression

has been run. However, the errors are likely to be heteroscedastic. In addition, the cross-equation error correlation ought to be accounted for by using generalized least squares.

If sufficient repetitions are not available a generalized version of the maximum-likelihood procedure must be used, because it guarantees consistent parameter estimates and correct large-sample statistics (Pindyck, 1998).

2.2.2 Chi-square Test

In analyzing the data, it is used descriptive analysis such as frequency, percentage, mean and indexing analysis. For the indexing analysis, it is tested by Chi-square test to find out if there is any statistically significant differences or not. Chi-square test is symbolized by χ^2 that is useful for categorical data to test the association between row and column variables in a two-way variables. The null hypothesis H_0 for this method is no association between variables and the alternative hypothesis H_a is that some asscociations (at least one) exist. The statistic χ^2 only inform any association existance, but could not give any information about what type of association among variables. χ^2 test in is computed as

$$\chi^2 = \sum\sum \frac{(O_{ij}-E_{ij})^2}{E_{ij}} \quad (2.5)$$

The statistic distribution of χ^2 is chi-square with $(r - 1)(c - 1)$ degrees of freedom, where r represents the number of rows in the two-way table and c represents the number of columns. From the equation, *i* and *j* index the rows and columns of the table. The distribution is denoted by df called degrees of freedom and is defined for all positive values. The p-*value* for the chi-square test is the probability of observing a value at least as extreme as the test statistic for a *chi-square* distribution with $(r - 1)(c - 1)$ degrees of freedom (J. Cohen, 1977).

2.2.3 Discrete Choice Model

Designing Hypothetical Choice Experiment

In the hypothethical choice experiment, designing sets of choice alternaitves are the first important step. The design usually has to satisfy with three characteristics, namely being mutually exclusive, exhaustive and finite (Train, 2009). The alternatives being mutually exclusive mean that there is no possibility to choose beyond the alternatives given. The choice set is exhaustive if the decision makers allow to not choosing any of the alternatives provided. The alternatives being finite mean that they can be counted and finally be stopped counting. Discrete choice model usually satisfy with the third characteristic, since the attributes are nominal or ordinal type of data that gives finite number of choice alternatives.

In practice the design must cover all possible choices that respondent is possibly to select to deal with mutually exclusive. However in the case that respondent usually has more than one possible choice, such as transportation mode that is usually used to go to the working place, one respondent maybe select "train only", but other respondent take two different modes, bus before taking the train. One technique to solve this problem is to provide all possible combination of choice, for example "bus only", "train only", "bus and train", etc. Another technique is to make some limitation in the question before asking the respondent to select, for example set the question as "what is the main transportation mode used during the trip to work?".

To satisfy with the second characteristic, common way is to provide alternative of no-choice or delay choice in the choice set, but this way depend on the objective of the research (D. A. Hensher, Rose, & Greene, 2005). If the objective wants to measure the market share, alternative of no choice or delay choice available is necessary. But if the objective focus on analyzing the relationship between attributes of alternatives, forcing the respondent to choose the exiting alternative without "no choice" is more helpful. However forcing choice design still can be exhaustive with realistic result, by excluding the decision makers with "no choice" or "delay choice" in the sample (Train, 2009).

The other things, that need to consider for getting the response effectively, are giving an example and keeping a choice independent to other choices (D. A. Hensher et al., 2005). Sometime the respondent needs a time to understand fully what they have to do during the experiment. Providing an example and explanation of each attributes will make the respondent giving the proper response. In addition, the choice experiment usually asks several choice sets to one respondent. And it is possible one response given to the first choice set influence to the next choice set. Some procedures can take to keep the responses independent, such as informing the respondent in prior before answering the next choice that each choice set are assumed in separate situation, or hiring an interviewer to monitor the response for giving independent response.

Developing Choice Probability

The choice experiment approach to analyzing the travel behavior change in response to hypothetical choice experiment is now widely used (Ortuzar & Willumsen, 2011). A choice experiment model is a stochastic alternative model that simultaneously infers alternative positions and the distribution of individual preference (Yang & Sung, 2010). The design of hypothetical choice experiment has to satisfy with three characteristics, namely being mutually exclusive, exhaustive and finite (Train, 2003). The alternatives being mutually exclusive mean that there is no possibility to choose beyond the alternatives given. The choice set is exhaustive if the decision makers allow to not choosing any of the alternatives provided. The alternatives being finite mean that they can be counted and finally be stopped counting. The discrete choice model usually satisfy with the third characteristic, since the attributes are nominal or ordinal type of data that gives finite number of choice alternatives.

Discrete choice models estimate their parameters under an assumption of decision maker's behavior in maximizing their utility towards some alternatives of choice set (Train, 2003). The discrete choice models are defined simply to explain the relationship between a set of explanatory variables and a choice, without to know exactly how the process of choice is made.

Deriving a basic choice model is equivalent to individual's choice measured from a probability of an alternative being chosen (D. A. Hensher et al., 2005). Each individual, labeled n faces J alternative of choice set. Each alternative would provide a specific level of utility to the individual. The utility that the individual n gets from alternative J is represented by $U_{nj}; j = 1, \dots, J$ alternatives. The utility is only recognized by the individual, but not by other people. The individual will choose one alternative, which gives the highest level of utility. In other word, this model shows that alternative i would be chosen if only if $U_{ni} > U_{nj}$ for all $j \neq i$. The individual's utility can be examined by measuring some attributes of choice alternatives, labeled x_{nj} for all j, and attributes related to characteristics and background of individuals, labeled s_n. Therefore it is possible to determine a utility function, as $V_{nj} = V(x_{nj}, s_n)$ for all j, explaining

relation of these measured attributes to individual's utility. Since the utility function does not capture all part of utility, the utility can be composed as

$$U_{nj} = V_{nj} + \varepsilon_{nj} = V(x_{nj}, s_n) + \varepsilon_{nj} \tag{2.6}$$

The utility is set linear in parameters as expressed

$$U_{nj} = \beta' x_{nj} + \theta s_n + \varepsilon_{nj} \tag{2.7}$$

where ε_{nj} describes part of utility that cannot be explained by the utility function. The ε_{nj} called error terms, ε_{nj} for all j, are not known and treated as random. It can be set as a random vector $\varepsilon_n' = (\varepsilon_{n1}, \dots, \varepsilon_{nj})$ that has a joint density function, denoted as $f(\varepsilon_n)$.

So, if the measurement of utility is from the sample but not population, the probability of individual n chooses alternative i can be stated as

$$Prob_{ni} = Prob\left[(V_{ni} + \varepsilon_{ni}) \geq (V_{nj} + \varepsilon_{nj})\right] \forall\, j = 1, \dots, J; i \neq j \tag{2.8}$$

From equation (2.4), it can be written into

$$Prob_{ni} = Prob\left[(V_{ni} - V_{nj}) \geq (\varepsilon_{nj} - \varepsilon_{ni})\right] \forall\, j = 1, \dots, J; i \neq j \tag{2.9}$$

It means that the probability of individual choosing alternative i is equal to the probability that the difference in the unobserved sources of utility of alternative j compared to i is less than (or equal to) the difference in the observed sources of utility associated with alternative i compared to alternative j after evaluating each and every alternative in the choice set of $j = 1, \dots, i, \dots, J$ alternatives. How to handle the information of ε_j associated with each individual, the utility maximization must be random. This step to consider for the unobserved elements of utility associated with each alternative. To cover this issue the assumption must be set to ensure that the sampled population resides along a bounded line and randomly assigned a location, or it is called the distributions. Different utility model has specific assumptions towards the distribution or density function of the error term and the correlation over the observed alternatives. By holding the ε_j as independently identically distributed (*i.i.d.*) assumption, the cumulative choice probability can be derived from equation (2.9).

$$Prob_{ni} = \int I(V_{ni} - V_{nj}) \geq (\varepsilon_{nj} - \varepsilon_{ni})\, f(\varepsilon_n) d\varepsilon_n \;\forall\, j = 1, \dots, J; i \neq j \tag{2.10}$$

From equation (2.10) can be derived the general closed-form expression (Train, 2003) as expressed in equation (2.11). The probability of an individual n choosing i out of the set of J alternatives is equal to the ratio of the (exponential of the) observed utility index for alternative i to the sum of the exponentials of the observed utility indices for all J alternative, including the i_{th} alternative and it is formulated as:

$$Prob_{ni} = \frac{e^{V_{ni}}}{\sum_{j=1}^{J} e^{V_{nj}}} = \frac{e^{\beta'_{ni}}}{\sum_{j=1}^{J} e^{\beta'_{nj}}}; j = 1, \dots, i, \dots, J \tag{2.11}$$

Mixed-logit Modeling

The mixed logit model divides the density function of random terms, some portion of random terms follows to the specified distribution such as normal, lognormal, triangular, and other unobserved factor distributed *i.i.d.* extreme value. The choice probability of mixed logit model can be expressed by the following linear form (Train, 2003):

$$Prob_{ni} = \int \prod_{t=1}^{T} \left(\frac{e^{\beta x_{nit}}}{\sum_j e^{\beta x_{njt}}} \right) f(\beta) d\beta \tag{2.12}$$

The choice probability of mixed logit is a weighted average of the standard logit probability towards all possible values of parameter β and its respective probability density $f(\beta)$ as the weight factors. Parameter β can be determined to follow specific distribution e.g. normal, lognormal, uniform and triangular (D. A. Hensher et al., 2005). Due to this, the mixed logit remove the constraints in standard logit model by accommodating the heterogeneity of preference across different individuals, existing correlation among observed attributes, and inconstant pattern of substitution that release form the IIA property (Train, 2003). The parameters are estimated using maximum likelihood and using 1000 Halton quasi-random draws. For the Halton quasi-random draws, there is no magical number but by simulating the Halton number to get the stability of parameters estimated is needed, for example 10, 25, 50, 100, 500, 1000 draws. The bigger the Halton draws the parameters estimated will be more stable. Each parameter can be estimated with the simulation of the equation (Train, 2003):

$$\beta_n = \frac{\int \beta_n \left[\prod_{t=1}^{T} P(choice\ j | x_{nt}, \beta_n) g(\beta|\theta) \right] d\beta_n}{\int \left[\prod_{t=1}^{T} P(choice\ j | x_{nt}, \beta_n) g(\beta|\theta) \right] d\beta_n} \tag{2.13}$$

where $g(\beta|\theta)$ is the distribution of β in the population, and θ is its vector of parameters.

The most commonly used way to derive the mixed logit probability is based on random coefficients. According to linear equation, the mixed logit model can be rearranged as follows (D. A. Hensher et al., 2005):

$$U_{nj} = \beta_p p_j + (\beta + \gamma s_n + \delta_{xn})' x_{nj} + \theta s_n + \varepsilon_{nj} \tag{2.14}$$

The model treats homogeneity in price with a fixed parameter β_p. β represents a vector of population mean parameters, δ_{xn} is a vector of stochastic deviation of individual's preference from the population mean that in this study is assumed to be distributed normally with zero means and covariance matrix Σ_β which is really a diagonal matrix. γs_n describes interactions between main attributes and consumer attributes with fixed parameters γ. From equation (2.10), a coefficient of main attribute k incorporating random parameter and interaction with consumer attribute can be expressed:

$$\beta_k^* = \beta_k + \gamma_k s_n + \delta_{xnk} \tag{2.15}$$

The estimated mean of the coefficient is defined as follows

$$\hat{\bar{\beta}}_k^* = \hat{\bar{\beta}}_k + \hat{\gamma}_k s_n \tag{2.16}$$

2.2.4 Total Willingness to Pay (WTP)

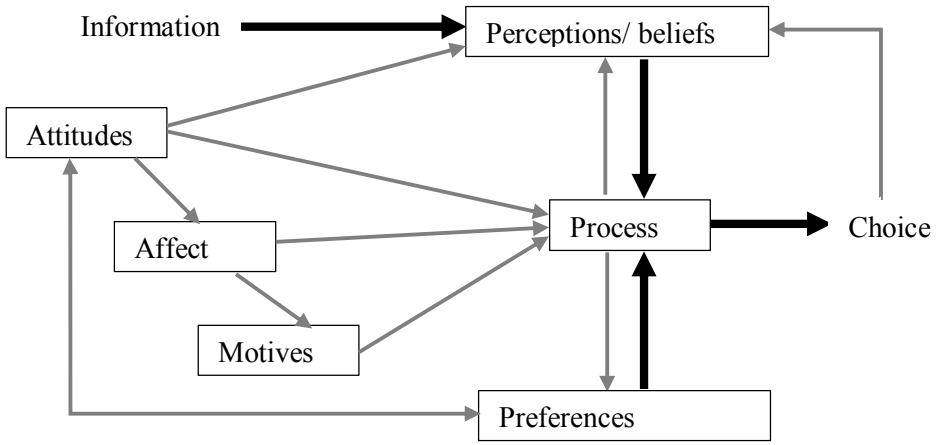
Total WTP calculation is estimated based on the formulation of consumer surplus (Train, 2009) or compensating surplus (CS) welfare (Hoyos, 2010) which is calculated based on a change in the utility, in dollar term, that person receives in the certain choice situation. Commonly it is called a change of utility from alternative 0 "current condition" and alternative 1 "proposed condition", as defined below.

$$\Delta E(CS_n) = \frac{1}{\alpha_n}\left[ln\left(\sum_{j=1}^{J^1} e^{V_{nj}^1}\right) - ln\left(\sum_{j=1}^{J^0} e^{V_{nj}^0}\right)\right] \quad (2.17)$$

Where superscript 0 and 1 refer to before and after the change and $\Delta E(CS_n)$ considered as change of expected consumer surplus of individual n from alternative j; e is known as constant; V is utility; $\propto_n$ marginal utility of income of individual n (Train, 2009). So, it can be calculated the estimation of total economic value after MRT operated under certain scenarios. And It is common to report not only the marginal WTP but also the spreading of welfare changes (Hoyos, 2010).

2.3 Terminology

There are some terminology used in this research especially related to the people behaviors. Daniel McFadden (1999) explained the relationship of behavioral theory. Figure 2.5 depicts the relationship of perception, attitude, and preference which are part of the process in choices.



Source: Daniel McFadden, 1999

Figure 2. 5 The Decision process of choice behavior

The definition of each terminology is defined below:

1. Perceptions are the cognition of sensation, and include beliefs (probability judgments).
2. Attitudes are defined as stable psychological tendencies to evaluate particular entities (outcome or activities) with favor or disfavor.
3. Preferences are comparative judgments between entities. Preferences can be represented with utility.
4. The cognitive process for decision making is the mental mechanism that defines the cognitive task and the role of perceptions, beliefs, attitudes, preferences and motives in performing this task to produce a choice.

Chapter 3 Commuters' Behaviors and Attitudes toward Current Transport Mode

3.1 Introduction

Since the private vehicle use has grown rapidly during the last decade in Jakarta, the impacts become chronic. Moreover, on the social level, the private vehicle use threatens the urban quality of life, not only contributing on the environmental damage but also yielding the traffic accidents. However, in developing countries, private vehicles especially cars are the symbol of the social status. People who have higher income have preferences to buy cars and once they have it, they will use it.

As a consequence, it is reasonable and common that most of the people depend on the private vehicles, for daily commuting. It is because by driving cars, it can give people autonomy because it is more convenient, reliable and increase their accessibility (Hiscock, et al., 2002). Other reason for driving cars is that it will get physiological benefits such as mastery, self-esteem, feelings of autonomy, protection, and prestige (Ellaway et al., 2003). The evidence from Hong Kong why people depend on the cars is after having a car it will change their lifestyle, and a car becomes necessary (Cullinane and Cullinane, 2003).

The high growth rate of private vehicle use should be offset with the development of infrastructure. Still, the lack of infrastructure is always a problem in the growth economy countries like in Indonesia. The growth rate of private vehicles is much higher than the growth of road capacities. As predicted by previous study, Jakarta would have experienced on deadlock in 2014 (BAPPENAS & JICA, 2004). Although in 2014, it was not deadlock but the traffic flow was very low. With the average speed less than 20 kilometer per hour, Jakarta has been nominated to be one of the congested cities in the world.

Encouraging people to use public transportation will give positive effects, although it is not so an easy task if without any benefits that commuters can get. Nevertheless, shifting to use public transport will give positive impacts to be more efficient in term of energy consumption and less pollution. This condition will enhance the quality of life in cities and regions (Xiaojun Hu et.al, 2010).

Current policies of urban transportation in Indonesia will focus on sustainability on social, economic, and environmental. Safe, clean and energy-efficient transport is the vision in order to achieve green growth and energy security (Ministry of Transportation & Directorate Urban Transport System, 2012). Improving public transportation services both in capacity and quality are implementing transit-oriented-development (TOD), developing transport networks and constructing infrastructure for mass transportation, improving inter-modalities and public transport accessibility, and improving the public

transport system ownership. Management and manipulation of traffic are also needed to improve the road capacity by implementing Adaptive Technology Computing Services (ATCS) and Intelligent Transportation System (ITS), traffic management, and analysis of traffic impacts. However, the policy measures must be effective, feasible and acceptable to the public. Coercive measures such as prohibition of car traffic, 3 in 1 system, which is the only cars with three passengers or more passengers, can enter the central business area in Jakarta during the peak hours, morning and after office hours. The other policy implemented is not allowing on-street parking. Moreover, the government is also improving the provision of public transport namely Bus Rapid Transit (BRT), revamp the Jabodetabek Railway but the capacity and the level of services cannot meet the demand. As the consequence, the growing of private vehicles is still high, and the congestion is getting worse.

It is needed to understand the commuters' characteristics in term of socio-demography, behaviors and attitudes as a basis to choose the best policy that should be implemented to attract people to shift to use public transportation. Moreover, commuters' behaviors and attitudes have long been recognized as important determinants on transport mode choices. Analyzing the role of individual's perception and preferences in travel demand decision making has been an interesting research both theoretical and empirical. Transport mode choice behavior of the individuals can be explained by socio-economic characteristics and attributes of the mode.

This first analysis chapther will answer the following objectives such as 1) assigning the commuters' profiles, 2) identifying the determinants of current commuters' behaviors in transport mode decisions, and 3) describing the attitudes of commuters, especially private vehicle users either car or motorcycle users. By understanding the commuters' profiles and their behaviors and attitudes, it can be used as a basis to deliver appropriate policies that can encourage people to use public transport.

3.2 Research Method

3.2.1 Data

This study uses secondary data obtained from Statistics Indonesia, the National Socio-economic Survey (NSS) and the National Labor Force Survey (NLFS) within the last 6 years, from 2009 to 2014, to explore the commuters profiling and behaviors. NSS, known as SUSENAS, is a survey conducted by Statistics Indonesia every year to collect information and data for some fields, such as population, health, education, family planning, housing, as well as consumptions and expenditure. Since 2011, this survey is carried out quarterly, visiting about 75,000 households per quarter. It selects the households as sampling unit that is annually representing total Indonesia population. The respondent covered by this survey is all members of the selected households. The designed questionnaire consist of two parts, namely core and modules. There are three different modules, such as module of household consumption and expenditure, a module of social, culture and education, a module of housing and health. The module is rotated every year, meaning that each module is being questioned every three-year (BPS, 2014b).

NLFS, known as SAKERNAS, is another survey managed by Statistics Indonesia and conducted by every quarter to record data that describe general figures of labor force and employment continuously. Annually it covers 200,000 households, distributed into 20,000 census-blocks in all provinces. Total samples from this survey are about 5,000 census-blocks per quarter, selected by probability sampling. However for the third

quarter on August, it boosts the total sample up to 20,000 census-blocks, including 5,000 basic census-blocks and additional 15,000 census-blocks, to get figure estimation fit for the level of municipality or city. This survey targets to all members of selected households, who age equal or greater than ten year-old, as the respondent to be questioned regarding marital status, education, employment, and working experience. Since 2011, it has utilized panel sampling. Therefore the parameters of labor force and employment can be compared directly with one period to another period (BPS, 2014a).

In addition, to find out the attitudes of commuters, the analysis use primary data, which are obtained from field survey to commuters who are using private vehicles, cars and motorcycles, for daily commuting and mainly they are working in the CBD of Jakarta. The survey also asked about the reasons why respondents have and use private vehicles for daily commuting, the necessity of private vehicles, and the factors deterrence from driving cars or motorcycles. Due to the data collected by using questionnaire, validity and reliability analysis of the questionnaires carried out shows that the questionnaires are valid and reliable. Among the main variables concerned are correlated and significant at 1%, and the value of Cronbach Alpha is 0.909.

3.2.2 Multinomial Logit Model

The determinants of current commuters' behaviors can be estimated by using multinomial logit model . Based on the data availability, the attributes used in transport mode choices are transportation cost. The respondent characteristics are education, occupation, and the home location. Based on these variables, the MNP can be expressed in linear model to be:

$$log\frac{P_{ij}}{P_{ik}} = constant + \beta_1 transportcost_i + \alpha_1 education_i + \alpha_2 worker_i + \alpha_3 student_i + \alpha_4 housekeeper_i + \alpha_5 southjakarta_i + \alpha_6 eastjakarta_i + \alpha_7 centraljakarta_i + \alpha_8 westjakarta_i \quad (3.1)$$

3.2.3 Chi-square Test

There are basically two types of random variables and they yield two types of data: numerical and categorical. A chi square (X2) statistic is used to investigate whether distributions of categorical variables differ from one another. Basically categorical variable yield data in the categories and numerical variables yield data in numerical form In this analysis, Chi-Square test will be used to know the the correlation of the length of ownership either cars or motorcycles with other variables namely occupation and income.

3.3 Results and Discussion

3.3.1 Jakarta's Commuters Profiling

The profiles of respondents covered in this study that are related to the transport behavior chosen can be described based on the gender, education, and monthly income. The data shows that the numbers of male and female commuters are significantly different, where the male is much higher than female within the last six years. No significant changes in the proportion of commuter gender. Figure 3.1 describes the gender data of commuter within six years.

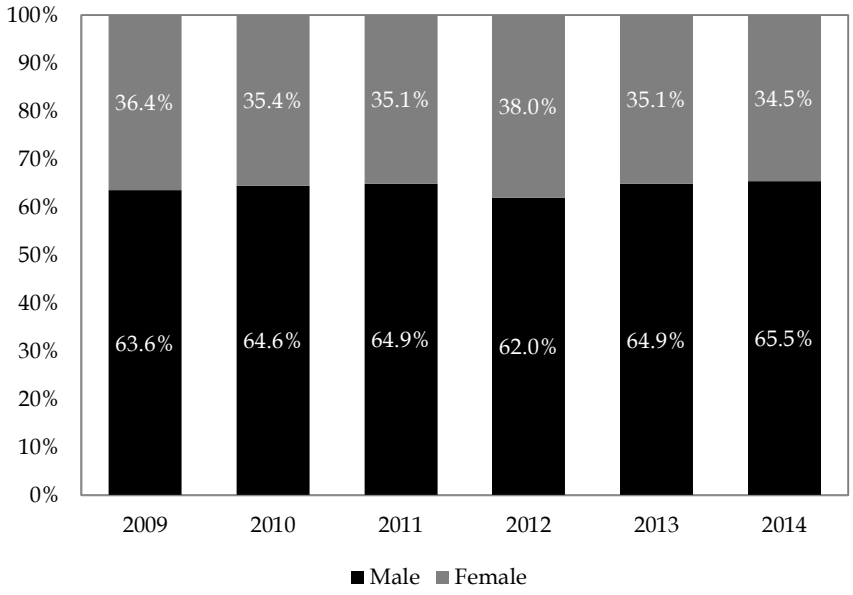


Figure 3. 1 Gender of commuters

Most of the commuters have age between 25-year-old and less than 45-year-old, giving an evidence of high urbanization in the region since most of them are people in the productive ages. However, the education level of commuters mostly is the senior high school, but within six years, the numbers of commuters who have at least undergraduate level are increasing. It is inlined also with the income of commuters which is increasing about 60% in 6 years. The higher the education level, the higher the income that the commuters can earn. Figure 3.2, Figure 3.3, Figure 3.4 are described the commuters' profile of gender, age, education and income respectively.

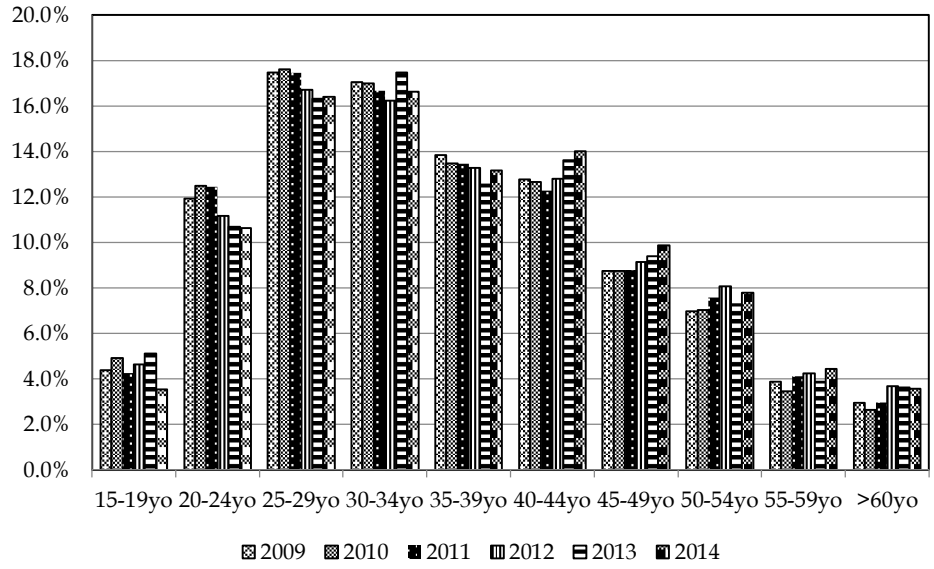


Figure 3. 2 Age of commuters

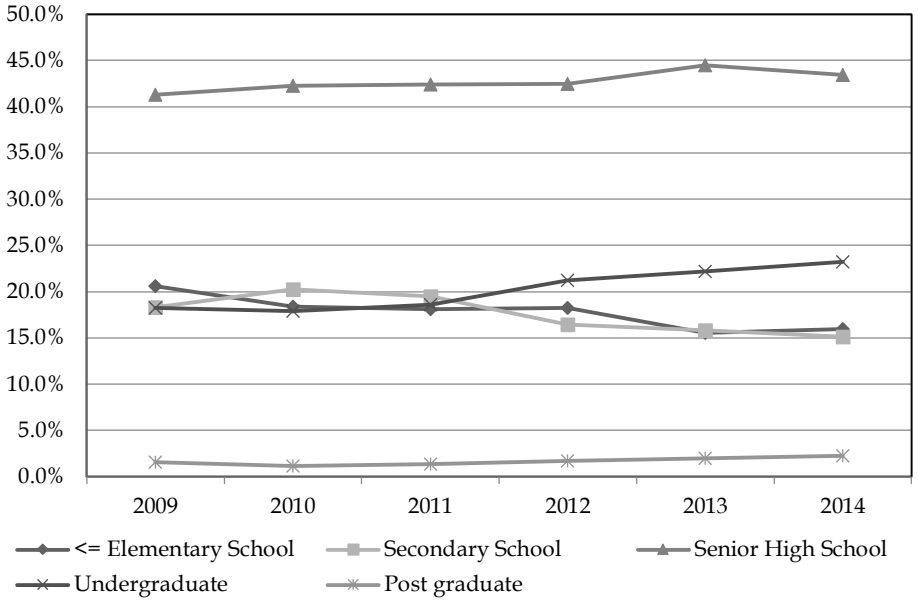


Figure 3. 3 Education level of commuters

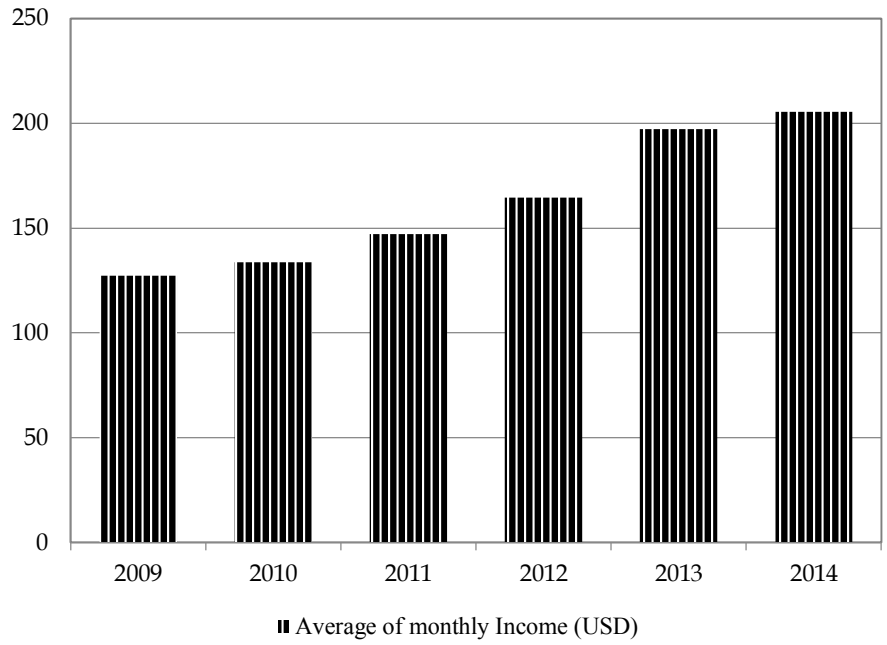


Figure 3. 4 Average of monthly income of commuters

3.3.2 Commuters' Behavior toward Transport Mode Chosen

The travel distance of commuters during six years is getting farther, approximately within the range 10-29 km. There are some possibilities: the commuters cannot get any private houses inside of Jakarta areas because of already full space, or they could not afford to buy very expensive houses in the middle of Jakarta areas. And also because of the high urbanization, the buffer areas of Jakarta, Bodetabek, becomes the reasonable targets to get private houses. This is very common in the metropolitan areas where they are working in the middle of the city and living outside of the city. Figure 3.5 shows the travel distances of commuters in the last six years.

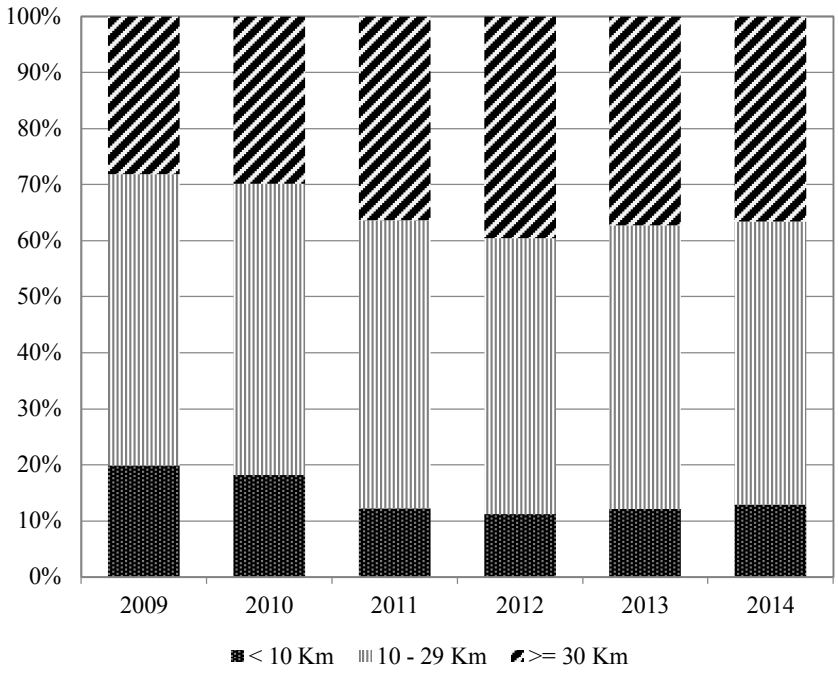


Figure 3. 5 Change in travel distance of commuters between 2009 and 2014

From the figure 3.6, it is described that number of commuters who lives in Botabek area and travel to Jakarta for work is increasing. While the number of commuters who live and work in Jakarta is not changed significantly.

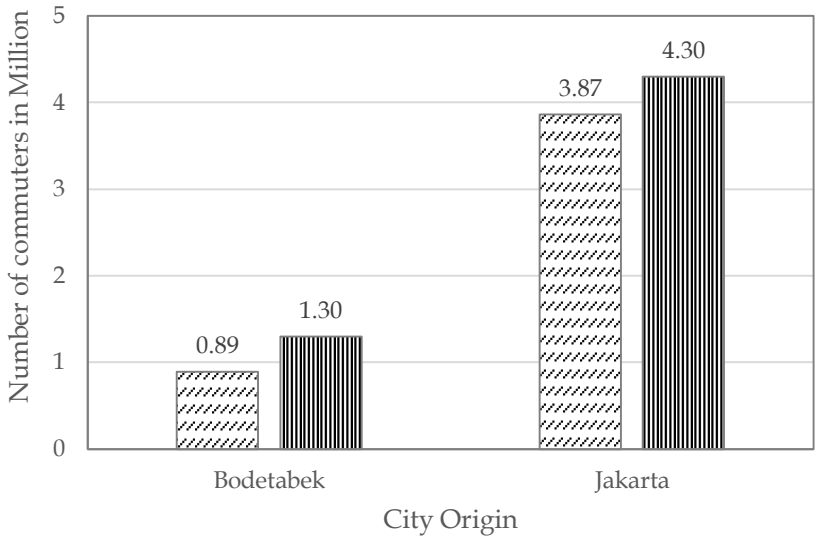


Figure 3. 6 Total commuters to Jakarta by city origin between 2009 and 2014

Figure 3.7 describes the share of male and female across different transport mode chosen. Female commuters mostly prefer to choose non-motorized, public transport, and other transports, on which their shares are almost equal to male. On the other hand, male commuters tend to drive motorcycle and car to support their mobility. The shares of male for both modes are more than 70%.

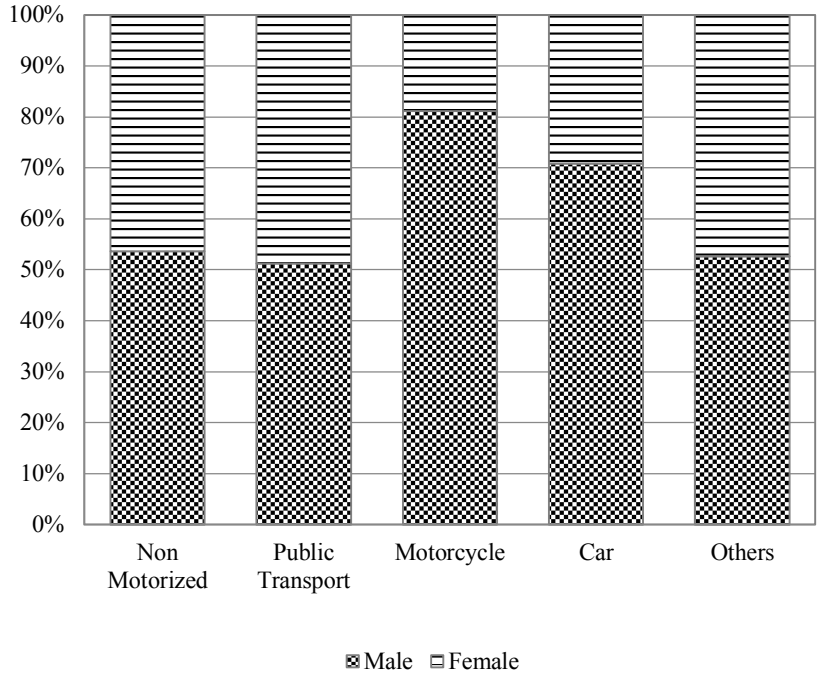


Figure 3. 7 The modal share based on commuters' gender 2013

Based on income level, the Figure 3.8 describes very clear evidence that commuters who are using cars are mostly from high-income group. In addition middle-income level are likely to choose motorcycle and public transport. Interestingly, the motorcycles are preferred by people with all the range incomes. Even the high-income people, they still prefer to choose motorcycle for their commuting. While non-motorized are mostly used by the lowest income group, even the public transport has the smallest share for this group as well as in group total.

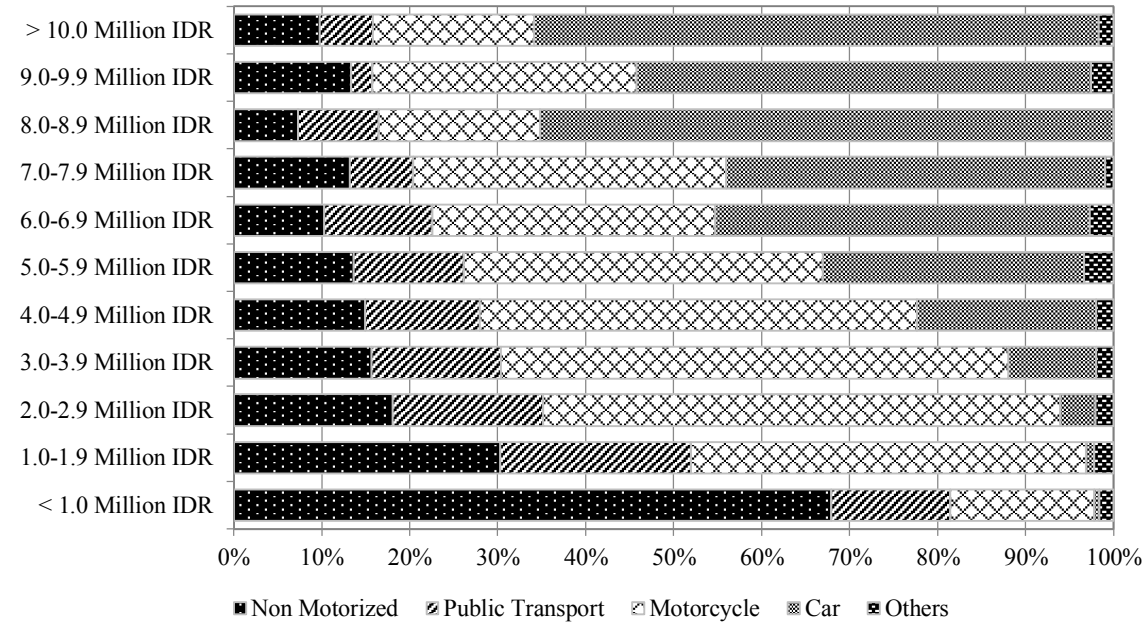


Figure 3. 8 Modal share by commuters' income 2013

If it is compared the modal share in 2011 and 2013, although within two years, it can be seen that the share of public transport is going down by 3%, and the share of motorcycles is increasing by 5%. In general, the share of private vehicles has increased.

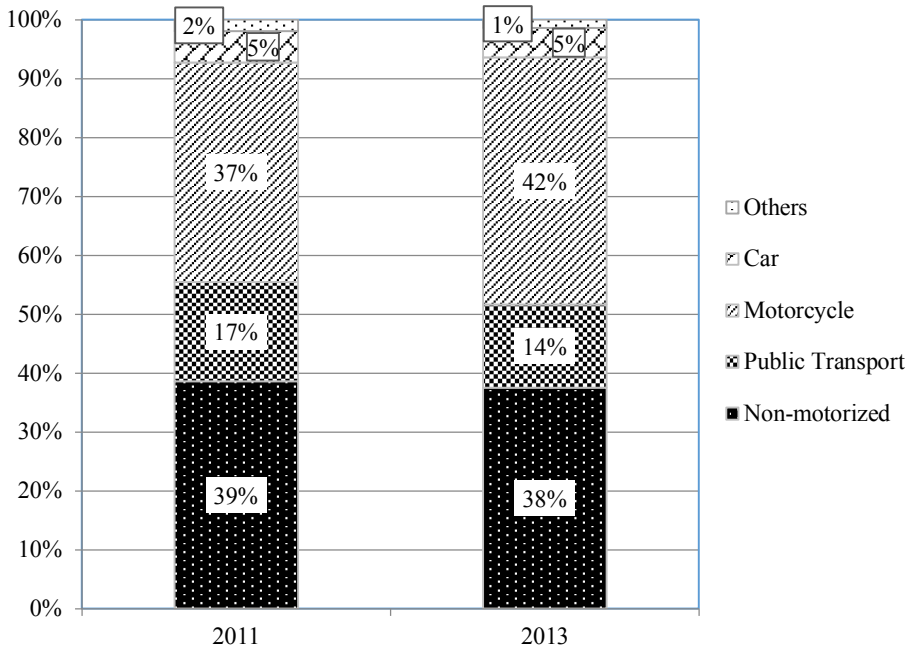


Figure 3. 9 Change of modal share between 2011 and 2013

Based on the education level, interestingly the share of public transport among commuters who got degree from senior high school or university degree is high. It is also similar to the share of the motorcycle that is still high. Moreover, it is clearly proven that most of the car users are come from the commuters who have a university degree. Another important thing is the share of non-motorized for a university degree is quite big because recently there is a trend that commuters prefer to ride their bicycles to work in Jakarta. They have a community that is called by "Bike to work." Figure 3.10 shows the modal share based on the education level of commuters.

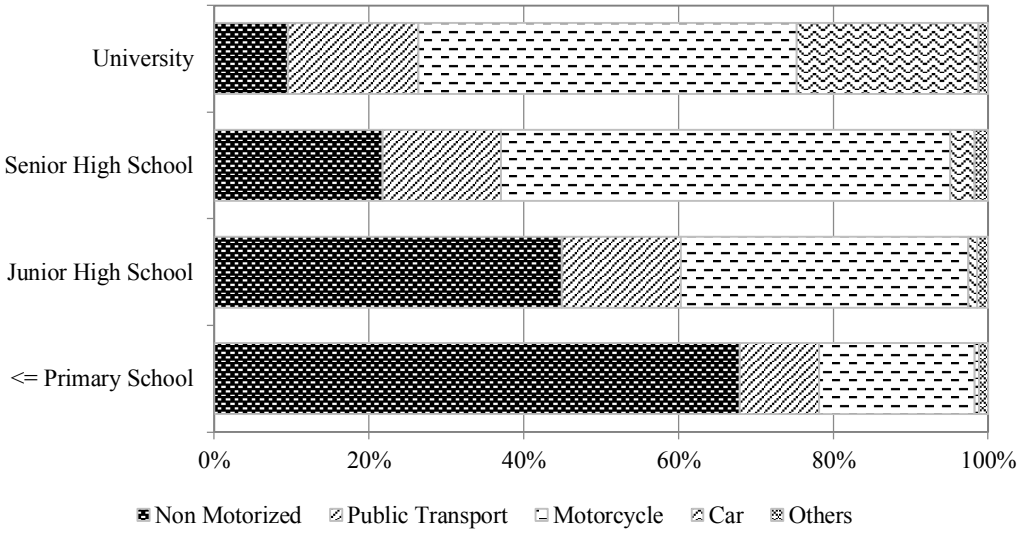


Figure 3. 10 Modal share by commuters' education level

Based on the NSS data, it is also can estimate the work travel demand of commuters by using multinomial logit where the dependent variable is the transport mode chosen. The model fitted information shows the Chi-square test is statistically significant at 1% level and all the independent variables used are also statistically significant at 1% level. It represents that the ratio of transport cost to expenditure affects the transport mode choice. Other variables, such as education, occupation and the city of living, also influence the current transport mode choice. Pseudo R-Square refer to the Cox and Snell and also Nagelkerke is very high, more than 0.2, but for McFadden Pseudo R-square is 0.12. Since there are three measurement of Pseudo R-square, two of them are good enough, then the model can be used for further analysis.

Table 3. 1 Likelihood ratio tests

Likelihood Ratio Tests				
	Model Fitting Criteria	Likelihood Ratio Tests		
Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	7944.078[a]	0.000	0	
transport cost/expenditure	8005.993	61.916	4	.000
Education	8788.250	844.173	4	.000
Occupation	8008.959	64.882	12	.000
City of living	7984.346	40.269	16	.001

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Table 3. 2 Pseudo R-Square

Pseudo R-Square	
Cox and Snell	.264
Nagelkerke	.286
McFadden	.118

Table 3.3 described the parameter estimates of the multinomial logit model for all transport modes chosen. Based on the parameter estimates, where public transport chosen as the reference category, the model confirms that the commuters who travel using cars have significantly higher costs compared to use public transport. The education of car commuters is also higher than the education of public transport users. In term of the occupation, only workers have the significant different from public transport users. The other types of occupations are not significant different. Interestingly, the commuters who live in the West Jakarta prefer to use cars to commute, and the commuters who live in the Central Jakarta less prefer to use cars. It is because most of the business areas as well as the government offices are located in the Central Jakarta. Meaning that, their distance is not so far and no need to use cars to commute. The results of this parameter estimation for car users are not big different from the motorcycle users. The difference is only on the travel cost ratio to the expenditure, where for motorcycle users it is not significant different compared to the public transport users. For the non-motorized commuters that are using bicycles and walking, almost all variables are not significant different from the public transport users. The different significant variables are only education and transport cost which is negative sign which means that if the transportation cost by using bicycle or walking is increased, people prefer to use public transport.

Table 3. 3 Parameter estimates of multinomial logit model

Parameter Estimates transport chosen								95% Confidence Interval for Exp(B)	
		B	Std. Error	Wald	df	Sig.	Exp(B)	Lower Bound	Upper Bound
Car	Intercept	-8.297	.826	100.862	1	.000			
	transport cost/expenditure	1.199	.623	3.704	1	.054	3.317	.978	11.248
	Education	.500	.032	243.974	1	.000	1.649	1.549	1.756
	Worker	1.585	.688	5.312	1	.021	4.877	1.267	18.765
	Student	-16.5	8021.9	.000	1	.998	6.4E-08	0.000	.[b]
	Housekeeper	1.823	1.158	2.477	1	.115	6.189	.640	59.899
	South Jakarta	-.274	.270	1.031	1	.310	.760	.447	1.291
	East Jakarta	-.101	.256	.156	1	.693	.904	.547	1.493
	Central Jakarta	-.541	.287	3.545	1	.060	.582	.331	1.022
	West Jakarta	.464	.264	3.088	1	.079	1.590	.948	2.667
Motorcycle	Intercept	-.397	.402	.979	1	.322			
	transport cost/expenditure	-.320	.501	.407	1	.523	.726	.272	1.939
	Education	.051	.017	9.311	1	.002	1.053	1.019	1.088
	Worker	1.200	.352	11.602	1	.001	3.319	1.664	6.620
	Student	-.375	1.459	.066	1	.797	.687	.039	11.984
	Housekeeper	.646	.773	.697	1	.404	1.908	.419	8.687
	South Jakarta	.092	.181	.259	1	.611	1.096	.770	1.561
	East Jakarta	.118	.170	.477	1	.490	1.125	.806	1.570
	Central Jakarta	-.428	.188	5.203	1	.023	.652	.451	.942
	West Jakarta	.328	.181	3.285	1	.070	1.388	.974	1.978
Bicycle	Intercept	-.256	.703	.133	1	.716			
	transport cost/expenditure	-.228	.933	.060	1	.807	.796	.128	4.950
	Education	-.130	.027	24.152	1	.000	.878	.833	.925
	Worker	.452	.646	.490	1	.484	1.572	.443	5.574
	Student	-16.866	0.000		1		4.7E-08	4.7E-08	4.7E-08
	Housekeeper	1.063	1.116	.908	1	.341	2.895	.325	25.798
	South Jakarta	.077	.316	.060	1	.807	1.080	.581	2.008
	East Jakarta	-.221	.318	.484	1	.487	.802	.430	1.495
	Central Jakarta	-.276	.341	.655	1	.418	.759	.389	1.481
	West Jakarta	-.052	.320	.027	1	.870	.949	.507	1.777
Walking	Intercept	2.579	.376	47.073	1	.000			
	transport cost/expenditure	-4.649	.817	32.355	1	.000	.010	.002	.047
	Education	-.154	.017	84.269	1	.000	.857	.830	.886
	Worker	.214	.327	.428	1	.513	1.238	.653	2.348
	Student	-16.9	4174.8	.000	1	.997	4.4E-08	0.000	.[b]
	Housekeeper	1.890	.682	7.673	1	.006	6.618	1.738	25.200
	South Jakarta	.163	.189	.738	1	.390	1.177	.812	1.705
	East Jakarta	-.026	.181	.020	1	.888	.975	.683	1.391
	Central Jakarta	.028	.192	.022	1	.883	1.029	.706	1.499
	West Jakarta	.251	.189	1.768	1	.184	1.286	.888	1.862

a. The reference category is: Public Transport.

b. The floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

c. This parameter is set to zero because it is redundant.

3.3.3 Private Vehicle Users' Attitudes

To understand the commuters' attitudes toward current transport mode chosen, the analysis in this part is specified for the private vehicle users, since it is important to know what are the factors that can discourage them in using private vehicles. Table 3.4 shows that the main reasons why people owning car prefer to use it for daily commuting are being more comfortable, more flexible and more helpful for carrying things. The first reason is also supported by the second reason that is flexibility. In the people mindset by using public transportation, it is difficult to change the transportation modes to reach their destination. Some people try to find out the easiest and fastest way by using taxi motorcycle, called by "ojek" in Indonesia. Although these taxi motorcycles are non-formal public transportation due to no rules to regulate it, people prefer to use it with all the risks.

Another reason such as "Just a habit" is still in high rank that is rank fifth. Although car owners in Jakarta can access public transportation easily, indicating by a close distance of their home to nearest public transportation in average about 0.326 kilometers, they prefer to use a car than public transportation. Moreover, the public transportation system is not well developed, and it can be seen mainly no regular schedule, especially for para-transit and bus that are operated by the city. Due to this uncertainty and low in security and safety, people prefer to use private vehicles.

Table 3. 4 The three main reasons why respondents have and use a car for daily commuting

Reasons	Importance ranking			Total	Weight score[a]	Rank of weighted score
	1st	2nd	3rd			
Don't like public transport	7	4	9	20	38	8
Helpful for carrying things	22	20	22	64	128	3
Take children to school and other activities	11	16	12	39	77	6
Public transport not available	0	1	1	2	3	10
Improves status	5	14	20	39	63	7
Flexibility	22	43	46	111	198	2
More comfortable	78	48	30	156	360	1
Saves time	22	12	16	50	106	4
Just a habit	11	18	23	52	92	5
Disability in household	0	0	0	0	0	11
Company car	2	4	1	7	15	9

[a] Weighted scores are calculated by multiplying 1st rank by 3, 2nd rank by 2 and 3rd rank by 1.

Table 3.5 shows the list of reasons why people want to have and use motorcycles including the rank of each reason. The first main reason of using motorcycles is that it can save the time. Then, the second and third main reasons are following to the reasons for the car users, which are being more comfortable and giving more flexibility. That is true by using motorcycles it can be faster to reach the destination because the traffic congestion in Jakarta becomes worse recently. The fact that motorcycles are the fastest way to commute is supported by the data that the average speed for motorcycles is 33 kilometers per hour, where the average speed of cars and bus is 21 kilometers per hour and 17 kilometers per hour respectively (R. Suryo et al. 2007).

Table 3. 5 The three main reasons why respondents have and use a motorcycle for daily commuting

Reasons	Importance ranking			Total	Weight Score[b]	Rank of weighted score
	1st	2nd	3rd			
Don't like public transport	7	9	12	28	51	6
Helpful for carrying things	5	5	9	19	34	8
Take children to school and other activities	15	9	10	34	73	5
Public transport not available	1	1	2	4	7	10
Improves status	3	3	6	12	21	9
Flexibility	19	35	40	94	167	3
More comfortable	12	50	33	95	169	2
Saves time	104	36	23	163	407	1
Just a habit	7	27	37	71	112	4
Disability in HH	7	5	8	20	39	7
Company motorcycle	7	9	12	0	0	11

[b] Weighted scores are calculated by multiplying 1st rank by 3, 2nd rank by 2 and 3rd rank by 1.

With the targeted respondents are people who use cars and motorcycles for daily commuting, it means at least they have one of those private vehicles. From the data, it shows that 63.3% of respondents have at least one car and some, 8.1% respondents, have more than one car. Respondent perception of the necessity of having a car is that 64.4% said totally necessary, and 35.0% said quite necessary. This number is higher than the respondent perception in Hong Kong which is 38% and 46% for totally necessary and quite necessary respectively (Culliname and Cullinane, 2003). However, if it is compared to the result from a household survey in UK conducted in 1990, it is slightly lower. They found that the necessity of cars in UK was about 69% (Cullinane, 1992).

Table 3.6 exposes that there is a relationship between the necessities of owning car and length of car ownership. It says the longer in having a car, the more necessary and it is signed by the highest percentage of respondents who have a car more than five years. The highest percentage, 79%, of totally necessary is the respondents who have a car between 6 to 10 years. This result is different with in Hong Kong study, where the level of perceived necessity is correlated significantly with annual mileage besides the length of ownership.

Table 3. 6 Necessity of car by length of ownership

	<=5 years	6-10 years	>=11years	Total
Totally necessary	52 (59)	33 (79)	31 (62)	116 (64)
Quite necessary	35 (40)	9 (21)	19 (38)	63 (35)
Not very necessary	1 (1)	0 (0)	0 (0)	1 (1)
Total	88 (100)	42 (100)	50 (100)	180 (100)

$\chi^2 = 17.105$, df = 4, p = 0.002, number in parantheses is the percentage

In addition, the Chi-square test also shows the significance of the relationship between the necessity level of owning car and other variables. The necessity of owning car is also related to the respondent occupation that is shown in table 3.7 and monthly household income as explained in Table 3.8. Respondents who work as a business person or self-employed considered cars are totally necessary, 80% than respondents who work as public servant or part time job. Moreover, respondents who work as part-

time job mentioned that cars are quite necessary, 76%. The higher their income, the more necessary to have a car, if it is compared with group income, 74% respondents with income <7.9 million rupiahs said having a car is totally necessary, as well as the group with income more than 12 million rupiahs.

Table 3. 7 Necessity of car by respondent occupation

	Business person or self-employed	Public servant or organization staff	Part-time job	Student	Others	Total
Totally necessary	28 (80)	67 (66)	5 (24)	13 (68)	3 (75)	116 (64)
Quite necessary	7 (20)	33 (33)	16 (76)	6 (32)	1 (25)	63 (35)
Not very necessary	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	1 (1)
Total	35 (100)	100 (100)	21 (100)	19 (100)	4 (100)	180 (100)

$\chi^2 = 20.413$, df = 8, p = 0.009, number in parantheses is the percentage

Table 3. 8 Necessity of car by monthly household income (million rupiahs)

	<7.9	7.0 – 8.9	9 – 11.9	>=12	Total
Totally necessary	25 (74)	31 (69)	19 (41)	41 (74)	116 (64)
Quite necessary	9 (26)	13 (29)	27 (59)	14 (26)	63 (35)
Not very necessary	0 (0)	1 (2)	0 (0)	0 (0)	1 (1)
Total	34 (100)	45 (100)	46 (100)	55 (100)	180 (100)

$\chi^2 = 18.264$, df = 6, p = 0.006, number in parantheses is the percentage

The findings regarding the relationship between necessity of owning vehicle and the socio-economic variables, as applied for car users above, are not strongly significant for motorcycle users. The correlation between the necessity of motorcycles and length of ownership is significant at 10% level. The chi-square tests between the necessity of motorcycles and occupation as well as household income are not significant. However, based on the contingency tables below from table 3.9, table 3.10 and table 3.11 show that 85% of motorcycle users mentioned that motorcycles are totally necessary, and 15% mentions quite necessary. There are no respondents who answered "Not very necessary". Meaning that having motorcycles is very important for those people who live in Jakarta. As mentioned before that almost every household in Jakarta has motorcycles, as the data indicate 95.3% of total households having motorcycles.

Table 3. 9 Necessity of motorcycle by length of ownership

	<=5 years	6-10 years	>=11years	Total
Totally necessary	70 (86)	42 (76)	41 (93)	153 (85)
Quite necessary	11 (14)	13 (24)	3 (7)	27 (15)
Not very necessary	0 (0)	0 (0)	0 (0)	0 (0)
Total	81 (100)	55 (100)	44 (100)	180 (100)

$\chi^2 = 5.656$, df = 2, p = 0.059, number in parantheses is the percentage

Table 3. 10 Necessity of motorcycle by respondent occupation

	Business person or self-employed	Public servant or organization staff	Part-time job	Student	Others	Total
Totally necessary	20 (87)	97 (85)	13 (81)	15 (83)	8 (89)	153 (85)
Quite necessary	3 (13)	17 (15)	3 (19)	3 (17)	1 (11)	27 (15)
Not very necessary	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	23 (100)	114 (100)	16 (100)	18 (100)	9 (100)	180 (100)

$\chi^2 = 0.392$, df = 4, p = 0.983

Table 3. 11 Necessity of motorcycle by monthly household income (million rupiahs)

	<7.9	7.0 – 8.9	9 – 11.9	>=12	Total
Totally necessary	57 (83)	31 (82)	34 (90)	31 (89)	153 (85)
Quite necessary	12 (17)	7 (18)	4 (10)	4 (11)	27 (15)
Not very necessary	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	69 (100)	38 (100)	38 (100)	35 (100)	180 (100)

$\chi^2 = 1.605$, df = 3, p = 0.658

During the survey it is also questioned what make them avoiding to use cars for commuting, with giving some factors and asked them to give responses to each factor by score, from very much (score 5) to not at all (score 1). Table 3.12 displays their responses where the traffic congestion is the most reason to avoid driving a car, then at the second and third rank is related to parking, both parking cost and parking availability at destination and the unreliability of parking. The stress of driving is also in the fourth rank that could deterrence people from driving. Moreover, the traffic congestion is the triple time that deters respondents to drive a car compared to parking costs and the parking availability. Regarding toll and petrol costs are not the most factors deterrence from driving a car. It is because the toll cost and petrol cost in Indonesia are cheaper compared to other countries and still affordable by people. Furthermore, the petrol cost is still subsidized by government and the price is about 0.6 USD per liter recently.

Table 3. 12 Rank of factors deterrence from driving a car

Factors	Not at all	Not very much	Neutral	Quite a lot	Very much	Average	Rank
Traffic congestion	7	22	14	54	83	4.02	1
Parking costs at destination	3	35	59	55	28	3.39	2
Parking availability at destination	2	37	54	63	24	3.39	2
Unreliability of parking availability	1	44	62	59	14	3.23	3
Toll cost	5	49	85	37	4	2.92	6
Petrol cost	4	44	68	57	7	3.11	5
Route unfamiliarity	8	89	64	18	1	2.53	7
Stress of Driving	9	39	65	55	12	3.12	4

The results for motorcycle users regarding the factors that deter from driving a motorcycle is shown in Table 3.13. Traffic congestion is still in the first rank, but it is accompanying by the stress of driving. Driving a motorcycle is much more stressful compared to driving a car because the safety is very low. Then, the next factors are related to the parking: second rank is parking cost; third rank is parking availability, and fourth rank is the unreliability of parking.

Table 3. 13 Rank of factors deterrence from driving a motorcycle

Factors	Not at all	Not very much	Neutral	Quite a lot	Very much	Average	Rank
Traffic congestion	15	21	21	42	81	3.85	1
Parking costs at destination	8	37	48	50	37	3.39	2
Parking availability at destination	2	41	66	50	21	3.26	3
Unreliability of parking availability	3	50	64	47	16	3.13	4
Petrol cost	16	72	61	27	4	2.62	6
Route unfamiliarity	7	49	55	54	15	3.12	5
Stress of Driving	15	21	21	42	81	3.85	1

3.4 Discussion

The number of cars and motorcycles will increase continuously as well as the travel distance is significantly increased. Since the quality of public transport services is not improved yet, commuters prefer to shift to motorcycles for daily commuting. The provision of integrated public transportation is still limited. Only Bus Rapid Transit (BRT), known as TransJakarta, is integrated with Jabodetabek railway at some points. It makes people quite difficult to change to other types of transportation modes. The punctuality of public transportation is also very low, and even much public transportation does not implement the fixed schedule. As a result, the congestion is getting worse, and pollution from transportation is also increased.

In addition, fuel price, which is partly still subsidized by the government, is one of factor deterrence from driving. Although now Indonesia has become net oil import country, until at the end 2014 the government of Indonesia is still giving subsidy especially for transportation fuel such as petroleum until at the end of 2014 and diesel fuel until now. The diesel fuel is still having fixed subsidy by 1,000 IDR (Indonesian Rupiahs) or equal to 0.1 USD (United State Dollar) per liter. The current petroleum price without subsidy is about 6,700 IDR or only increased by 12% compared to the last year price. The few increase of fuel price is because the international market fuel price now is decreasing. As the consequence, if the operational cost in using private vehicle is very low, it discourages people not leaving their vehicles.

Therefore it is pointless to only make restrictions discouraging people in using their private vehicles without any commitments from government to provide better public transport with better services. The MRT development, constructed currently by Jakarta city government, is one of breakthrough policies by providing alternative mass transport mode that is expected to give better services. Moreover, this also should be supported by other policies such as park and ride system, where parking areas are

needed at the points of public transports stops. Other types of policies, such Transit Oriented Demand are also needed to implement.

3.5 Concluding Remarks

Based on the analysis, it is shown that there are different numbers between male and female. Most of the commuters are in the productive ages between 25-year-old and less than 45-year-old. The education levels of commuters are getting increase although it is still dominated by the senior high school level, and it inline with the average income of commuters that has been increasing significantly within the last six years.

Regarding the commuters behavior, it describes that the preference of commuters to live longer distance from their work place has been increased, confirmed by the increasing numbers of commuters from the buffer areas of Jakarta, Bodetabek. Private vehicles are still the commuters' favorite across all socio-economic groups, especially motorcycles which are chosen by commuters in all the income ranges. However it is different for car users that most of them are from high-income group. As a consequence, the share of public transport is continuing to decrease in the recent year. These findings are supported by the model used to know the factors affected the transport modes chosen. From the parameter estimations, it shows clear evidence that the private vehicle users either cars or motorcycles have higher education level compared to the public transport users. Most of the private vehicle users are workers and live farther than the public transport users. However, the transport cost is also bigger than the cost of using public transport. Meaning that, for people who face longer commutes, cars become more attractive options, especially with a higher wage level and opportunity cost of commuting time.

The attitudes of private vehicle users can be defined based on their main reasons choosing either cars or motorcycles to commute and how their dependency on the private vehicles. The main reasons for using cars and motorcycles are more comfortable, more flexible and could save the time especially for motorcycles. Their dependences to cars and motorcycles are very high because of lack of services in public transportation such as the punctuality, not integrated with them, security and safety as well.

3.6 The Policy Implications

There is no such kind of policies to discourage people to use private vehicles especially motorcycles. Some policies have been introduced such as 3 in 1 system, in the CBD area of Jakarta since 2005 to burden people to use their cars, it does not work well. People still can through the areas with using jockey and pay them with a small amount, maximum 20,000 IDR or about 2 USD. To burden the cars or motorcycle to enter the CBD areas can use road pricing, no matter the number of passengers inside, as long as it passes through the CBD areas, it will be charged. The area pricing scheme can levy rate the shifting of private vehicle users to BRT (Yagi and Abolfazl Mohammadian, 2007).

Moreover, people will give up in using their vehicles if no parking space and the parking price is expensive. So, government should impose the parking price especially in CBD area and provide parking space at some stations such as some main points of TransJakarta, Jabodetabek railway, then people can follow park and ride system, where they can use their cars or motorcycles from home to the stations and continuing by using mass public transport. At the same time, the government should improve the services of public transportation through increasing the frequency, improving the punctuality,

safety, and security. A previous study conducted by Zhang, Z. et al. (2014) mentioned that by giving incentive to the commuters through reducing the ticket price and also provide additional entertains such as fast food restaurant that including into the ticket as well as giving free wifi in public transport areas can improve the commuters' utility. However, before implementing those such policies, it is needed to study further either the policies can well implement in Jakarta or not.

Chapter 4 Mixed Policy Scenarios for Increasing Willingness to Shift to MRT

4.1 Introduction

The capital city of Indonesia, a special administrative city of Jakarta Province (locally refers to DKI Jakarta), has been known to be one of the most congested cities in the world (Cunningham & Cunningham, 2010). The economic cost only for time losses of the congestion was modestly estimated to be 5.6 billion USD a year (Japan International Cooperation Agency, 2012) which accounts for approximately 5% of GRDP of DKI Jakarta (Statistics Indonesia, 2014a). Amid the serious situation, the growth rate of vehicles continues to be much greater than that of transport infrastructure provisions (Santos et al., 2010).

Various efforts have been made to mitigate the congestion while addressing both the travel demand and supply. For example, the "3-in-1" regulation, in which only a car with more than three passengers, can enter the central arterial roads during peak hours has implemented since December 2003 (BAPPENAS & JICA, 2004). The bus rapid transit (BRT) known as TransJakarta has been introduced and expanded gradually and is presently operated in 12 corridors since 2004 (Transjakarta, 2013). The upgrading and revamp of the Jabodetabek (Jakarta Bogor Depok Tangerang Bekasi) Railway System are also implemented to strengthen the inter-city public transport (Turner, 2012).

Despite such efforts, however, motorization has been prevailing with high growth rates of cars and motorcycles, driven fundamentally by the rapid economic growth and urbanization in DKI Jakarta (Statistics Indonesia, 2014b). During the last ten years, number of registered passenger cars in DKI Jakarta has grown by 11.9% annually while that of motorcycles has grown much faster by 16.3%. The motorized passengers with cars and motorcycles dominantly share about 98% of transport mode choices, in which commuters are the largest subcategory in terms of trip purpose with 50% (Ministry of Economic Affairs & Japan International Cooperation Agency, 2012). In addition, the low-cost green cars (LCGCs) as subsidized compact and fuel-efficient cars, which are recently promoted by the government are making the congestion even worse as once an individual has purchased an automobile, there is a strong eagerness to use it for traveling (Chin & Smith, 1997).

Based on the utility theory, the transport mode chosen should give the highest value of expected utility (Noland, Small, Koskenoja, & Chu, 1998), as composite effect of all the influencing factors including physical and non-physical features. Making public transportation the most attractive requires giving the highest utility among the available transport options. The reliable, highly frequent, and comfortable public transport increase the utility (Beirão & Sarsfield Cabral, 2007; Redman, Friman, Gärling, & Hartig, 2013). Also, the availability of parking areas in the public transit system could enhance the use of public transport (Duncan & Cook, 2014), implying that connectivity

with other transportation modes is important for public transport. However, the literature also pointed out multiple factors to robustly make the private vehicles being the most attractive transport mode for people to commute among the other transport modes, including comfort, flexibilities in time and route, speed and fulfilling various symbolic and emotional needs (Anable, 2005; Bergstad et al., 2011; de Groot & Steg, 2007; Hagman, 2003; Jensen, 1999; Redman et al., 2013; Steg, 2005; Widodo & Kidokoro, 2012).

As a consequence, it was concluded that the BRT could not successfully attract the vehicle commuters to shift but most of people from the other public transports (Kumar, Zimmerman, & Agarwal, 2012; Yagi & Mohammadian, 2008). Furthermore, vehicle commuters would shift to the BRT if the costs of using cars and motorcycles were higher by the means of policy interventions such as area pricing scheme to the central business district (CBD) (Yagi & Mohammadian, 2008).

It is then required to change the relative utilities between public transport and private vehicle use in a consistent manner. The government of Indonesia and city of Jakarta currently plan to introduce new Mass Rapid Transit (MRT) and emerging concerns exclusively concentrate on providing better services of the MRT in term of frequency, speed, and parking facilities to make a transit system more attractive (MRT Jakarta, 2013b). Yet, introducing MRT without sufficient simultaneous countermeasures to discourage vehicle commuters such as electronic road pricing (Yagi & Mohammadian, 2008), increasing fuel price or fuel subsidy removal (Elvik & Ramjerdi, 2014) would result in failure for solving the congestion. Therefore, empirical evidence to quantify the scale of impacts of such policies to discourage vehicle commuters on the relative utilities is significant for better policy making.

In the literature, the standard approach to address expected behavioral changes in transportation mode choice is to study on the valuation of revealed preferences for different attributes of transport modes (D. A. Hensher, 2006; D. A. Hensher, 2008). Ito, Takeuchi, & Managi (2013) estimated the potential demand on the basis of how much people are willing to pay for alternative fuel vehicles under various refueling scenarios. It often includes contextual scenarios as external factors in the attributes of the choice sets, when choice experiments are employed. Alternatively, the background scenarios can be separated from the attributes in the choice sets, by which the cognitive burden is considered to be reduced for respondents (DeShazo & Fermo, 2002; Fischer et al., 2014; Zhao et al., 2013). For example, Wouter Botzen and Van Den Bergh (2012) treat government compensation scenarios as contextual background, while attributes of flood probability and climate insurance are exclusively included in the choice sets.

In reference to Wouter Botzen and Van Den Bergh (2012), the present study employs the road pricing and the fuel subsidy removal as contextual policy scenarios and services of the planned MRT as attributes in the choice sets to primarily analyze revealed preferences of changes in transport mode for vehicle commuters in DKI Jakarta. Here, the contextual policy scenarios offer the pushing effects by discouraging vehicle commuters to use the private cars and motorcycles, whereas improvements of MRT services offer pulling effects by encouraging vehicle commuters to shift.

The main research questions of this paper are: 1) how is the future commuters' behaviors on transport mode choices once MRT successfully completed under different policy scenarios? 2) how big its benefits to increase economic value? Based on this research questions, the main objective of this research is to provide empirical evidence to quantify the scale of impacts of such policies to discourage vehicle commuters on the relative utilities for better policy making.

The remainder of the paper is organized as follows: Next section briefly explains Jakarta MRT development followed by the third section on methodological details including analytical model, the design of the questionnaire, and survey method. The section four reports empirical findings and the fifth section conclude the study.

4.2 Jakarta MRT Development Overview

Multiple benefits are expected for the development of MRT in Jakarta: to increase transport capacity of passengers; to reduce travel time, to mitigate air pollution; to reduce traffic accidents, and to improve the country's investment climate and consequently further to enhance social and economic development (MRT Jakarta, 2013b). The development of MRT connecting the south and the north is divided into two stages of MRT construction. The first stage will connect from Lebak Bulus in the south to Bunderan Hotel Indonesia over 15.7 kilometers with 13 stations consisting of 7 elevated stations and 6 underground stations. Currently, it is currently under construction and scheduled to begin the operation by the end of 2016. The second stage will be further stretched from Bunderan Hotel Indonesia to Kampung Bandan with total length of 8.1 kilometers with eight underground stations and be completed in 2018. The MRT will be operated from 05.00 am to 00.00 am with every 8 minutes frequency (the headway), and the total travel time for the first stage is about 43 minutes with the speed at 30 kilometers per hour on average. In addition, the parking facilities are not available at all the MRT stations, but only in major stations. Each train will have six carriages with the capacity of approximately 250 passengers of each carriage. In the third-year operation, it is targeted to carry 412,000 passengers daily.

The total cost of the MRT construction is about 1.44 billion USD (MRT Jakarta, 2013b), of which 1.2 billion USD is financed by loan and the payment will be shared between Jakarta province budget (30%) and national budget (70%). The remaining 0.24 billion USD is shared between Jakarta Province budget (58%) and national budget (42%).

Although it is not possible in the near future, the current plan acknowledges the following needs in the long run; (1) the MRT will be integrated with the other public transport modes such as city buses, BRT, and Jabodetabek railway system; (2) supporting facilities of adequate pedestrian and parking spaces at all MRT stations for park-and-ride system; (3) commercial and public buildings will be constructed near the MRT stations.

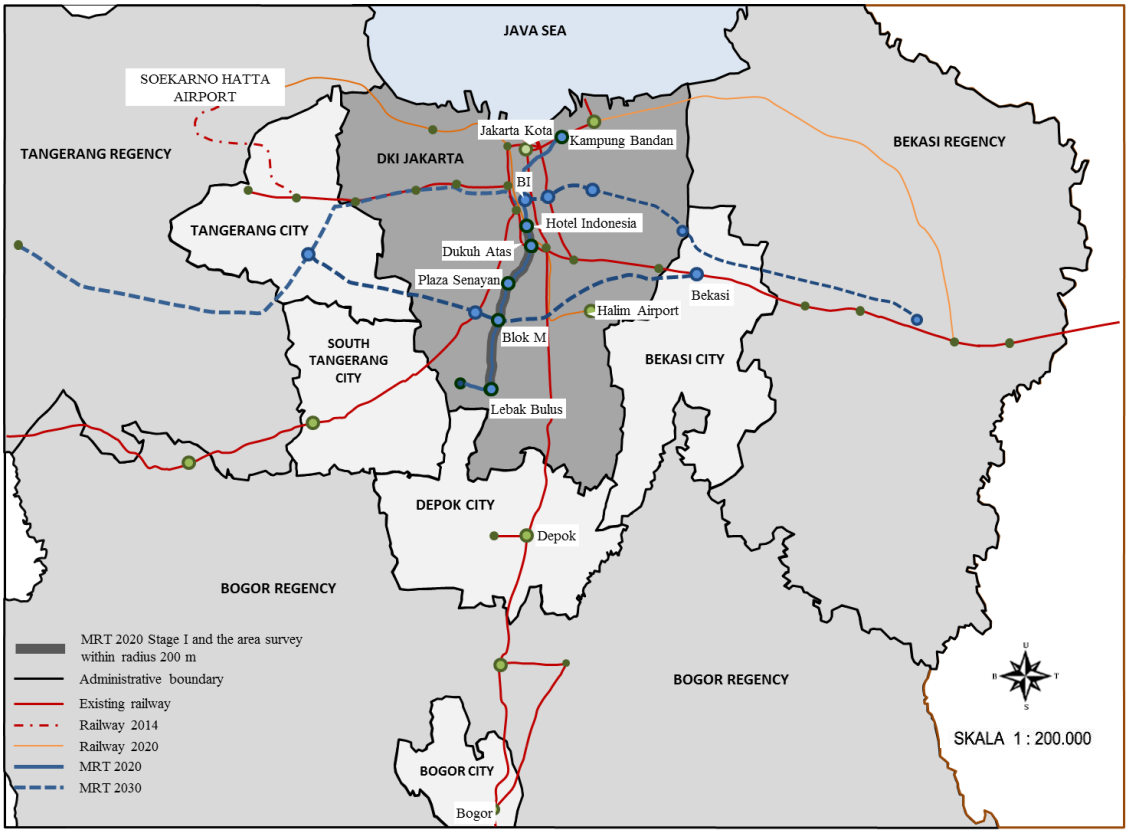
4.3 Research Method

4.3.1 Sampling Area

This study uses primary data, which are obtained from the survey interviewing commuters who drive with cars or motorcycles to carry out their main activities in the CBD of Jakarta during the weekday. The MRT is planned to be constructed at the center of existing wider roads and thus the sampling target of the survey is selected to be buildings along the roads from Lebak Bulus in South Jakarta to Hotel Indonesia in Central Jakarta shown in Figure 4.1.

The buildings include commercial business offices, governmental offices, schools, hospitals, restaurants, shops, super markets, etc. We focus primarily on the buildings in the first line directly facing to the roads with MRT since there are many residential buildings behind the first line. Although sampling area is in DKI Jakarta as

places of daytime activities, residential locations of respondents vary over all satellite cities around DKI Jakarta, Jabodetabek.



Source: General Plan of Railway Network in Jabodetabek 2014-2030,
Directorate General of Railway, Ministry of Transportation Indonesia, modified by author

Figure 4. 1 The map of study

4.3.2 Selection of Attributes

In designing questionnaires of the choice experiment (CE), the selection of attributes is a crucial step because it will affect the respondent choices (Nguyen, Robinson, Kaneko, & Komatsu, 2013). As mentioned earlier, the attributes of choice set exclusively focus on services of the MRT, whereas other policies are treated as contextual policy scenarios. The attribute selection for this study utilize the existing findings from Focus Group Discussion (FGD) which was conducted by Jakarta Transportation Agency (MRT Jakarta, 2013a). The purpose of FGD was broadly to understand users' preference for services of MRT and their willingness to use MRT once it starts. Total respondents were 18 commuters including private vehicle users and public transportation users with different income levels. The conclusions from the FGD are that the commuters potentially want a faster public transportation than using their private vehicles, if short headway (high frequency) and parking areas for cars and motorcycles around the MRT close to their home are available. Other concerns such as comfort, safety, and accessibility to the MRT from their working place are found to be also important.

To incorporate the FGD findings, the attributes of choice cards in the questionnaires are comprised of headway, average speed, and parking availability. Yang and Sung (2010) used similar attributes, travel time, frequency and travel cost, in

constructing a mixed-logit model to analyze the effects of new transport mode introduction on modal shift. Moreover, Mazzulla and Ebol (2006) measures the service quality attributes by using frequency, number of stations (bus stops), the comfort of the bus (seat availability), security and information. Other researches also employed frequency and comfort as the common factors when considering public transport as a viable alternative mode (i.e., Beirão & Sarsfield Cabral, 2007).

The first attribute is headway defined as a measurement of the time between train under consideration and the next train behind in the same traffic lane (Heidemann, 1990), that represents maximum waiting time at the station. The headway is one of the key elements in the public transportation users' satisfaction with service quality and in mode choice decisions (Luethi, Weidmann, & Nash, 2007). The current master plan of MRT designs the headway of MRT to be every 8 minutes on average. The improved services should be shorter and feasible headways compared to the current master plan. Therefore, the combinations of current and improved services are developed with three levels of headway (every 3 minutes, every 5 minutes and every 8 minutes). Speed is the second attribute that is defined as the time spent traveling between specified points (Redman et al., 2013). The speed attribute is somewhat related to the headway but not exactly same in terms of quality of services (Pucher, Park, & Kim, 2005). Similar to the headway scenarios, we consider three levels of speed to generate the choices, 30 kilometers/hour as in the current MRT master plan, 40 kilometers/hour and 50 kilometers/hour. The third attribute is parking availability with two cases: parking is partially available but not in all MRT stations as in the current plan and parking is available at all stations as an improved scenario. Another attribute used is the financial burden or indirect tax imposed on the MRT development. This financial burden is fundamentally defined by two ways: private burden and social burden. When it comes to future infrastructure development, we employed social burden in this study as fee of MRT is not announced and lots of costs are barred by non-users as much of tax revenue of DKI Jakarta is collected from motor vehicle tax, which accounts for approximately 60% according to Sudjarwoko (2010). We estimate per capita social cost of the MRT construction as follows. The financial burden to construct the MRT is shared between national government and the government of DKI Jakarta by 55% and 45% respectively. When the 45% of total cost of the MRT construction is divided by total population of DKI Jakarta, we get 52 USD, which is used as baseline. Then we estimate additional costs of service improvements such as replacement of better trains, increase in number of trains and provisions of parking stations that found to be maximum 50% increase. With these considerations, we set 52 USD (current plan), 65 USD (25% increase) and 78 USD (50% increase), respectively. Table 4.1 explains the detail attributes and levels of the CE.

Table 4. 1 The attributes and levels of choice experiments

Attributes	Improved Services	Current Plan	Status Quo
Headway	1. Every 3 minutes 2. Every 5 minutes 3. Every 8 minutes	Every 8 minutes	Not shifting to MRT (using current mode, either cars or motorcycles)
Speed	1. 50 kilometer /hour ≈ 31 minutes 2. 40 kilometer /hour ≈ 35 minutes 3. 30 kilometer /hour ≈ 43 minutes	30 kilometer /hour ≈ 43 minutes	
Parking availability in all MRT stations	1. Not available 2. Available	Not available	
Financial Burden for the People	3. 52 USD 4. 65 USD 5. 78 USD	52 USD	USD

4.3.3 Experimental Design

The experimental design assigns combinations of values to the attributes to set a choice card that is shown to a respondent. There are maximum 54 (3x3x2x3) combinations of choice cards that can be generated. Due to constraints of budget and time, we decided to implement choice experiment at three times for each respondent and thus three different choice cards are at least required for each respondent. When we prepare different types of choice cards, we need more choice cards and accordingly more choice sets depending on how many choice sets are contained in each choice card. When we prepare three different types of combination for three choice cards, and each of the cards contains two choice sets, we need 9 choice cards and 18 choice sets.

Among the 54 combinations, we could reduce 18 choice sets randomly, while being logically acceptable and still fulfilling the orthogonality (D. A. Hensher et al., 2005) that ensures zero correlation between attributes. The 18 choice sets are used with status quo conditions and the current plan of MRT development, which is a special case of 54 combinations to develop choice cards as shown in Figure 4.2 as an example. That is, each choice card contains four combinations of choice sets where the first and second choice sets are common (status quo and current plant), and the other two combinations are selected and paired from the 18 combinations. Thus, we created 9 different choice cards. Finally, we created has 3 groups of choice cards, namely types I, II and III.

CHOICE CARD I

Select one either Status Quo, Current Plan, Option A or Option B

Attributes & Current Conditions	Status Quo (not change)	Current Plan	Option A	Option B
Frequency		Every 8 minutes	Every 8 minutes	Every 5 minutes
Average speed of MRT		30 km/hour ≈ ± 43 minute	40 km/hour ≈ ± 35 minutes	40 km/hour ≈ ± 35 minutes
Parking availability in all stations		Not available	Not available	Available
Financial burden for the people	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	650,000/ person or 2,600,000/ family (assumed 4 members/ family)	780,000/ person or 3,120,000/ family (assumed 4 members/ family)
I will use MRT or not change from current condition (check only ONE)	☐	☐	☐	☐

Figure 4. 2 An example of a choice set

To ask the respondent's preference for commuting mode, besides the main attributes it is also introduced the contextual policy scenarios, which are not treated as the attributes, but as external factors. As mentioned, there are two policy scenarios proposed, the road pricing and fuel subsidy removal. With two policy scenarios, it can develop three combinations including implementation of both policies together. In total, there are four scenarios with baseline policy where none of the two policies are implemented.

The suggested minimum required numbers of respondent are 75-100 for each segment of respondents (Kumar and Rao, 2006) and 50 for each alternative (Hensher et al., 2006), we set number of target respondents for each type to be 60 in total in this study. Since we have four policy scenarios, 15 respondents are assigned for each type. Furthermore, we have two subcategories of targets segment, car commuters, and motorcycle commuters. Therefore, finally we have 360 respondents consisting of 180 respondents for each segment as summarized in Table 4.2.

Table 4. 2 The allocation of targeted respondents

No	Policy Scenarios	Choice Set					
		Car			Motorcycle		
		Type I	Type II	Type III	Type I	Type II	Type III
1	No policy scenarios	15	15	15	15	15	15
2	RP (Road Pricing Policy)*	15	15	15	15	15	15
3	FS (Fuel Subsidy Removal Policy)**	15	15	15	15	15	15
4	JP (Joint Policies of Road Pricing and Fuel Subsidy Removal)	15	15	15	15	15	15
Total respondents of each Choice set groups		60	60	60	60	60	60
Total respondents based on the type of vehicles		180			180		
All respondents targeted		360					

*Road Pricing scenario is between 0.6 USD and 2.1 USD depend on the vehicle types
**Fuel price without subsidy assumes to be 0.9 USD per liter

4.3.4 Questionnaire structure

The questionnaire used in the survey is developed by four main parts and screening questions included at the beginning of questionnaires. There are two questions in the screening: the first screening question is to exclude any respondents who potentially give bias response due to their occupation in the transportation and automotive marketing sector, and the second screening question is to make sure that the targeted respondents are either using cars or motorcycles to commute every day.

The first part of the questionnaire consists of questions about the current usage of transportation modes in general and their detail information of daily commuting behaviors. The second part has questions about willingness to buy new vehicles. The third part is a choice experiment of a possible change in their mode choice for daily commuting when new MRT is introduced. The last part is about respondents' profile (gender, age, education, occupation, personal income and household income). All the contents of questionnaires are almost identical except for the choice experiment part as explained earlier.

In the third part of the questionnaire, the hypothetical choice experiment, considering the experimental, which considers the experimental design explained above, makes the questionnaire created several versions based on three types of choice-set groups and four scenarios. Therefore, there are 9 questionnaire versions developed and applied in the survey.

4.3.5 Pretest

Before doing the main survey, the pretest of the survey was conducted, and total samples are 24 respondents consisted of 12 respondents of car commuters and motorcycle commuters, respectively. Face to face interview is applied. The validity of questionnaires shows that among main variables concerned are correlated and significant at 1%. The reliability of questionnaires is calculated by using Cronbach Alpha, and the value is 0.909. Referring to these numbers, it can be concluded that the questionnaires are valid and reliable. On the other way, it indicates that respondents could understand the questions of the questionnaires.

4.3.6 Model Specification

The utility models of this study consist of four utility equations, describing basic alternative as the status quo condition, where people do not want to shift to MRT and three alternatives for people who want to shift to MRT. These three alternatives consist of a current plan of MRT provision and two improved services of MRT provision.

The utility model of basic alternative only includes constant, all policy scenarios and cost which is named by financial burden. This utility model is used as a based model because the main interest of this study is want to measure how the policy scenarios can discourage the commuters in using private vehicles, either cars or motorcycles to shift to public transport, MRT.

The utility models of other alternative *j* contain all main attributes defined in the Hypothetical Choice Experiment (HCE). However, the attribute frequency and speed were transformed into lognormal because the assumption of both variables follows the lognormal function, not linear. The value of frequency and speed attributes is defined to be non-negative value. The other attributes are parking and cost. The parking is dummy variables. One, if the parking is available at all MRT stations and zero is otherwise. The attribute cost is the indirect tax that people have to pay to develop MRT. The increasing costs are assumed to be the better services of MRT provision compared to the current plan.

In the alternative *j* utility fucntion, it is also incorporated some variables that are related and those are the current vehicle type used, travel time, and consumer attributes. In addition, to develop the model, it is indicated interactions of some variables especially the interaction to vehicle types. It is because, there is hypothesis that types of vehicles will give different response and have different reasons regarding their behaviors in transport mode choices. The interactions, that are included into models, are between vehicle types and travel time and vehicle types and policy scenarios. The travel time of people who use cars and motorcycles is different. So, it is needed to know the interaction between them. Regarding the policy scenarios, since the charge of road pricing is different and depend on the vehicle types, the interactions between policy scenarios and vehicle types are also needed to be estimated. Another interaction is between attribute parking and people home addresses. It is assumed for some people

who live closer to MRT stations, they do not need to park their vehicles compared to people who live farther.

Based on those assumptions and hypothesis, the model is specified below:

$$V_i^0 = ASC1 + ASC_{RP} \cdot RP + ASC_{FS} \cdot FS + ASC_{JP} \cdot JP + \overline{\alpha^0} \cdot cost^0 + \varepsilon_i^0 \quad (4.1)$$

$$V_i^j = \alpha_i^1 \cdot headway_i^j + \alpha_i^2 \cdot speed_i^j + \alpha_i^3 \cdot parking_i^j + \overline{\alpha^4} \cdot cost_i^j + \beta_i^1 \cdot motorcycle_i + \beta_i^2 \cdot TT_i + \beta_i^3 \cdot employer_i + \beta_i^4 \cdot student_i + \beta_i^5 \cdot age_i + \beta_i^6 \cdot edu_i + \beta_i^7 \cdot male_i + \beta_i^8 \cdot familyincome_i + \beta_i^9 \cdot hhsize_i + \beta_i^{10} \cdot jakarta_i + \beta_i^{11} \cdot (motorcycle * RP)_i + \beta_i^{12} \cdot (motorcycle * FS)_i + \beta_i^{13} \cdot (motorcycle * JP)_i + \beta_i^{14} \cdot (motorcycle * TT)_i + \beta_i^{15} \cdot (parking * jakarta)_i + \varepsilon_i^j \quad (4.2)$$

Table 4. 3 Definition of variable used in the utility models and the expected signs

Code	Description	Expected sign
Dependent variable		
Chosen	1 if the alternative is chosen, 0 otherwise	NA
Explanatory- main attributes		
Headway	Headway of MRT, every 8 minutes, 5 minutes and 3 minutes. The headway was transformed into frequency per hour (60 minutes/headway) in lognormal form (random variable)	-
Speed	The Speed of MRT, 30 km/hour, 40 km/hour and 50 km/hour. The speed was transformed into lognormal (random variable)	+
Parking	1 for parking available; 0 for otherwise (random variable)	+
Cost	Indirect tax imposed to the people to develop MRT or it is called financial burden, for the current plan is 52 USD, and the improved services are increased to be 65 USD and 78 USD.	-
Explanatory-exogenous variable (policy scenarios)		
RP	1 for road pricing implemented; 0 for otherwise (random variable)	-
FS	1 for fuel subsidy removal implemented; 0 for otherwise (random varible)	-
JP	1 for joint policy, RP and FS are implemented; 0 for otherwise (random variable)	-
Explanatory-Current travel behavior		
motorcycle	1 motorcycle commuters; 0 car commuters	-
TT	Current travel time from home to the office	+
Explanatory-demographic, socio-economic variables		
employer	1 if respondents employers; 0 otherwise	+/-
student	1 if respondents are students; 0 otherwise	+/-
age	Age of respondents in years	-
edu	Education of respondents in years	+/-
male	1 if male, 0 female	+/-
familyincome	Average monthly income in USD	-
hhsize	The number of household members	+/-

Code	Description	Expected sign
jakarta	1 if respondent's home address is located in Jakarta; 0 otherwise	-
Explanatory-interaction between vehicle type and policy scenarios		
motorcycle*RP	Interaction between motorcycle and road pricing	-
motorcycle*FS	Interaction between motorcycle and fuel subsidy removal	-
motorcycle*JP	Interaction between motorcycle and joint policy	-
motorcycle*TT	Interaction between motorcycle and travel time	-
Explanatory-interaction between attribute and location		
parking*jakarta	Interaction between parking and respondent's home address	-

4.4 Results and Discussion

4.4.1 Respondents and Responses

The socio-demography of respondents covered in this research is described in table 4.4. The proportion of male and female respondents is almost same for all respondents, but there is different to motorcycle commuters where males is much higher than females, being consistent with the findings on sub-chapter 3.3.2. Most of respondents are in the productive age that it can be seen from the average age in 33 years-old.The range of respondent age is between 20 years-old and 50 years-old. The motorcycle commuters are younger than car commuters on average. The education level of car and motorcycle commuters is also different, where car commuters have higher education level compared to motorcycle commuters.

The average of personal income is about 454 USD. If it is compared with car and motorcycle commuters, the different income is about 209 USD. The average of the household income of car commuters is almost double of motorcycle commuters. It also shows that the distance between respondents' homes and offices between car and motorcycle commuters is not different. It is about 17 kilometer on average. Although the distance between car and motorcycle commuters is not different, but the travel time for car and motorcycle commuters is different. The travel time for motorcycle commuters is about 2.38 hours and this is faster than car commuters that need 38.6 minutes more. All these variables related to the households and individuals are all included in the models either as dummy or continues variables because these variables can affect the people behavior (Ben-Akiva, De Palma, & Isam, 1991).

Table 4. 4 Socio-demography of respondents

Total Sample	Car commuters	Motorcycle commuters	All respondents
	180	180	360
Gender (%) *Male/Female*	44/56	61/39	53/47
Age in year *Average/ Standard Deviation/ Min./ Max.*	33.8/7.9/20/50	32.6/7.9/20/49	33.2/7.9/20/50
Year of Education *Average/ Standard Deviation*	14.6/2.4	12.9/2.4	13.7/2.4
Occupation (%) *Employer/Employee/Others*	31/58/11	22/68/10	27/63/11
Household Size *(Median)*	4	4	4
Monthly Personal Income *In USD* *Average/ Standard Deviation*	558.4/290.6	349.8/201.7	454.1/270.8
Monthly Household Income in USD *Average/ Standard Deviation*	971.1/275.0	650.0/312.4	810.6/334.9
Distance from Homes to Offices in Km *Average/ Standard Deviation*	17.0/9.5	17.1/9.3	17.1/94
Travel time/ Standard Deviation in hour *Average/ Standard Deviation*	3.03/1.03	2.38/0.81	2.71/0.98

Source: Field survey, all respondents as base

Table 4.5 describes the description of attributes for improvement of MRT services for the total samples and differentiates between cars and motorcycle commuters. The Mean of headway is 6.17 minutes which is more frequent compared to the current plan that is 8 minutes. The mean of headway for car commuters is expected slightly to prefer more frequent compared to motorcycle commuters.

Table 4. 5 Characteristics of the attributes in the model

Attribute	Unit	Car Commuters		Motorcycle commuters		All respondents	
		Mean	*Std* [a]	*Mean*	*Std* [a]	*Mean*	*Std* [a]
Headway	*minutes*	6.17	2.15	6.00	2.17	6.35	2.12
Speed	*kilometer per hour*	36.69	8.46	36.40	8.34	36.11	8.22
Parking availability	*%*	0.24	0.18	0.19	0.15	0.21	0.17
Cost	*USD*	62.6	9.8	61.5	10.1	62.1	10.0
Sample size	*person*	180		180		360	
Total observations	*responses*	540		540		1080	

[a] Std = standard deviation

Source: Field survey, all respondents as base

The average speed that respondents expected is about 36 kilometers per hour, slightly faster compared to the current plan which is about 30 kilometers per hour. Currently, based on the calculation of the samples, the average speed for car and motorcycle commuters is 10.9 and 13.9 kilometers per hour respectively. Commuters expect that the MRT should be faster than the current condition. For the parking availability, the mean score is 0.21, meaning that there is approximately 21% of car communters prefer to development of MRT station with parking facility. Furthermore

the car commuters expect higher than motorcycle commuters, meaning that the car commuters have a higher preference to parking their cars in the stations than motorcycle commuters. Based on the average for both car and motorcycle commuters, they expect to improve services with the consequence that they want to pay more for the current condition with the average is 62 USD. If it is compared, the car commuters want to pay about 63 USD, which is higher than motorcycle commuters, 61 USD.

4.4.2 The Choice Model

Estimating the parameters of utility models utilized Nlogit software by generating the sample of random parameters by Halton number, setting to panel data with four utility equations, specifying the number of points in the simulation to 100, and a setting maximum number interaction to 200. Based on Hensher and Greene (2001), the Halton sequences provide greatly improved accuracy with fewer draws and computational time compared to standard pseudo-random sequences. In selecting the number of Halton draws, it is no magical number and it varies which depend on the model specification. Hensher (2001) concluded that a small number of Halton draws (as low as 25) can produce model fits and mean value of travel time savings almost indistinguishable. Using 100 Halton number draws for this research is more than enough to get the stability of parameter estimations.

Due to the mixed logit model specified, setting the main attributes of the choice cards to be random is needed. For this model estimated, all the main attributes are treated to be random except the cost attribute which is treated to be fixed parameter. The random parameters should follow certain distributions. Selecting the distribution of the random parameters is essential to be arbitrary approximations to the real behavioral profile (Hensher and Green, 2001). They also mentioned, if the response parameter is to be a specific (non-negative) sign, the lognormal form is suggested. If the variable is a dummy, a uniform distribution is more appropriate. For this study, the attribute speed and headway should not have negative signs, so the lognormal distribution is applied. For parking attribute which is a dummy variable, the uniform distribution is used.

As shown in table 4.6, the parameter estimation for utility model is significant at 1% level with pseudo R2 about 0.17. According to parameter estimations, the cost has significant negative impact, as expected, on private vehicle users' willingness to shift to public transport (MRT). The main attributes, speed, and frequency, have significant positive impacts on commuters' utility by choosing MRT to commute by 0.7999 and 1.257 points, respectively. The parking availability also provides significant positive impact to increase the commuters' utility to choose MRT by 1.936 point. It indicates that if the parking is available at all MRT stations, the commuters' utility will increase by 1.936 point. However, the parking has a significant negative impact if the commuters live in Jakarta by -1.212. For commuters who have homes in Jakarta, by providing parking, their utility is still increased but it is not as big as the people who live outside Jakarta. The utility of Jakarta's commuters by providing parking is only 0.724 point.

The interesting results are the policy scenarios that all have significant negative signs. Meaning that, by implementing these policies, it can discourage people to use their private vehicles. The impacts of road pricing and fuel subsidy removal are almost similar, but if these policies are implemented together, the impact is higher although it would not be a double. In addition the joint policy scenarios give much higher impact on motorcycle commuters, it is signed by the interaction between motorcycle and joint policy implementation has a significant coefficient.

There are four variables of demographic, socio-economic that have significant coefficients. The negative sign of coefficient of employer indicates that they do not prefer to use MRT for daily commuting. Surprisingly, the higher the education level of commuters, their preference to shift to MRT is bigger, and it is also happened to the families who have many members. But, for commuters who live in Jakarta, their preference is less than people who live outside Jakarta. The parking area at all MRT station is not so important for the Jakarta people. Meaning that, once they shift to use MRT, they do not want to drive their vehicles even only to the closest MRT stations.

Table 4. 6 The parameters estimated of the model specification

Variables	Estimate	t-value
Main Attributes		
ASC	17.581**	2.376
frequency (R)	0.799***	2.666
speed (R)	1.257***	47.572
parking (R)	1.936***	7.317
Cost	-0.171***	-15.116
Policy Scenarios		
RP	-7.676**	-2.206
FS	-7.341**	-2.107
JP	-8.438**	-2.485
Current travel behavior		
Motorcycle	1.965	0.429
TT	-1.325	-1.642
Demographic, socio-economic		
Employer	-2.436**	-2.048
Student	-2.577	-1.059
Age	-0.083	-1.199
Edu	0.584**	1.949
Male	1.257	1.225
familyincome	0.002	0.987
Hhsize	1.099**	2.273
Jakarta	-2.896**	-2.209
Interaction between vehicle type and policy scenarios		
motorcycle*RP	-2.779	-0.686
motorcycle*FS	-5.721	-1.352
motorcycle*JP	-8.078*	-1.910
motorcycle*TT	-4.061*	-1.684
Interaction between attribute and location		
parking*jakarta	-1.212***	-4.473
Derived standard deviations of parameter distributions		
frequency	1.292***	6.503
speed	2.491***	186.953
parking	3.257***	5.225
McFadden Pseudo-R2	0.178	
Chi-squared	533.848***	
Prob[ChiSqd > value]	0.000	

*** Significant at 1% level

** Significant at 5% level

* Significant at 10% level

(R) Random Variables distributed normally of Mixed Logit Model

4.4.3 The policy scenarios impacts people who stick on driving

Based on the model, it describes that the policy scenarios are effective to discourage people in using private vehicles, either cars or motorcycles and shift to public transport provided, MRT. Figure 4.3 depicts that the utility of car and motorcycle commuters is decreasing by introducing road pricing and fuel subsidy removal. The impacts of policy scenarios are similar to car and motorcycle commuters except the joint policy implementation that give the big impact on motorcycle commuters. The road pricing affects slightly bigger in reducing the utility for people who keep driving. As the expectation, the joint policy is the most effective policy to discourage people to use private vehicles, and it is expected to shift to public transport, especially for motorcycle commuters. By providing MRT and implementing policy scenarios, it seems effective to encourage people to use public transport. The figure shows how big the impacts of policy scenarios to discourage people from using private vehicles.

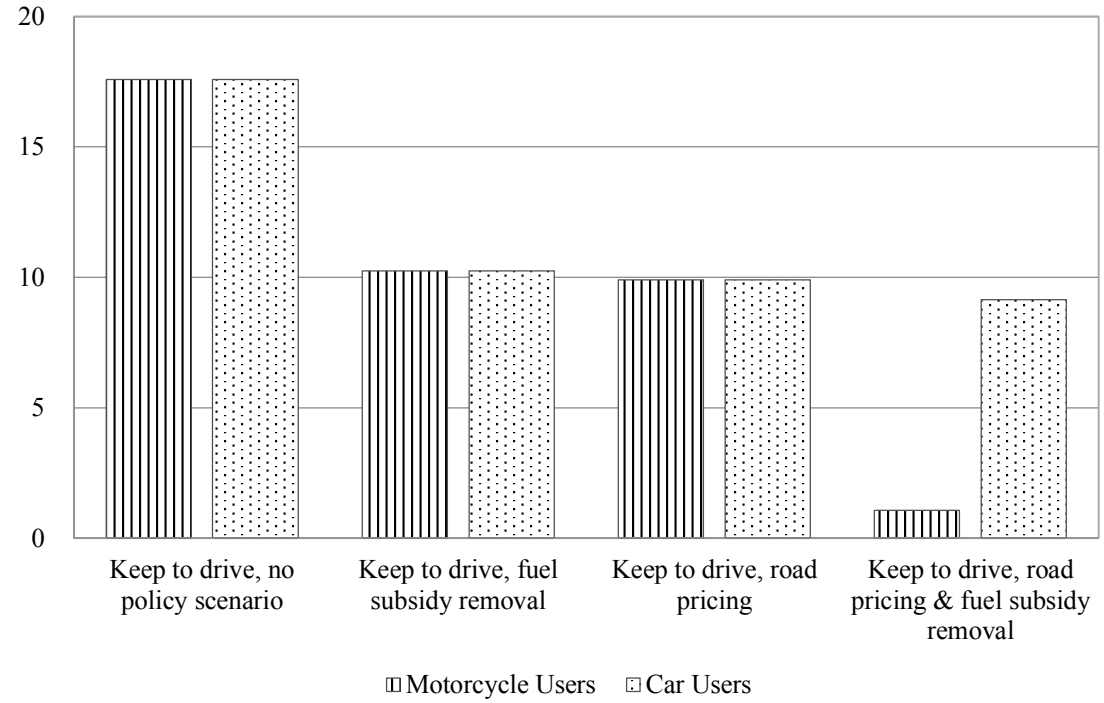


Figure 4. 3 The policy impacts on utility of car and motorcycle commuters

From the utility, it can calculate the willingness to pay (WTP) to people who still want to use private vehicles for daily commuting. The meaning of WTP, in this case, is their willingness to pay more for the social cost imposes. The results show that without any policy instrument introduce, the car and motorcycle commuters want to pay about 73.6 USD more compared to the current social cost imposes, which is 52 USD. With the road pricing implemented, their willingness to pay is decreasing to 28.6 USD. This is similar to the implementation of fuel subsidy removal, where WTP of people also decreases to 30.5 USD. The interesting is if the joint implementation of road pricing and fuel subsidy removal implemented, the WTP of car commuters is still positive, meaning that they are not affected by this joint policy implementation. But, the WTP of motorcycle commuters become negative. It means that the motorcycles commuters will be suffered if joint policy implemented.

4.4.4 The utility changes toward MRT service improvement

Figure 4.4 shows the changes in people's utilities by shifting to MRT for daily commuting. By shifting to the current plan, the start point of utility is at 5.02. The utility will shift to 6.95 by providing parking area at all MRT stations. By improving the speed and headway, it also will increase the utilities. However, the available parking at all MRT stations gives the higher impacts compared to the improvement of speed and headway. It can be caused the speed and headway that are offered better than the current public transport. The best service which are 3 minutes of headway, 50 km/hour of MRT speed and available parking at all MRT station give the highest utility for people who shift in using MRT.

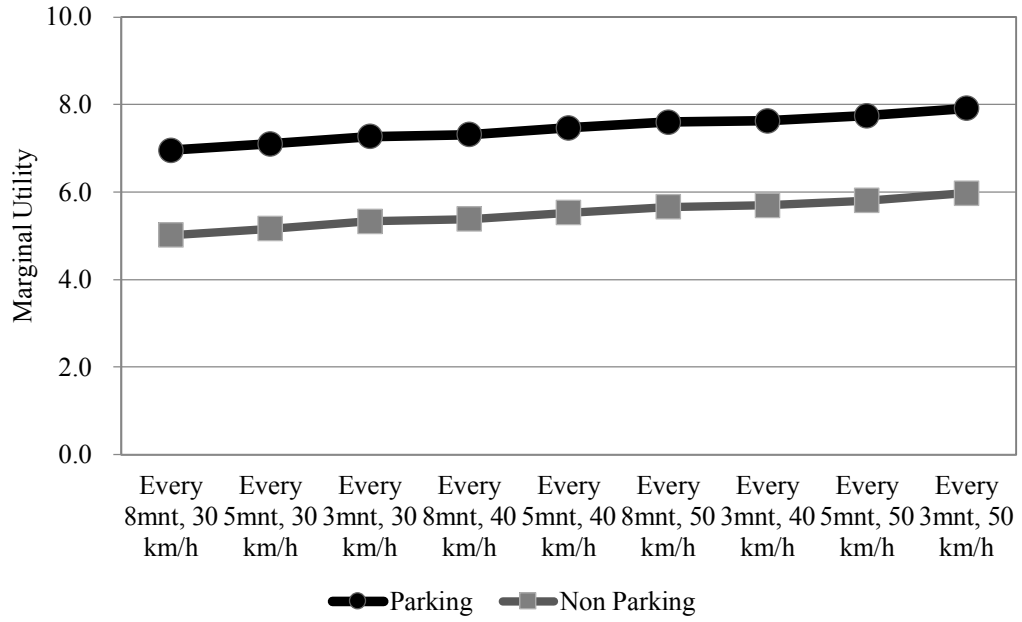


Figure 4. 4 The utility changes by shifting to MRT with service improvement

The WTP of people who want to shift to MRT is not affected by the policy scenarios because they already decided to use public transport. So, whatever the policy to burden the using of the private vehicle, it will not affect them. The base of WTP is the current plan of MRT development. By improving the services, the WTP of people in using MRT will increase. Table 4.7 describes the WTP of people who want to shift to MRT either to current plan or the improved services in term of speed, headway and also parking availability.

From the table is shown that the highest WTP is the best services offered where headway is every 3 minutes, the speed is 50 km/hour, and parking areas are available at all MRT stations. The other information from the graph is that the parking attribute gives a bigger effect on the WTP. It can be seen by comparing the same headway and speed with and without parking where WTP has a big different. It seems the availability of parking areas at all MRT stations is important, since the public tranports are not well integrated yet. By having parking areas at MRT stations, commuters can follow the park and ride system, where the commuters can drive their cars or motorcycles from home to the stations and continue by using MRT to reach their workplaces.

Table 4. 7 Summary of WTP by shifting to MRT

	WTP of the MRT Services	
Headway, Speed	**Parking is not available**	**Parking is available**
Every 8mnt, 30 km/h	*0.00*	11.34
Every 8mnt, 40 km/h	2.12	13.45
Every 8mnt, 50 km/h	3.76	15.10
Every 5mnt, 30 km/h	0.86	12.20
Every 5mnt, 40 km/h	2.98	14.32
Every 5mnt, 50 km/h	4.62	15.96
Every 3mnt, 30 km/h	1.84	13.18
Every 3mnt, 40 km/h	3.96	15.29
Every 3mnt, 50 km/h	5.60	*16.94*

4.5 Concluding Remarks

The method used for this chapter is repeating choice experiments for private vehicle commuters, either car or motorcycle commuters, in Jakarta on preference to be willing to shift to MRT once it becomes available. The mixed logit model revealed that the scale of impacts on probability to shift for MRT due to fuel subsidy removal or implementing road pricing is significantly large compared to that of the best available feasible options for MRT service improvements. Moreover, this effect is leveraged by joint implementation of both policies, fuel subsidy removal and implementing road pricing. It indicates that the commuters will shift to use MRT if the operational costs of using cars or motorcycles are getting expensive.

Based on the model estimation, there are 75.8% of private vehicle commuters want to shift to use MRT for commuting either to the current plan or the improved services. The alternative chosen to improve the MRT services should provide the parking areas at MRT stations since the alternatives with available parking always give the higher benefits for commuters. In term of demographic variables included in the models and other control variables, there are some different significant results between car and motorcycle commuters.

Chapter 5 Impacts of Fuel Subsidy Removal on Willingness to Shift to MRT

5.1 Introduction

The Government of Indonesia (GoI) has made a positive move to improve Indonesia's budget by removing the subsidy for fuel (gasoline) at the end of 2014. The policy will bring overall net positive impacts to Indonesia despite the fact that the government will also face lower revenue from oil export. Moreover, the increase of fuel price within the range 12% to 30% during the last six months from November 2014 to March 2015 also give impacts to the Indonesia's economy including transportation sector.

One of the impacts on transportation is increasing the transportation costs. It also will affect the significant changes in travel behavior through a change in the use of transport (Solaymani, Kardooni, Kari, & Yusoff, 2014). However, based on Kitamura (1990), the behavior is contemporaneous, if can satisfy the assumptions of the behavoral changes in instantaneous, symmetric or reversible and the relation is stationary (invariant over time). The changes in travel behavior could be signed by the daily traffic flow. Bento, Hughes, & Kaffine (2013) mentioned that the traffic flows in mainline lanes also decrease when fuel prices increase, and this effect is stronger when the presence of a carpool lane provides a substitute to driving alone. The changes of travel behaviors especially from private vehicle users are supported by the findings of a study that was conducted by Mattson (2008). The study concluded that public transport has been benefitted by the rise of gas prices from the increased numbers of riderships. The riderships prefer to use public transport rather than own vehicles due to the high cost of tank of gas. In addition, the increase of fuel price lead to changes not only in the expenditure but also in income (Henao, 2013).

There are many studies have been conducted to increase the share of public transport rate as well as how to discourage commuters in using private vehicles for daily trips by introducing certain policies. However, there is no study that joint policies as the scenarios that will affect the commuters' behavior changes. In this study, it will introduce three types of policy scenarios as mentioned also in the chapter 4 and one of the scenarios is the joint policy between the road pricing and fuel subsidy removal.

This study will analyse how the commuters' behavior changes in choosing transport modes, especially the changes of willingness to use MRT in future, after removing the fuel subsidy. Comparing the commuters' behavior changing in different time, t and t+1, for both that are affected by stated preference (SP). The SP model in this model will analyse the impact of fuel price increase to the current and future commuter behavior by using the hypothetical scenarios.

The method used to estimate the parameters is mixed Logit models. Subsequently, mixed logit models account for the scaling and unobserved error correlations and also can capture the preference heterogeneity (Brownstone, Bunch, & Train, 2000). It is a more plausible behavioral foundation, offer possibility for improved predictive accuracy in forecasting, and the most effective to evaluate the transport planning (Kitamura, 1990).

5.2 Data

The choice experiment (CE) method is used to collect the SP and RP choice data. The survey has been conducted in May 2015 with the main targeted respondents are the private vehicle commuters who have main activities during weekdays in the CBD (Central Business District) of Jakarta where will be passed by MRT. The respondents are classified into two groups that are car and motorcycle groups and each group consists of 180 respondents.

The objective of RP survey is to provide data for the current commuters' behavior changes after the subsidy of fuel has been removed. The objective of SP survey is to obtain the data to model the travel behavior responses of MRT development. The main emphasis of this survey is to know the commuters' behavior changes after the removing fuel subsidy.

The experimental design for this survey is followed exactly the methods used in chapter 4. There are four main attributes used: headway, speed, parking availability in all MRT stations and the financial burden for the people. Each attribute has different level and include the current plan and improved services. From 54 combinations of choice sets that were generated, it is used 18 choice sets to create 9 choice cards and each respondent was repeated three times. In total there are three groups of choice cards, that is called type I, II and III (explained in chapter 4). The survey was also included the contextual policy scenario as the external factors and the scenarios are:

1. No policy scenarios
2. Road pricing, or it is called ERP (electronic road pricing)
3. Informing the previous fuel price before subsidy removed and current fuel price without subsidy
4. Combinations of scenario 2 and 3.

In the questionnaire, it also asked the behaviors of commuters last year, before the fuel subsidy removed and current commuters' behavior after no subsidy for fuel. Since the questionnaires used are same as the previous survey, the pretest was not conducted.

For more detail, the survey contents mainly include:

1. Personal information comprises sex, age, gender, occupation, education, personal income, household income, household size or number of household family, location of household either inside or outside of Jakarta area, and so on.
2. Revealed behavior survey comprises daily trips that consist of travel time and distance, travel cost (parking fee, fuel fee, other fees or fee for public transport if they used public transport before), both before and after fuel subsidy removed.
3. The provision of MRT that will be operated in 2020, and offering two main group of services that are as a plan and improved services. The MRT provision as the alternative transport mode in future is part ofo the stated preference survey. In addition, the road pricing that will be implemented in near future is also part of the SP data survey.

5.3 Respondent Profiles

Most of respondents are male and the number of male is mucah higher for motorcycle commuters. The average of respondent education is more than senior high school and they are employee. The median of household size is 4 with the average individual income is 433.2 USD/monthly. Car commuters have higher income compared to motorcycle commuters for both individual and family income. The distance of car commuters is farther than the distance of motorcycle commuters. The different average travel time between cars and motorcycles is about one hour. The respondent's profile from second survey here is not so different with the profiles of respondents in the first survey. The detail respondent's profile is depicted at table 5.1.

Table 5. 1 Socio-demography of respondents

Total Sample	**Car commuters**	**Motorcycle commuters**	**All respondents**
	180	180	360
Gender (%) *Male/Female*	66/34	85/15	75/25
Average of Age/Standard Deviation/ minimum/ maximum (year)	32.4/10.0/18/63	31.9/9.4/17/63	32.0/9.4/17/63
Average of Education Level	14.2/1.8	12.5/1.4	13.4/1.7
Occupation (%) *Employer/Employee/Others*	17/79/4	14/72/14	16/75/9
Household Size *(person)*	4	4	4
Average Personal Income/ Standard Deviation *(In USD/Month)*	495.7/270.1	370.7/189.6	433.2/241.3
Average Household Income/Standard Deviation *(In USD/Month)*	793.6/299.1	556.7/298.4	675.1/321.1
Average Distance from Homes to Offices/ Standard Deviation *(kilometers)*	19.1/11.2	15.0/9.6	17.1/10.7
Average Travel time/ Standard Deviation *(hours)*	3.12/1.23	2.16/0.97	2.64/1.15

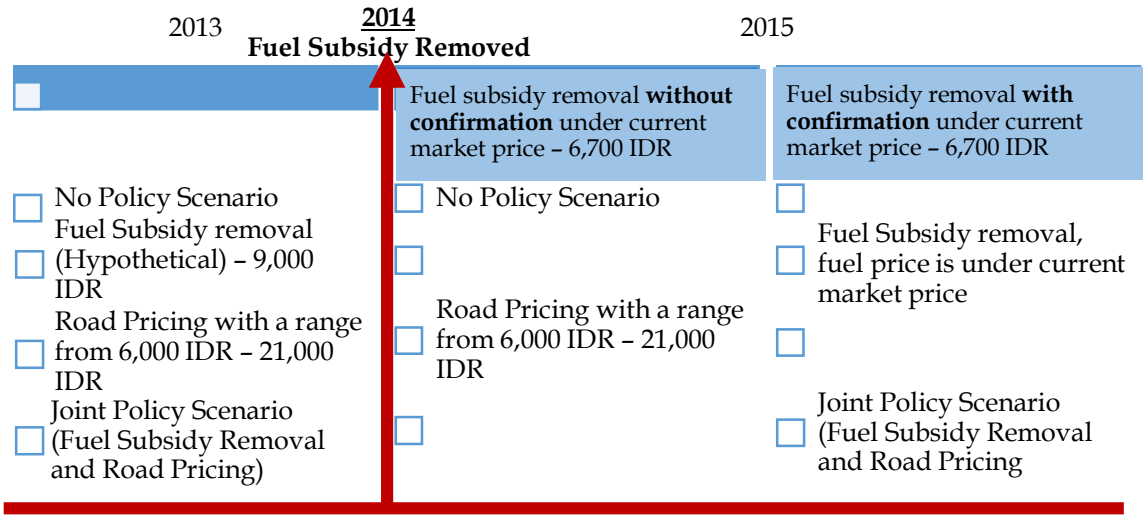
Source: Field survey, all respondents as base

5.4 Stated Preference Models

5.4.1 The Choice Experiment

The illustration of policy scenarios used in the choice experiment is shown at table 5.2. The policy scenarios implemented are similar for both years, 2013 and 2015.

Table 5. 2 The differences of policy scenarios in the choice experiment between 2013 and 2015



However, in 2015 after the fuel subsidy removed, the increased of fuel price that is based on the current market price is informed to the respondents or just confirmed to respondents. In fact, all respondents already face the same current fuel price. By using this method, the respondents who are under fuel subsidy removal scenario either only removing fuel subsidy or joint policy are confirmed by the increase of fuel price. On the other hand, the respondents who are under no policy scenario and road pricing scenario are not confirmed with the increase of fuel price, although they also already got the same situation where the fuel price has been increased.

5.4.2 Model specification

The proposed model for this analysis is mainly the SP model to see the effect of fuel subsidy removal to the commuters' behavior changes. The model developed is not different from the model in chapter 4, but in this model the policy scenario of fuel subsidy is not under hypothetical policy scenario. The fuel subsidy removal indirectly also has been affected all commuters, so that the other parameters related to the changes of commuters' behaviors before and after fuel subsidy removed will be analyzed in this chapter.

The model specification is explained by below formula:

$$V_i^0 = ASC1 + ASC_{RP} \cdot ERP + ASC_{FS} \cdot FS + ASC_{JP} \cdot JP + \overline{\alpha^0} \cdot cost^0 + \varepsilon_i^0 \quad (5.1)$$

$$V_i^j = \alpha_i^1 \cdot headway_i^j + \alpha_i^2 \cdot speed_i^j + \alpha_i^3 \cdot parking_i^j + \overline{\alpha^4} \cdot cost_i^j + \beta_i^1 \cdot motorcycle_i + \beta_i^2 \cdot TT_i + \beta_i^3 \cdot employer_i + \beta_i^4 \cdot student_i + \beta_i^5 \cdot age_i + \beta_i^6 \cdot edu_i + \beta_i^7 \cdot male_i + \beta_i^8 \cdot familyincome_i + \beta_i^9 \cdot hhsize_i + \beta_i^{10} \cdot jakarta_i + \beta_i^{11} \cdot (motorcycle * RP)_i + \beta_i^{12} \cdot (motorcycle * FS)_i + \beta_i^{13} \cdot (motorcycle * JP)_i + \beta_i^{14} \cdot (motorcycle * TT)_i + \beta_i^{15} \cdot (parking * jakarta)_i + \varepsilon_i^j \quad (5.2)$$

Table 5. 3 Definition of variable used in the utility models and the expected signs

Code	Description	Expected sign
Dependent variable		
Chosen	1 if the alternative is chosen, 0 otherwise	NA
Explanatory- main attributes		
Headway	Headway of MRT, every 8 minutes, 5 minutes and 3 minutes. The headway was transformed into frequency per hour (60 minutes/headway) in lognormal form (random variable)	-
Speed	The Speed of MRT, 30 km/hour, 40 km/hour and 50 km/hour. The speed was transformed into lognormal (random variable)	+
Parking	Dummy variable 1 for parking available and otherwise (random variable)	+
Cost	Indirect tax imposed to the people to develop MRT or it is called financial burden, for the current plan is 52 USD, and the improved services are increased to be 65 USD and 78 USD.	-
Explanatory-exogenous variable (policy scenarios)		
RP	Electronic road pricing implemented	-
FS	Fuel subsidy removal implemented	-
JP	Joint policy, RP and FS are implemented	-
Explanatory-Current travel behavior		
motorcycle	1 motorcycle commuters; 0 car commuters	-
TT	Current travel time from home to the office	+
Explanatory-demographic, socio-economic variables		
employer	1 if respondents employers; 0 otherwise	+/-
student	1 if respondents are students; 0 otherwise	+/-
age	Age of respondents in years	-
edu	Education of respondents in years	+/-
male	1 if male, 0 female	+/-
familyincome	Average monthly income in USD	-
hhsize	The number of household members	+/-
jakarta	1 if respondent's home address is located in Jakarta; 0 otherwise	-
Explanatory-interaction between vehicle type to policy scenarios and attributes		
motorcycle*RP	Interaction between motorcycle and road pricing	-
motorcycle*FS	Interaction between motorcycle and fuel subsidy removal	-
motorcycle*JP	Interaction between motorcycle and joint policy	-
motorcycle*TT	Interaction between motorcycle and travel time	-
motorcycle*Headway	Interaction between motorcycle and headway or frequency	+/-
Motorcycle*Speed	Interaction between motorcycle and speed	+/-

Code	Description	Expected sign
Explanatory-interaction between attribute and location		
parking*jakarta	Interaction between parking and respondent's home address	-

The mixed logit SP model in table 5.2 was estimated using SP responses from each commuter from the latest survey. The coefficients for the generic attributes (frequency in term of headway, speed, and parking) are all significant with the expected signs. The positive signs of main attributes indicate that by improving the MRT services, the commuters' willingness to use MRT is higher. These three main attributes are also treathen to be random parameters and tested by using Lagrange multiplier test from Mcfadden & Train (1997). The test indicates that there were significant random components for frequency and speed, but it is not significant for parking. The hypothesis of parking as a ramdom parameter cannot be accepted. Meaning that, the parking attribute is not vary among the commuters.

The policy scenarios introduced in the model show that the road pricing or it is called RP and joint policy implementation (RP and removing fuel subsidy) are effectively policy that can discourage commuters in using private vehicles. The bigger JP coefficient compared to the RP coefficient means that the joint policy has bigger impacts to the commuters. However, the fuel subsidy removal in this policy scenario is not significant and this is different from the previous findings from the data collected before fuel subsidy removed. In the previous findings, in chapter 4, it shows fuel subsidy removal is the effective policy to discourage commuters in using private vehicles. Insignificant coefficient of FS in this model is because the fuel subsidy has been removed and it is already affected to all commuters to current behaviors.

In terms of demographic and socio-economic, almost all parameters estimated are significant except the current travel time and the dummy of house location. Travel time that was expected to be significant but in this model estimation, it cannot be proven that travel time affect the commuter's preference in choosing transport modes. It can be caused by the traffic condition in Jakarta in the last ten years. The traffic congestion is getting worse and even commuters seem hopeless with the condition. Either commuters choose to use private vehicles or public transports, they still face the congestion.

However, the motorcycle commuters have higher preferable to use MRT compared to car commuters. Commuters who are working and young ages, female and higher education are more favor to choose MRT rather than using private vehicles. The interaction between vehicle types and policy scenarios expresses that only the interaction with joint policy scenario is significant. It implies that the joint policy scenario give bigger impact to the motorcycle users since the operation cost using motorcycles is getting expensive.

Table 5. 4 The model estimation after fuel subsidy removal

Variables	Estimate	t-value
Main Attributes		
ASC	12.280***	4.088
frequency (R)	0.143***	2.975
speed (R)	0.397***	7.473
parking (R)	1.942***	7.943
Cost	-0.121***	-14.760
Policy scenarios		
RP	-0.865*	-1.672
FS	-1.311	-0.632
JP	-1.761**	-2.266
Current travel behavior		
Motorcycle	5.921**	2.487
TT	0.551	1.558
Demographic, socio-economic		
employer	-2.798**	-3.065
student	-2.577***	-2.051
age	-2.214**	-1.996
edu	0.582***	3.771
male	-1.907***	-3.178
familyincome	-0.002**	-2.251
Hhsize	0.612***	2.645
Jakarta	-1.134	-1.174
Interaction between vehicle type to policy scenarios and attributes		
motorcycle*RP	0.448	0.355
motorcycle*FS	-1.655	-0.491
motorcycle*JP	-5.365**	-2.172
motorcycle*TT	-0.869*	-1.651
Interaction between attribute and location		
parking*jakarta	-2.561***	-9.475
Derived standard deviations of parameter distributions		
frequency	2.706***	130.211
speed	2.228***	95.091
parking	0.169	0.198
McFadden Pseudo-R2	0.192	
Chi-squared	574.581***	
Prob[ChiSqd > value]	0.000	

*** Significant at 1% level
** Significant at 5% level
* Significant at 10% level
(R) Random Variables distributed normally of Mixed Logit Model

5.4.3 The policy scenarios impacts people who stick on driving after fuel subsidy removed

Based on the model, it describes that the policy scenarios are effective to discourage people in using private vehicles, either cars or motorcycles and shift to public transport provided, MRT. Figure 5.1 depicts that the utility of car and motorcycle commuters is decreasing by introducing those policies. However, since the policy of fuel subsidy removal is not significant to affect the commuters' utility, the graph shows that

utility of commuters either car commuters or motorcycle commuters is not decreasing. The utility is same to the utility if no economic policy instruments implemented. The interesting result is the utility to keep driving motorcycles is higher than the utility to keep driving cars in all policy scenarios. It can be happened since the data shows that motorcycles are used by all income levels (based on the findings in chapter 3).

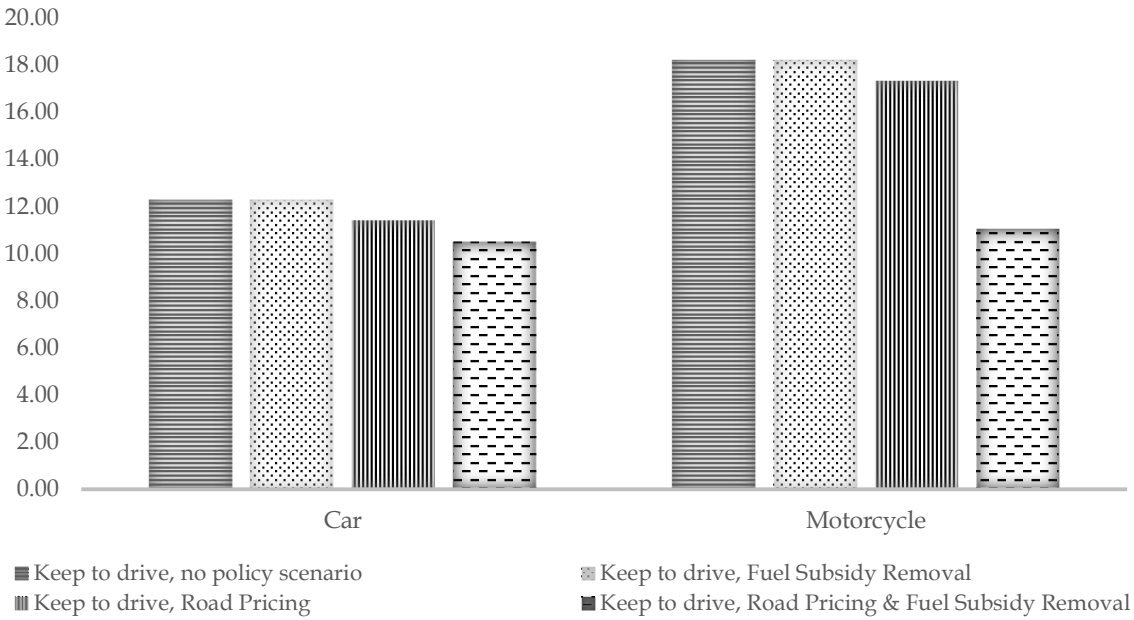


Figure 5. 1 The policy impacts on utility of car and motorcycle commuters after fuel subsidy removed

5.4.4 The utility changes toward MRT service improvement

The changes in people's utilities by shifting to MRT for daily commuting are described by figure 5.2. The pattern of utility changes toward the MRT service improvement is not different if it is compared to the utility changes before fuel subsidy removed. The highest utility is the best service improvement of MRT with speed 50 kilometer per hour, short headway or every 3 minutes and parking availability at all MRT stations.

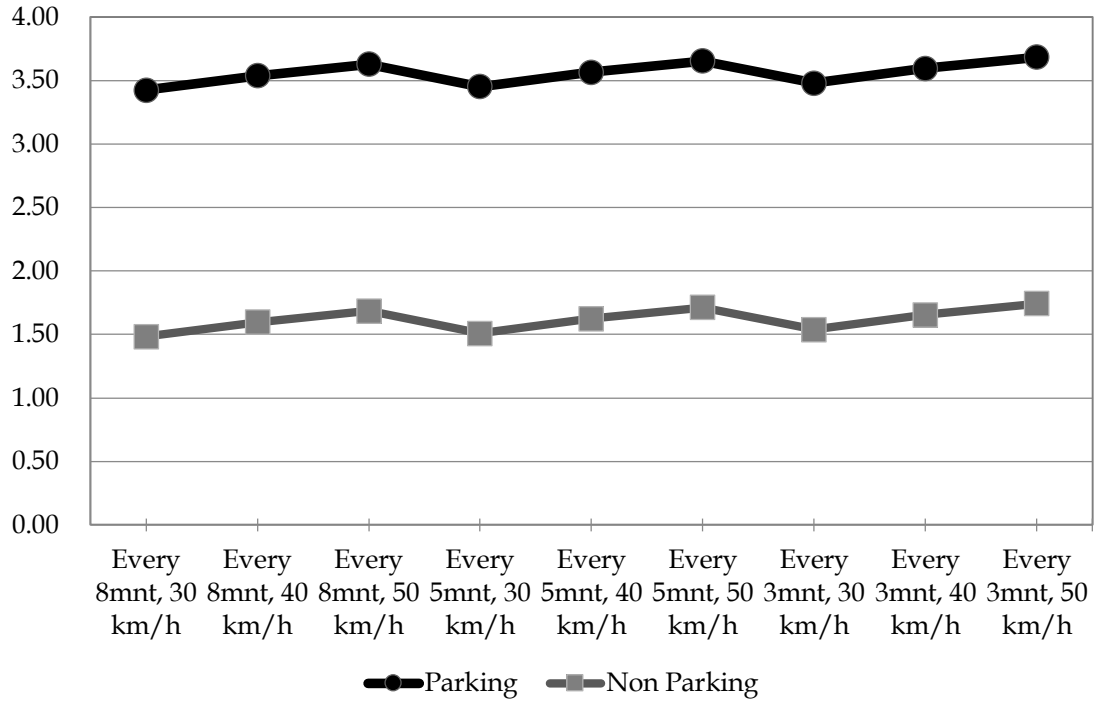


Figure 5. 2 The utility changes by shifting to MRT with service improvement after fuel subsidy removed

Table 5.5 describes the WTP of commuters who want to shift to use MRT either to current plan or the MRT with the service improvement after fuel subsidy removed. The base of WTP is the current plan of MRT development and by improving the services, the WTP of using MRT is increasing.

Table 5. 5 Summary of WTP by shifting to MRT after fuel subsidy removed

	WTP of the MRT Services	
Headway, Speed	**Parking is not available**	**Parking is available**
Every 8mnt, 30 km/h	12.26	28.31
Every 8mnt, 40 km/h	13.20	29.25
Every 8mnt, 50 km/h	13.93	29.98
Every 5mnt, 30 km/h	12.48	28.53
Every 5mnt, 40 km/h	13.42	29.47
Every 5mnt, 50 km/h	14.15	30.20
Every 3mnt, 30 km/h	12.72	28.77
Every 3mnt, 40 km/h	13.67	29.72
Every 3mnt, 50 km/h	14.40	30.45

The highest WTP is the best improvement of MRT services where the headway is every 5 minutes, the speed is 50 kilometer per hour and the parking is available at all MRT stations.

5.5 The Impacts of fuel subsidy removal to the commuters' behaviors

After having the two different models under the stated preference models based on 2013 and 2015 data, most of the parameters estimated have the same signs although some of coefficients are different. The main attributes of choice cards which are frequency, speed and parking availability at all MRT stations have the same impacts which can increase the commuters' willingness to use MRT. However, the magnitude of coefficients for data 2015 is smaller, including the attribute cost. The main objective in this comparison is to know the impacts of fuel subsidy removal policy scenario before and after the implementation. Based on the models, it can be seen that all policy scenarios are having negative signs. Meaning that, the policies can be used to discourage commuters in using their private vehicles, either cars or motorcycles. However, after the implementation of fuel subsidy removal, the coefficient of fuel subsidy removal scenario is not significant. The stressing confirmation about the fuel subsidy removal to the respondents did not give significant impacts. It seems the respondents are already aware with the current fuel price without subsidy.

Some variables which are part of the demographic and socio-economic show the improvement in the significancy. The dummy of motorcycle commuters is significant and positive. It means their willingness to use MRT is bigger than car commuters after fuel subsidy has been removed. Employer is less prefer to shift to MRT compared to the employee. Since in the first survey, the higher education of respondents the higher their willingness to use MRT. The significancy and coefficient both in 2013 before fuel subsidy removed and in 2015 after fuel subsidy removed. The data in 2015 shows that the family income is getting significant. It indicates that the total income has been affected by the increase of fuel price. In Indonesia, the increase of fuel price is always got the negative reaction from people. As consequent, prices of goods and services are increased. By this condition, the total family income is affected not only in response to the increase of transportation cost but also the increase of other prices.

Another interesting finding is the travel time for both models is not significant. It can be caused by the current situation in Jakarta that has faced congestion all days, not only in the morning and after office hours. Household size for both models show the significant positive. In contrast the home location in Jakarta in 2015 data is not giving significant sign. It can be indicated that either for commuters who live in Jakarta, they prefer to shift to MRT rather than using private vehicles.

Overall model, the SP model in 2015 is improved since the number of significant parameters is increased and also the McFadden Pseudo-R2 is higher from SP model based on data in 2013. In detail, the comparison models are depicted in table 5.6 below.

Based on this model. It can calculate the marginal utility of each attributes. Figure 5.3 shows the comparison of utility to keep driving before and after fuel subsidy removed. The implementation of policy scenarios decreases the commuters' utility to keep driving either cars or motorcycles. However, after fuel subsidy removed, the utility of fuel subsidy becomes not significant anymore. From the figure, it can be seen that the utility to keep driving under fuel subsidy removal scenario is not different with the utility to keep driving under no policies implemented. The interesting finding is the utility of car commuters has been changed after fuel subsidy removed. It is explained by comparing the car commuters' utility before and after fuel subsidy removed. On the other hand, the utility of motorcycle commuters after fuel subsidy removed is higher than before. It is still reasonable since motorcycles are very efficient in using fuel. The increase of fuel price did not affect much to their utility. However, the utility is still decreasing if the road pricing and joint policy are implemented.

Table 5. 6 Comparison the parameters estimated of stated preference models

	2013		2015	
Variables	**Estimate**	**t-value**	**Estimate**	**t-value**
Main Attributes				
ASC	17.581**	2.376	12.280***	4.088
frequency (R)	0.799***	2.666	0.143***	2.975
speed (R)	1.257***	47.572	0.397***	7.473
parking (R)	1.936***	7.317	1.942***	7.943
Cost	-0.171***	-15.116	-0.121***	-14.760
Policy Scenarios				
RP	-7.676**	-2.206	-0.865*	-1.672
FS[1]	-7.341**	-2.107		
FSR[2]			-1.311	-0.632
JP	-8.438**	-2.485	-1.761**	-2.266
Current travel behavior				
Motorcycle	1.965	0.429	5.921**	2.487
TT	-1.325	-1.642	0.551	1.558
Demographic, socio-economic				
Employer	-2.436**	-2.048	-2.798**	-3.065
Student	-2.577	-1.059	-2.577***	-2.051
Age	-0.083	-1.199	-2.214**	-1.996
Edu	0.584**	1.949	0.582***	3.771
Male	1.257	1.225	-1.907***	-3.178
familyincome	0.002	0.987	-0.002**	-2.251
Hhsize	1.099**	2.273	0.612***	2.645
Jakarta	-2.896**	-2.209	-1.134	-1.174
Interaction between vehicle type and policy scenarios				
motorcycle*RP	-2.779	-0.686	0.448	0.355
motorcycle*FS	-5.721	-1.352	-1.655	-0.491
motorcycle*JP	-8.078*	-1.910	-5.365**	-2.172
motorcycle*TT	-4.061*	-1.684	-0.869*	-1.651
Interaction between attribute and location				
parking*jakarta	-1.212***	-4.473	-2.561***	-9.475
Derived standard deviations of parameter distributions				
frequency	1.292***	6.503	2.706***	130.211
speed	2.491***	186.953	2.228***	95.091
parking	3.257***	5.225	0.169	0.198
McFadden Pseudo-R2	0.178		0.192	
Chi-squared	533.848***		574.581***	
Prob[ChiSqd > value]	0.000		0.000	

*** Significant at 1% level

** Significant at 5% level

* Significant at 10% level

(R) Random Variables distributed normally of Mixed Logit Model

[1] Fuel subsidy removal under scenario with the price 0.9 USD

[2] Fuel subsidy removal based on the current market price (confirmed to the respondents that the fuel subsidy has been removed)

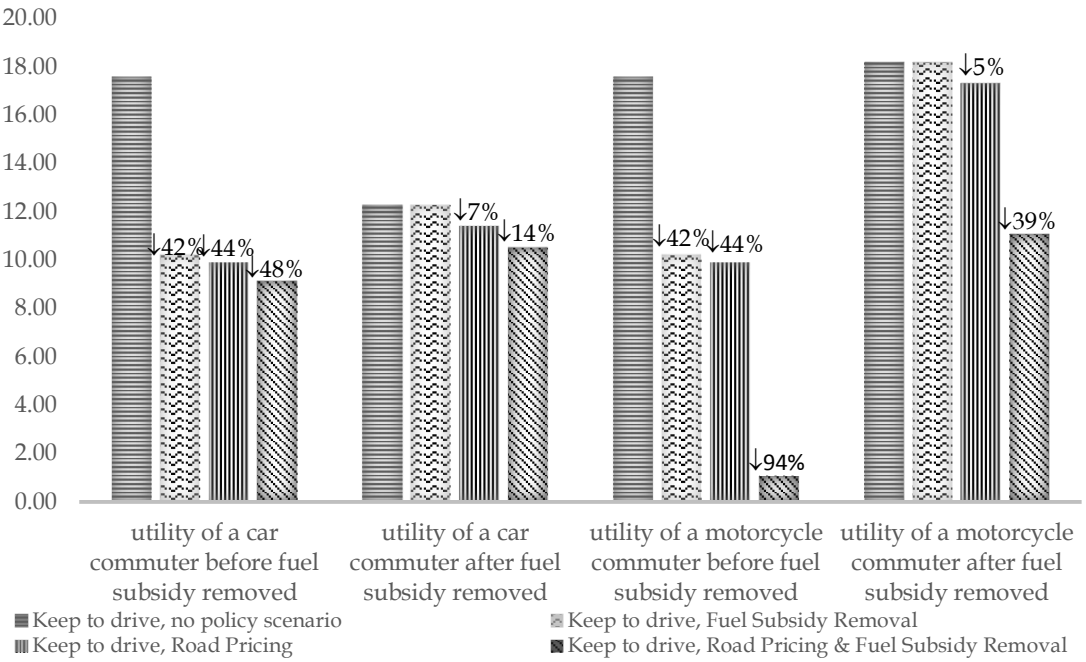


Figure 5. 3 Comparison the utility to keep driving before and after fuel subsidy removed

Moreover, the fuel subsidy removal has been affecting the commuters' behaviors in choosing transport modes. From the figure 5.4 the commuters' willingness to pay to use MRT is much higher than before fuel subsidy removed. The parking availability at all MRT stations is getting important since the WTP of parking availability is the highest. The commuters might have preference to drive their cars or motorcycles until to the stations and need parking areas to park their vehicles, then continue to use MRT to reach their offices. This system is called by park and ride system.

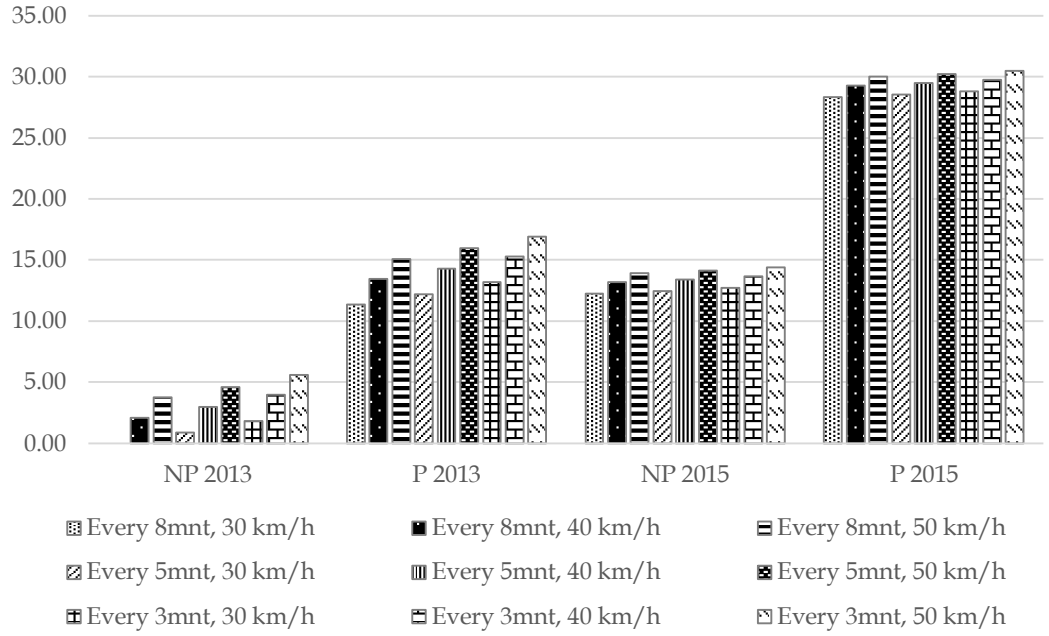


Figure 5. 4 Comparison the WTP by shifting to MRT before and after fuel subsidy removed

5.5.1 Transition of transport mode shares

The survey had been conducted both in 2013 and 2015 are the hypothetical survey for the MRT, because MRT is still under construction and will be operated in 2020. Sugie & Fujiwara (2004) mentioned there are effects of changing the travel environment on state preference data. To confirm these temporal changes of transport mode shares can follow the Markovian response pattern. There are three types of Markovian assumptions based on Kitamura & Van Der Hoorn (1987) and those are: 1) the individual's response to a change is nstantaneous without any time lag; 2) the response is reverible; 3) the behavior is stationary. By using this concept, it can see the temporal changes of commuters based on the actual transport modes that they use and the share of MRT (hypothetical). The following figures show the temporal changes of transport mode share if MRT will be operated. The red vertical line displays the fuel subsidy removal in 2014. The figures try to see the effect of fuel subsidy removal to the transport mode share. The status quo represents the current transport modes used, either cars or motorcycles. The current plan and improved represent the MRT. Current plan means that the MRT will be operated under current plan scenario and improved means that the offering of MRT services will be improved in term of frequency, speed and parking availability as explained in chapter 4.

In total, the share of MRT is increasing if it is compared between the data in 2013 and 2015. The share of cars or motorcycles that represent with status quo is decreasing by 3%. Among the policy scenarios, the road pricing scenario shows the sharply decrease of cars/ motorcycles share. The scenario of fuel subsidy removal does not give a significant impact to the share of private vehicle share since all the commuters had experienced with the increase of fuel price. Based on the figures, the fuel subsidy removal gives different impacts to different scenarios regarding the transport mode share.

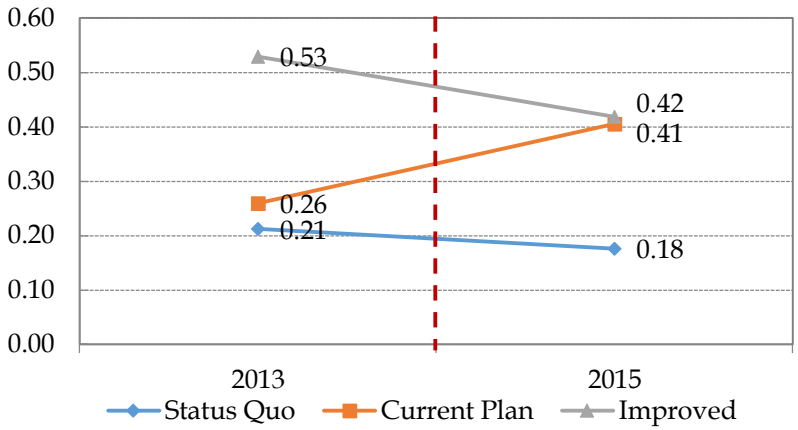


Figure 5. 5 Temporal change in transport mode choice in total

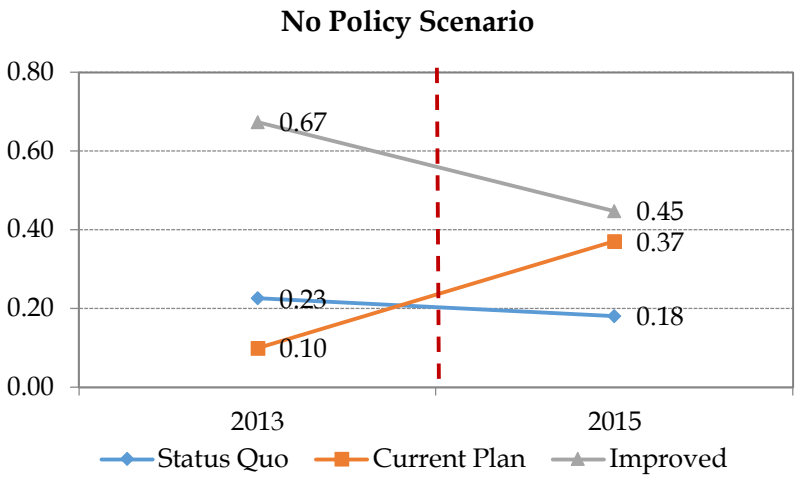


Figure 5. 6 Temporal change in transport mode choice under no policy scenario

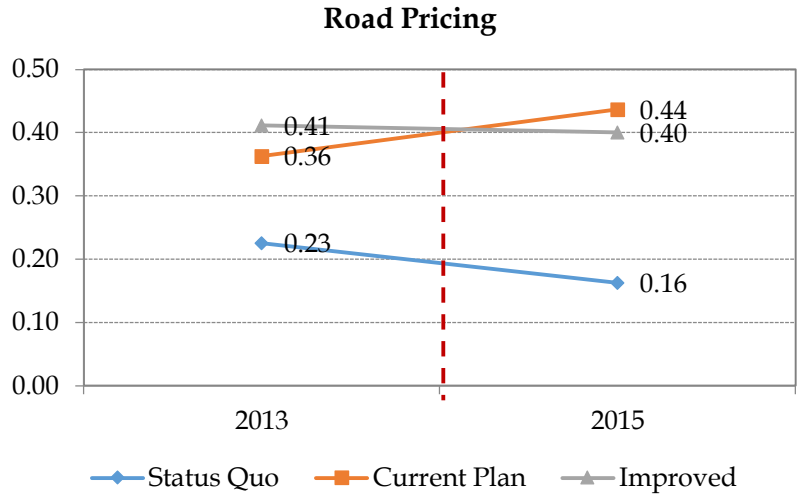


Figure 5. 7 Temporal change in transport mode choice under road pricing scenario

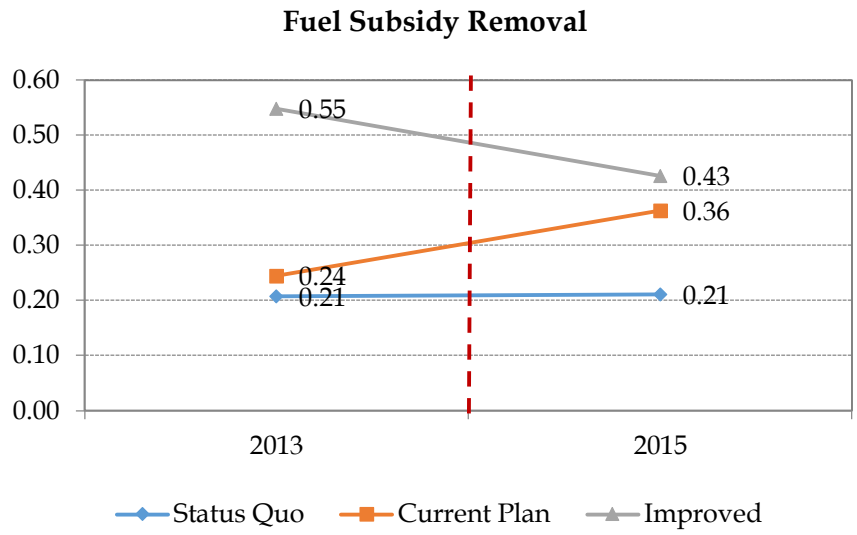


Figure 5. 8 Temporal change in transport mode choice under fuel subsidy removal

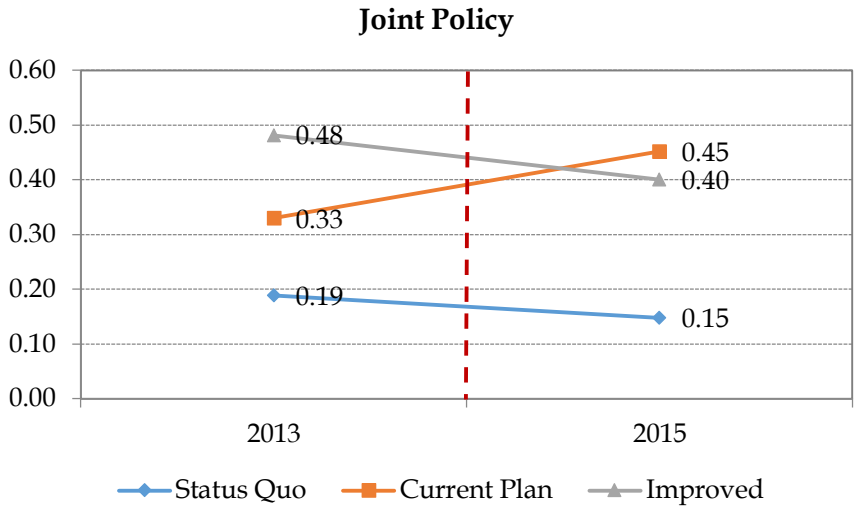


Figure 5. 9 Temporal change in transport mode choice under joint policy

5.6 Conclusions

This study confirmed that fuel subsidy removal has affected the commuters' behavior changes in choosing transport mode for daily commuting. In this case, it encourages commuters to use MRT, since the utility to keep driving either cars or motorcycles is decreasing. In contrast, the utility to shift to MRT is positive and higher with the all MRT service improvement.

If it is compared the commuters' utility before and after fuel subsidy removed, the utility to keep driving for cars and motorcycles is not affected anymore with the fuel subsidy removal scenario since all commuters have been experiencing with the current fuel price which is no subsidy. The interest finding is the WTP to use MRT after fuel subsidy removed is much higher than before fuel subsidy removed, especially if the parking areas are available at all MRT stations.

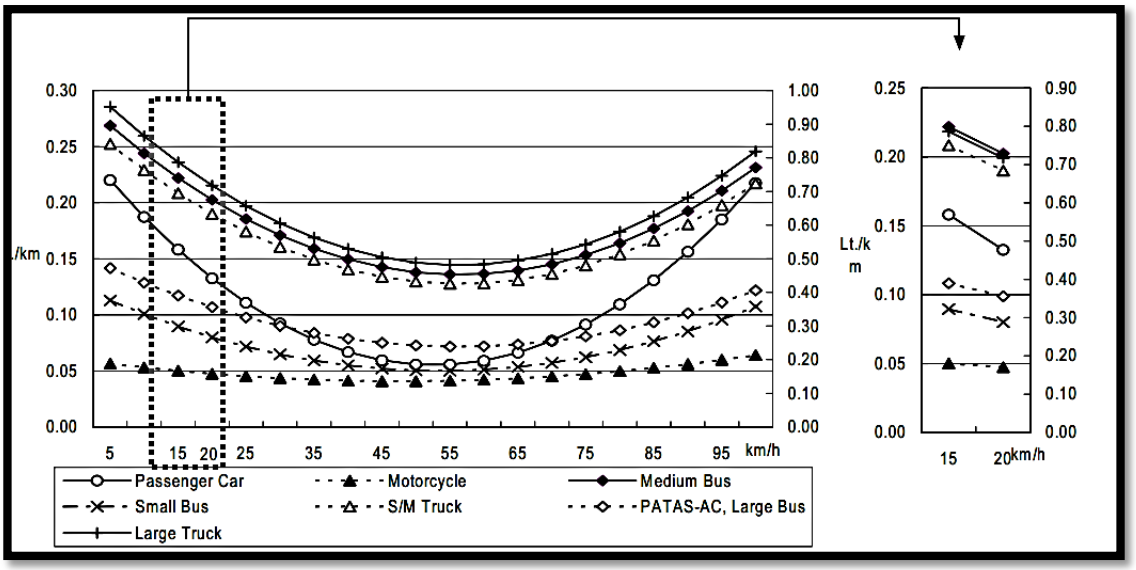
The temporal changes of transport mode shares also confirm that the scenario of fuel subsidy removal does not give a significant impact to the share of private vehicle share since all the commuters had experienced with the increase of fuel price. However, the fuel subsidy removal gives different impacts to different scenarios regarding the transport mode share.

Chapter 6 Economic and Social Benefits of MRT for Commuters in Jakarta

6.1 Introduction

The fast growth of motorization and urbanization is giving rise to several problems that hamper smooth transportation, such as traffic congestion due to road capacity shortage, diminishing use of public transportation modes and air pollution due to vehicle emissions, as well as increasing numbers of traffic accidents. If all these problems are monetized, it will loose a huge amount of money.

Now, the average travel speed in Jabodetabek area is slower where in 2010 the was about 30.5 kph, while in DKI Jakarta area is 8.3 kph (UKP4, 2010). Based on the minimum standard level of services, the average speed is 20 kph. So, the vehicles' speed in Jakarta is much lower than the minimum standard. In addition, based on the study has been conducted by JICA (2004) there is an optimum speed that consume fuel efficiently. From the figure 6.1 it can be seen that the speed below 40 kilometer per hour and over 70 kilometer per hour, the fuel consumption is increasing.



Source: (BAPPENAS & JICA, 2004)

Figure 6. 1 Speed-dependent Fuel Consumption Rates

As mentioned, Jakarta with average speed 8.3 kilometer per hour, the fuel consumption is about 0.2 liter per one kilometer or 1 liter for 5 kilometer.

Under the current situation, the effectiveness with which MRT is developed, and the parallel complementary measures which are implemented, will substantially influence the city's future. For a rapidly growing city MRT decisions will arguably be of great strategic importance, and not only are sound decisions required, but they are required at broadly the right time. When this is done, then congestion may be controllable and with this wide-ranging benefits can follow, but this is something that few cities have achieved. Evidence from the United Kingdom indicates that large transport prokects can have significant impacts on economy (Legaspi, Hensher, & Wang, 2015).

At a less ambitious level, MRT can allow the city centre to grow and avoid the worst excesses of a car-dependent low-density suburban sprawl. This policy allows the city to 'live with congestion', while mitigating some of its worse effects. Many large developing cities are seeking to follow this strategy. But when circumstances are adverse and/or decision-making is poor then MRT policy has a lesser strategic role, namely to make the best of a difficult situation, making worthwhile investments, but failing to achieve the benefits of policy synergy which otherwise may be possible. The commitment of government to implement other policies that can encourage the role of MRT as the main transport to commute is very urgent.

The environmental impacts after MRT operated were apparent savings in energy and air pollution. However, in the long-term the impact of the MRT is likely to increase urban sprawl, and reduce reliance on the car. The environmental benefits arising from these changes in the long-term could be substantial (Halcrow Fox, 2000).

This chapter will calculate the potential benefits of MRT development in Jakarta in term of economic, and environmental benefits. The economic benefits will be calculated based on economic value generated. The environmental benefits will focus on the GHG emission reduction especially how much the potential CO_2 emissions can be reduced after MRT operated by realizing "modal shift" from existing transport system. The calculation is only for CO_2 emission since CO_2 is the most significant contribution to GHG emissions.

The applicability of the calculation the CO2 reduction is:

1. The MRT system will have its own rapid railways infrastructures connecting from southern part of Jakarta (the highest density in Jakarta) to central of Jakarta (Central Business District).
2. The baseline transport system is road based
3. The motive power of rapid railways should be electric-powered and the pollution from the operation electric based MRT is negligible.

6.2 Literature review

A commuter train development, such as MRT, can facilitate the commuters with travel time savings or reductions in their trip expenses that encourages commuters to travel more thus increases the total number of trips. Even private vehicle users can also benefit through commuter train development, as shift of private vehicle users from cars or motorcycles to rail will free up the capacities on the paralleling roads. As a result it reduces the generalized cost of road travels and encourages new road trips. The benefits of on development of commuter train can be estimated by considering the travel cost savings accumulated by riders staying in mode and those shifting from other modes, based on the consumer surplus.

Some studies calculate the benefits and costs associated with specific long term outcomes criteria. The benefits measure including the benefits of accident reduction

savings, pavement maintenance savings, congestion savings to remaining highway users and emissions reduction savings as they relate to the five long term outcomes. The costs were initial construction and capital costs, operation and maintenance costs (NH Department of Transportation, 2010).

In the report of MBTA Commuter Rail Extention it is also mentioned the livability principle, which is Livability Principle number one is by providing more transportation choices, it develops safe, reliable and economical transportation choices to decrease household transportation costs, reduce our nation's dependence on foreign oil, improve air quality, reduce greenhouse gas emissions and promote public health.

Other study, Rhode Island Department of Transportation (2001), reported that the benefits can be calculated from net accident savings, travel time savings and net emission cost savings. The costs included construction/ capital costs and operation as well as the maintenance cost.

However, for this study, it will focus on calculating the benefits of the economic value generated of commuters who shift to use MRT and the environmental benefits based on the potential of CO_2 emission reduction. Regarding the costs of MRT development, it will show the total costs of whole the MRT construction, not including the costs of operation as well as maintenance costs since the MRT is still under construction, not operated yet.

6.3 Research Method

6.3.1 Method to calculate the total economic value

The most common way used to derive the mixed logit probability is based on random coefficients which have been explained in the theoretical framework, Chapter 2. Based on the reference, the mixed logit model can be rearranged as follows (D. A. (The U. of S. Hensher, Rose, & Greene, 2005):

$$U_{nj} = \beta_p p_j + (\beta + \gamma s_n + \delta_{xn})' x_{nj} + \theta s_n + \varepsilon_{nj} \tag{6.1}$$

The model treats homogeneity in price with a fixed parameter β_p. β represents a vector of population mean parameters, δ_{xn} is a vector of stochastic deviation of individual's preference from the population mean, that in this study is assumed to be distributed normally with zero mean and covariance matrix Σ_β which is really a diagonal matrix. γs_n describes interactions between main attributes and consumer attributes with fixed parameters γ.

In the theoretical framework, equation 2.14 of the rearranged linear mixed-logit model, marginal utility of observation i towards random choice attribute x_n and the marginal utility of price p is fixed across all observation can be derived, as follows:

$$MU_{ixn} = \frac{\partial U}{\partial x_n} = \frac{\partial V(x_n, s_n)}{\partial x_n} = \beta_i + \gamma s_n + \delta_{ixn} \tag{6.2}$$

$$MU_p = \frac{\partial U}{\partial p} = \frac{\partial V(x_n, s_n)}{\partial p} = \beta_p \tag{6.3}$$

Therefore, the marginal WTP of observation *i* can be estimated as

$$Marginal\ WTP_i = -\frac{MU_{ixn}}{MU_p} = -\frac{\beta_i + \gamma s_n + \delta_{ixn}}{\beta_p} \quad (6.4)$$

Considering different marginal WTP across different observation, total economic value is calculated based on conditional parameter estimates and unconditional parameter estimates. For the conditional parameter estimates, individual marginal utility or marginal WTP is estimated based on the sample data, but may be not appropriate to generalize for other population (D. A. Hensher et al., 2005). So it can be defined as the sum product of estimated individual marginal utility and individual weight, and then divided by marginal utility of price or the sum product of estimated individual marginal WTP and individual weight.

$$Total\ EV = -\frac{\sum_{i=1}^{n}(\hat{\beta}_i + \hat{\gamma} s_n + \hat{\delta}_{ixn}) \times w_i}{\hat{\beta}_p} = \sum_{i=1}^{n} Marginal\ WTP_i \times w_i \quad (6.5)$$

For the unconditional parameter estimates, the marginal utility is estimated based on data simulation. Considering the distribution of each random attribute with estimate mean of its parameter and stochastic deviation in the model estimation, we can generate data d_k (k = 1,…, m) from a normal distribution with mean $\hat{\bar{\beta}}_k$ and standard deviation $\hat{\delta}_k$, and then calculate the individual marginal utility, as follows:

$$MU_k = d_k + \hat{\gamma} s_n \quad (6.6)$$

where it has probability P_k. Therefore the unconditional total social economic value can be defined as the sum product of generated individual marginal utility and its probability, divided by marginal utility of price, and then multiplied by total population.

$$Total\ EV = -\frac{\sum_{i=1}^{m} MU_k \times P_k}{\hat{\beta}_p} \times Total\ Population \quad (6.7)$$

6.3.2 Method to calculate the CO2 reduction

The research is performed through quantitative method based on the measurement and secondary data collection. The data collection was carried out by surveying the literatures related to energy used in the transportation sector in Jakarta and its emission effect.

The data are used to calculate the CO_2 emission in 2013 as the based year and it will compate to the CO_2 emission once the MRT operated. The calculation used in this study is the CO_2 reduction from the commuters who shift to use MRT in 2020. Total number of commuters who shift to MRT was calculated based on the parameter estimated in the hypothetical analysis that asked the respondents' willingness to use MRT.

CO_2 emissions reduction due to MRT is calculated as the difference between the CO_2 emission with the existing transport systems (baseline) and those after the success of the modal shift to MRT (project emission).

$$ER_y = BE_y - PE_y\ (t - CO_2/y) \quad (6.8)$$

ER_y : CO_2 emission reduction due to project activity in year y ($t - CO_2/y$)
BE_y : CO_2 emission with existing transport systems in year y ($t - CO_2/y$)
PE_y : CO_2 emission after the success of modal shift to MRT from the existing transport system in year y ($t - CO_2/y$)
The BE_y is the baseline emission which is the CO_2 emission with existing transport systems in absence of a MRT. The PE_y is CO_2 emission with a MRT available.

To estimate baseline CO_2 emission is by multiplying the shared number of passengers with their CO_2 emission factor per passenger before the project starts and for this study using year 2013 as the baseline. The equation can be written as:

$$BE_y = \sum_i \left(EF_{P,v,y} \times P_{PJ,v,y}\right) \quad (6.9)$$

$EF_{p,v,y}$ = CO_2 emission factor per passenger for vehicle category v ($gr - CO_2/y$)
$P_{PJ,v,y}$ = Annual number of passengers transported by vehice category v after the MRT has been operated.

Determination of $EF_{p,v,y}$ is calculated based on CO2 emission factor per kilometer, average trip distance, and average occupancy rate of vehicle before the MRT will be operated. In the formula it can be written to be:

$$EF_{p,v,y} = \frac{EF_{KM,v} \times TD_v}{OC_v} \quad (6.10)$$

$EF_{KM,v}$: CO_2 emission factor per km for vehicle category v before the MRT operated
TD_v : Average daily trip distance driven by vehicle category v (km/vehicle)
OC_v : Average daily occupancy rate for vehicle category v (person/vehicle)
$EF_{KM,v}$: is calculated using the following formula:

$$EF_{KM,v} = \sum_x \left[\frac{(1-\alpha_{x,v})}{SEC_{x,v}} \times EF_{CO_{2,x}} \times \frac{N_{x,v}}{N_v}\right] \quad (6.11)$$

$SEC_{x,v}$: Specific fuel consumption per vehicle category v (km/L)
$EF_{CO_{2,x}}$: CO_2 emission factor of fuel category x (gr-CO_2/liter)
$N_{x,v}$: Number if vehicle category v using fuel category x (vehicle)
N_v : Number of vehicle category v (Vehicle)
Multiplying the total annual electricity consumption of MRT trains after operated, with the CO_2 emission factor of electricity.

$$PE_y = TC_y \times EF_{CO_{2,x}} \quad (6.12)$$

PE_y : GHG emissions of MRT after the project starts ($tCO_2/year$)
TC_y : Total annual electricity consumption of MRT trains after the MRT operated (kWh/y)
$EF_{CO_{2,x}}$: CO_2 emission factor of fuel category x (gr-CO_2/liter)

Determining of TC_y of MRT is estimated considering their electricity consumption rate multiplied by their total annual trip distance

$$TC_{et,y} = DD_y \cdot SEC_{et,y} \quad (6.13)$$

$SEC_{et,y}$: Electricity consumption rate (kWh/km)
DD_y : Total annual trip distance traveled by MRT (km/y)
Emissions for various types of vehicles are estimated by multiplying their shared

number of passengers with their CO_2 emission factor per passenger before MRT operated.

$$E_y = \sum_i \left(EF_{p,v,y} \times P_{i,y} \right) \quad (6.14)$$

$EF_{p,v,y}$: CO_2 emissions factor; p : passenger;
v : vehicle category (gr-CO_2/passenger)
$P_{v,y}$: Annual number of passengers transported by vehicle category v

6.4 Cost of MRT development

The total project cost is estimated about 1.44 Billion USD (for Lebak Bulus – Dukuh Atas, the total cost for Lebak Bulus-Bundaran HI is currently being calculated) with the eligible loan portion is about 1.20 Billion USD, and the rest of the project cost will be funded by National and City Budget. The project cost will be shared between National Government (42%) and City Government (58%). The fund will then be channeled to PT MRT Jakarta through DKI Jakarta as the implementer and operator of the project. As of today, we have manage to secure the loan agreement I and II, which is 42% of the eligible loan portion from JICA, that is granted to Provincial Government of DKI Jakarta. In 2009, JICA also has provided grant to do feasibility study of extension MRT corridor from Bundaran HI – Kampung Bandan (Kota) and the pre-feasibility study of MRT east-west corridor.

6.5 Economic benefits

Successfully promoting MRT under certain policy scenarios and the improved services from the current plan give some benefits for people who want to shift to use MRT. After understanding each benefit of each potential MRT passenger on average, it can be calculated the total economic value estimation with different combination of the improved MRT services for both car and motorcycle commuters.

To calculate the total economic valuation for all commuters who use either cars or motorcycles for commuting and the workplaces are along the MRT will be operated, it should know the number of car and motorcycle population that have destination to this area. Based on traffic counting data collected by Ministry of Transportation of Indonesia c.q. Directorate of Urban Transport System, the population of cars and motorcycles that enter the area in 2011 is about 384,250 and 334,553 respectively. Under the assumption the growth rate of cars and motorcycle are about 12% and 14% respectively (Statistics Indonesia, 2014a), it can estimate the proportion of car and motorcycle commuters who shift to MRT either to current and improved services from the model estimated, table 6.1 shows the estimated economic value of each combination chosen by respondents. Based on the data survey in 2013 or before fuel subsidy has been removed, the highest total economic value is about 498,879 USD for car commuters and 397,285 USD for motorcycle commuters, under the combination is headway every 3 minutes, with speed 30 kilometer per hour and parking is available at all MRT stations. However, after fuel subsidy has been removed at the end of 2014, based on the data of second survey, it can be seen that the total economic value is increasing because there are 3% increase of car and motorcycle commuters who want to shift to MRT. The highest of total economic values after fuel subsidy removed is 536,447 USD from car commuters and 516,470 USD from motorcycle commuters. From the table, it also can be confirmed that by increasing the fuel price the total economic value has been increased by 0.16 USD.

However, from the model it can be calculated the percentage of commuters who do not want to shift to MRT which is about 24.2%. If it is breakdown to the car and motorcycle commuters, the willingness of motorcycle commuters to use MRT is lower than car commuters, with different about 10% of each total number of vehicles. There are 80.6% of car commuters want to use MRT and 70.9% of motorcycle commuters want to use MRT. Although the policy scenarios can reduce their utility but the willingness to pay of the commuters who still want to use their own cars or motorcycles are still positive, meaning that the commuters of both vehicle are willing to pay additional cost imposed by the implementation of the contextual policy scenarios e.g. the road pricing, fuel subsidy removal, or joint policy to keep using their owned vehicles. For example, the car commuters are ready to pay the rising cost about 28.6 USD after implementation the contextual policies to keep driving their vehicle. If the government increase the cost more than their WTP, potentionally it could discourage them in using cars. The positive value of WTP also gives a sign that there is a potential economic value that government can generate from this group so that they choose the public transport, for example, by increasing the vehicle taxes, etc.

Table 6. 1 Economic value estimation by shifting to MRT with the improved services

The Combination of the Improvement of MRT services	Total Economic Value (USD)			
	Before fuel subsidy removed		After fuel subsidy removed	
	Car	Motorcycle	Car	Motorcycle
Every 8mnt, 40km/h, NP	39,930	31,085	54,295	40,410
Every 8mnt, 50km/h, P	428,816	345,292	387,026	448,879
Every 5mnt, 30km/h, NP	12,136	8,829	22,158	11,477
Every 5mnt, 40km/h, P	197,053	156,524	183,535	203,481
Every 5mnt, 50km/h, NP	186,362	148,184	177,637	192,639
Every 3mnt, 30km/h, P	498,879	397,285	536,447	516,470
Every 3mnt, 40km/h, NP	157,156	127,573	101,463	165,844
Every 3mnt, 50km/h, NP	161,689	130,781	143,577	170,016

mnt = menit km/h = kilometer per hour; NP = Parking is not available; P = Parking is available

6.6 Environmental benefits

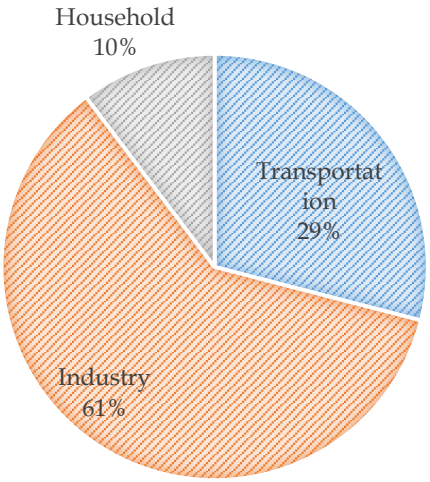
6.6.1 Overview of automobile fuel consumption and emissions

The total number of vehicles registered in Jakarta is about 12.5 million, it makes the fuel consumption high. Table 6.2 shows numbers of vehicles based on the types of fuel consumed. 89% of vehicles consumed the regular fuel and the diesel is consumed by the bus and truck. From the table, it also can be seen that the total number of motorcycles is very huge all of motorcycle types consume the regular fuel which had been subsidized by government until 2014. For the cars, 35% consume diesel fuel type.

Table 6. 2 Number of vehicle based on the fuel types used in 2013

No	Vehicle type	Number of vehicles		
		Regular	Diesel	Total
1	Car load	35,342	-	35,342
2	Private passenger car	314,371	170,512	484,883
3	Public passenger car	18,854	-	18,854
4	Private bus	-	960,473	960,473
5	Public bus	-	57,818	57,818
6	Truck	-	180,892	180,892
7	Three-wheel vehicle	18,065	-	18,065
8	Motorcycle	10,825,973	-	10,825,973
	Total	11,212,605	1,369,695	12,582,300

Since the high numbers of vehicles and also the congestion, transportation sector is the most in fuel consumption. As a result, transportation has a big contribution of the GHG emission. In Jakarta, transportation sector is the second largest contributor of GHG emission after industry sector. Figure 6.2 shows the percentage of GHG emissions based on the sector.



Source: Ministry of Environment Indonesia, 2013

Figure 6. 2 GHG emissions based on sectors in Jakarta

Generally, there are some factors that make the high energy especially fuel consumption in transportation sector. Those factors are people behavior in driving, life styles, as well as the high growth rate of the vehicle numbers especially motorycles and cars. The final energy use in transportation sector is predicted to increase by 12.8% annually until 2025. Although, currently the LNG, LPG, electricity and bioethanol is very few in using in transportation sector but it is predicted that the growth rate in using these types of energy will be increased about 13.9% annually (Ministry of Energy and Mineral Resources, 2014). It can be happened due to the national government policy to reduce the fuel subsidy so it will decrease the fuel consumption. All this prediction is assumed following the Business as Usual (BAU) scenario. However, if it is used non BAU the non fuel energy use is expected to increase higher.

Since in the past, the fuel was subsidized, it makes the government spending for subsidy is a huge amount, which is about 22% of national government spending. Fuel subsidi was expected to reach 24.65 billion USD, with total volume was about 46 million kilo liter (kl).

With high fuel consumption, it is not surprising that transportation sector has been contributing to GHG emissions. Technically, the emissions from vehicles are affected by some factors such as combustion engine, volume of cc, body drag, vehicle weight, and rolling resistance. Recently it has been developed the hybrid cars which is the most efficient for fuel use, but in Indonesia, the hybrid cars is still rare.

To reduce the GHG emissions from transportation sector is by decreasing the growth in vehicle miles of travel, easing congestion and supporting more efficient land use patterns, public transportation expected can reduce harmful CO_2 emissions. These savings represent the beginning of public transportation's potential contribution to national efforts to reduce greenhouse gas emissions and promote energy conservation.

By eliminating travel and also shifting to use public transportation can reduce carbon footprint and conserve energy. Based on American Public Transportation Association, one person, who is commuting alone by car, and shift to public transportation, can reduce one person's annual CO_2 emissions by a 10% reduction in all GHG produced by a typical two-adult, two car household. By eliminating one car and taking public transportation instead of driving, a saving of up to 30% of carbon dioxide emissions can be realized.

Public transportation offers an immediate alternative for individuals seeking to reduce their energy use and carbon footprints. This action far exceeds the benefits of other energy saving household activities, such as using energy efficient light bulbs or adjusting thermostats. Commuting by public transportation is one of the most significant actions to reduce the household carbon emissions. The increasing cost of fuel makes driving private vehicles even more prohibitive for many.

By reducing the number of trips using private vehicles and shifting them to use public transportation such as MRT, it will have potential impact in reducing GHG emissions. Commuting by public transportation can reduce carbon emissions and increasing the fuel price makes private vehicles' users more excessive. This section will show how much the potential GHG emissions can be reduced after MRT operated under certain scenarios.

Moreover, there are some previous works that have been done by some researcher to know the impacts of promoting public transports to environmental benefits. Dirgahayani (2013) proved that by promoting public transportation, BRT in Yogyakarta-Indonesia, it gives environmental co-benefits with GHG reduction. Promoting BRT system can reduce the distance travelled by private cars through a modal switch to public transportation and as a result, reduction in air pollutants and GHG emissions (Chavez-Baeza & Sheinbaum-Pardo, 2014). Other policies that can reduce the travel demand is by introducing Transit Oriented Development (TOD) concept in Jabodetabek. The study shows that TOD can improve the urban environment quality (Hasibuan, Soemardi, Koestoer, & Moersidik, 2014). Other findings from previous study is private vehicle control, fuel tax and fuel economy regulation are the effective policies to reduce energy demand, petroleum demand and GHG emissions significantly (Yan & Crookes, 2009).

6.6.2 The potential of CO_2 emission reduction

There are two parts to calculate the emission reduction after MRT operated:

a. Total emission reduction from the passengers who currently use private vehicles and shift to MRT
b. The emission from MRT operated (assumption electricity based)

Based on the calculation with the presence of MRT, the CO_2 emission can be reduced by 10.52% from the total current CO_2 emission from the vehicles in Jakarta. Because the CO_2 emission reduction calculated on this analysis is based on the number of commuters who shift from cars or motorcycles to use MRT, the CO_2 emission reduction is only come from cars and motorcycles. Other types of vehicles are assumed to be constant. The CO_2 emission reduction from cars is higher than from motorcycle.m although the total number of motorcycles are about four times from total number of cars. In fact the motorcycles are efficient in comsuming the fuel.

Table 6. 3 Total CO_2 emission reduction with the available MRT

Vehicle Category i	$EF_{km,v}$	EF	Eby $(ton - CO2/y)$	Epy $(ton - CO2/y)$	Emission Reduction (ER)
Motorcycle					
Gasoline	61	2,274	3,405,843	3,250,364	
Passenger car					
Gasoline	162	4,860	2,620,971	1,803,248	
ADO	156	4,684	631,416	631,416	
Car load					
Gasoline	65	1,334	59,930	59,930	
ADO	107	2,210	397,281	397,281	
Public passenger car/bus					
Gasoline	103	2,060	786,737	786,737	
ADO	183	1,221	1,088,013	1,088,013	
			8,990,190	**8,043,989**	**10.52 %**

Source: Author's calculation, 2015

After fuel subsidy removed, the changed number of car and motorcycle commuters who want to shift to MRT is not so different, which is about 3% increased. In addition, the population of cars and motorcycles that pass through the CBD has been increased. By using the same assumption of vehicle growth that is used to calculate the total economic value, it can calculate the changes of CO_2 emission reduction after fuel subsidy removed. Based on the data survey in 2015 and under some assumption of the vehicle growth, the total CO2 emission reduction will be 13.28%. Meaning that, there is improvement of environmental benefits by removing fuel subsidy.

The total economic benefits that have been calculated in this analysis is a partial benefit, since it is only calculated the benefits that can be got from potential private vehicle commuters who want to shift to use MRT in future. In order to calculate the total cost and benefit analysis, it can be done after the MRT will be operated. Based on the feasibility study of MRT in Jakarta, the Economic Internal Rate of Return (EIRR) and Financial Internal Rate of Return (FIRR) shows the positive values which are 7.39% and

1.99% respectively (MRT Jakarta, 2013a). Meaning that, the MRT in Jakarta is visible to develop in Jakarta.

6.7 Conclusion

Based on the calculation, it is proven that by shifting from cars or motorcycles to use mass public transports potentially give some benefits that generate the economic valuation as well as the CO2 emission reduction. The highest economic valuation that is come from car commuters is about 498,879 USD and for the motorcycle commuters is about 397,285 USD. However, after fuel subsidy removed, the total economic value has been increased. Total economic value from car commuters is about 536,447 USD and from motorcycle commuters is about 516,470 USD. In addition, MRT that is operated by using energy source that is environmental friendly such as electricity, it can reduce the emissions from transport sector. For the case of MRT in Jakarta, under the assumptions that MRT will be operated electric based and the CO_2 emission is negligible, the shifting of commuters from cars and motorcycles can reduce the CO_2 emission by 10.52% and it will reduced to be 13.28% after the fuel subsidy has been removed.

Chapter 7 General Conclusion and Policy Implications

7.1 General Conclusions

Based on the study that have been conducted, it can be summarize the findings as follow:

1. The characteristics of commuters in Jakarta have been changed within the last six years. The average of education level has been increased and it is followed by the increase of the commuters' income. It shows clear evidence that the private vehicle users either cars or motorcycles have higher education level compared to the public transport users.
2. Currently, private vehicles are still to be the commuters' favorite, especially motorcycles which are chosen by commuters in all the income ranges and it is different from car users that most of them have high-income level.
3. The distance of commuters has been increased and most of them prefer to use private vehicle, the share of public transport has been decreased since the commuters who use public transport have shorter distance. The increase of distance is confirmed by the increase of the number of commuters from buffer areas of Jakarta, called Bodetabek.
4. The main reasons for using cars and motorcycles are more comfortable, more flexible and could save the time especially for motorcycles. Their dependences to cars and motorcycles are very high because of lack of services in public transportation such as the punctuality, not integrated with them, security and safety as well.
5. It is also confirmed that the transport cost by using cars is also bigger than the cost of using public transport. Meaning that, for people who face longer commutes, cars become more attractive options, especially with a higher wage level and opportunity cost of commuting time.
6. Implementing mixed policies could be an effective way to change the people behavior to shift from cars or motorcycles to MRT. Implementing fuel subsidy removal or road pricing can discourage the commuters to drive cars or motorcycles. The scale impacts on commuters' willingness to shift to MRT under the policy scenarios is bigger and significant compared to the impacts of MRT service improvement.
7. The joint policies implemented both, road pricing and fuel subsidy removal, give a higher impact to encourage commuters to shift to MRT especially for motorcycle commuters, but for car commuters, it is not necessary joint policy implementation.

8. In addition, by offering a new public transport, MRT, 75.8% of commuters want to shift to use MRT for commuting either to the current plan or the improved services. The alternative chosen to improve the MRT services should provide the parking areas at MRT stations since the alternatives with parking available always give the higher benefits for commuters.
9. This study confirmed that fuel subsidy removal has affected the commuters' preferences in choosing transport mode for daily commuting. In this case, it encourages commuters to use MRT, since the utility to keep driving either cars or motorcycles is decreasing for road pricing scenario and joint policy implementation. In contrast, the utility to shift to MRT is positive and higher with the all MRT service improvement.
10. The interest finding is the WTP to use MRT after fuel subsidy removed is much higher than before fuel subsidy removed, especially if the parking areas are available at all MRT stations.
11. There are temporal changes of transport mode shares before and after fuel subsidy removed for all policy scenarios and in total, except the fuel subsidy removal scenarios since all the commuters had experienced with the increase of fuel price.
12. It is proven that successfully encourage private vehicle commuters to shift to MRT can generate economic value and environmental benefits. Total economic value generated would be increased after fuel subsidy removal. In addition, it also can reduce the CO2 emission by 10.52% and the CO2 reduction will be higher to be 13.28% after the fuel subsidy has been removed.

7.2 Policy Implications

Based on the findings, by introducing contextual mixed policy scenarios can increase the private vehicle commuters' willingness to shift to MRT, the government should consider to apply these such policies:

1. To keep the fuel price based on the market price and to implement road pricing in the CBD of Jakarta together with providing the better services of mass public transport, MRT.
2. Coordination to deliver the policies that related to the transportation sector is important, especially the fuel price and road pricing.
3. Since parking is important for private vehicle commuters, the parking management is urgently needed to be improved. Government should impose the parking price especially in CBD and provide parking areas at some stations of public transports, such as MRT, TransJakarta, or Jabodetabek railway. However, the precise of parking location is needed to study further.

7.3 Limitation of Study

There are some limitation of this study that is needed to be followed by further research.

1. In the analysis of mode choice behaviors, it is strongly assumed that the route choices and destinations of trips are fixed.
2. There is still remind the state preference biased problems, since the MRT is still under construction and respondents are still not sure yet with the types of MRT services.

3. Some of models have a low goodness of fit or below than 0.2. It can be caused some of variables included into the models are not significant and the samples selected are less varied. By increasing number of samples, it can be one of the solution.
4. The study is only focusing on commuting, not all other types of trips.

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Appendix 1. Questionnaires of First Survey

PRIVATE CAR USERS CA1_____
Name of surveyor: _____ Date of Interview _____ Start time: ____ : ____ end time: ____ : ____

QUESTIONNAIRE

Public Transportation Policies through Changes in People Behavior and Energy Consumption (Case of MRT Development in Jakarta)

Objectives:

1. To provide analytical results of future consumer's behaviors on transportation mode choices if the development of MRT would successfully completed as well as purchasing of motorcycles and passengers cars.
2. To illustrate a new approach to forecast the potential energy savings and environmental impact of promoting public transportation, especially after developing MRT.

Screening:

S1. Do you or anyone in your household work in any following sectors?

Transportation such as working at Ministry of Transportation, Transportation Agency, TransJakarta, PT. KAI, Paratransit/ Angkot, as a driver, and similar companies	1	**TERMINATE**
Company/ Manufacture/ Store of Automotive Products	2	**TERMINATE**
Others/ None of the above	99	

S2. How do you usually commute for working/ schooling? (at least 3 days in a week using the same mode)

By owned car	1	
By owned motorcycle	2	**TERMINATE**
By using public transport (e.g. bus, train, paratransit, etc.)	3	**TERMINATE**
Taxi	4	**TERMINATE**
Motorcycle taxi	5	**TERMINATE**
By bicycle	6	**TERMINATE**
Walking	7	**TERMINATE**
Others/ None of the above	99	**TERMINATE**

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I. TRANSPORTATION CURRENT USED

1. What is your purpose to commute in regular trips?
   - ☐ Working
   - ☐ Going to school
   - ☐ Others, _____
2. The distance from home to daily activity place (office, school, etc.)? _____ km
3. Where is the address of your work/ school location? Street name: _____City: _____
4. a. How far the nearest to access public transport from your home? _____ km _____ m
   b. What kind of public transport?
   - ☐ Paratansit (angkutan kota/ angkot)
   - ☐ Minibus (kopaja, metromini)
   - ☐ Big bus
   - ☐ TransJakarta (busway)
   - ☐ Shuttle bus, School bus
   - ☐ Others _____
5. How many vehicles do you have (in your household) totally?
   - ☐ Car, number: _____ cars
   - ☐ Motorcycle, number: _____ motorcycles
   - ☐ Bicycle, number: _____ bicycles
   - ☐ Others? _____ number? _____
   - ☐ None
6. Do you have driver license?
   a. Car driver's license? ☐ Yes ☐ No
   b. Motorcycle driver's license? ☐ Yes ☐ No
7. Information of the vehicles do you have and mostly used for daily commute:

a.	Model year	
b.	Fuel type (if mixed, please check the both answers)	☐ Premium ☐ Pertamax ☐ Solar
c.	Fuel efficiency (1 liter for how many km)	____ ltr : ____ km
d.	How many person usually ride together (including driver)	Persons
e.	Driving frequency in a week	/week
f.	The distance traveled in the recent one year	km
g.	How long does it take for commuting (total) per day	____hours ____mnt
	1) To go to office/ school/ others	____hours ____mnt
	2) To go home	____hours ____mnt
h.	Parking duration	hours
i.	Cost per week:	
	1) Fuel	IDR
	2) Parking	IDR
	3) Toll road	IDR
	4) Others	IDR

8. First time having own car? Year_____

9. What are your three main reasons to have a car? Give rank from 1 to 3

No	Reasons	Ranking for car
a.	Don't like public transport	
b.	Helpful for carrying things	
c.	Take children to school and other activities	
d.	Public transport not available	
e.	Improves status	
f.	Personal freedom	
g.	More comfortable	
h.	Saves time	
i.	Just a habit	
j.	Disability in HH	
k.	Company car	

10. How is the necessary to have car?
    - ❑ Totally necessary
    - ❑ Quite necessary
    - ❑ Not very necessary

11. What are the factors deterrents from driving car? Please give your responses for each question below:

No	Factors	Very much	Quite a lot	Neutral	Not very much	Not at all
a.	Traffic congestion	❑	❑	❑	❑	❑
b.	Parking costs at destination	❑	❑	❑	❑	❑
c.	Parking availability at destination	❑	❑	❑	❑	❑
d.	Unreliability of parking availability	❑	❑	❑	❑	❑
e.	Tunnel cost	❑	❑	❑	❑	❑
f.	Petrol cost	❑	❑	❑	❑	❑
g.	Route unfamiliarity	❑	❑	❑	❑	❑
h.	Stress of driving	❑	❑	❑	❑	❑

12. a. Do you drive by yourself? ❑ Yes → Q.13 ❑ No

    b. Who is the driver?
    - ❑ Driver paid by office
    - ❑ Driver paid by myself
    - ❑ Relatives (Husband/ Wife/ Parents/ Kid, Family)
    - ❑ Friends
    - ❑ Others _____

13. If not using the motorcycle or car to commute everyday, what is the alternative commuting travel mode do you use?
    - ❑ Walk or Bicycle
    - ❑ TransJakarta (Busway)
    - ❑ Bus
    - ❑ Train
    - ❑ Taxi
    - ❑ Paratransit (Angkot)
    - ❑ Auto rickshaw (Bajaj)
    - ❑ Ojek (motorcycle taxi)
    - ❑ Other _____

14. If using public transport, how much does it cost totally per day (a round trip)? _____ IDR

15. a. How long does it take on average by public transport to go to work/school?_____hours _____minutes
    b. How long does it take on average by public transport to go home? _____hours _____minutes

16. How to access the public transport?
    - ❑ By walking
    - ❑ By bicycle
    - ❑ Bajaj
    - ❑ Paratransit (angkot)
    - ❑ Motorcycle taxi/ delivered by other families by using motorcycle
    - ❑ Taxi/ delivered by other families by using car
    - ❑ Driving motorcycle and park closed to the stations/ bus stop
    - ❑ Driving car and park closed to the stations/ bus stop
    - ❑ Others, _____

II. WILLINGNESS TO BUY VEHICLES

17. a. For the next twelve months, do you have any attention to buy a car? ☐ Yes →P18 ☐ No
    b. For the next two years, do you have any attention to buy a car? ☐ Yes →P18 ☐ No
    c. For the next three years, do you have any attention to buy a car? ☐ Yes →P18 ☐ No
18. a. For the next twelve months, do you have any attention to buy a motorcycle? ☐ Yes→P19 ☐ No
    b. For the next two years, do you have any attention to buy a motorcycle? ☐ Yes →P19 ☐ No
    c. For the next three years, do you have any attention to buy a motorcycle? ☐ Yes→P19 ☐ No
19. Information of the vehicles do you want to buy (If one of the answers of Q.17 and Q.18 are Yes, please fill out this table, and if all the answers from Q.17 and Q.18 are No, continue to Q.21)

No.	Information	Type of vehicles	
		Car	Motorcycle
a.	Age of vehicle (yo=years old)	☐ New vehicle ☐ <=2 yo ☐ >2 yo - <=5yo ☐ >5yo - <=10 yo ☐ > 10 yo	☐ New vehicle ☐ <=2 yo ☐ >2 yo - <=5yo ☐ >5yo - <=10 yo ☐ > 10 yo
b.	Size (small, medium, large)	☐ Small (4-5 persons) ☐ Medium (6-8 persons) ☐ Large (>8 persons)	
c.	Type of vehicles (Conventional or Electric)	☐ Conventional manual ☐ Conventional matic ☐ Electric	☐ Conventional manual ☐ Conventional matic ☐ Electric
d.	Cylinder Capacity (CC) of vehicles	CC	CC
e.	Price range (IDR)	IDR	IDR

20. How to use your new vehicles? (Multiple answers). Based on the answer of Q.19. If wanting to buy both car and motorcycle, it should be questioned both.

No.	How to use your new vehicle	Car	Motorcycle
a.	For commuting until office/ school/ other routine activities	☐	☐
b.	For commuting until certain stations and then change to use public transport	☐	☐
c.	To deliver kids to go to school	☐	☐
d.	Will be used during weekend or holiday	☐	☐
e.	For shopping in certain days	☐	☐
f.	Others	☐	☐

21. Information of the LCGC (Low Cost Green Car) with affordable price

a.	Have you ever seen/ heard/ read any article or promotion or campaign about LCGC?	☐ Yes ☐ No → Q22
b.	How much are you interested with the LCGC?	☐ Very interested ☐ Interested ☐ Neutral ☐ Not interested → Q22 ☐ Not interested at all → Q22
c.	Will you consider this kind of product as one of favorite cars?	☐ Yes ☐ No
d.	Do you have any below activities toward LCGC? d1. Pay attention to the LCGC advertising	☐ Yes ☐ No
	d2.Find out information about LCGC to friends	☐ Yes ☐ No
	d3.Find out information about LCGC to automotive delaers	☐ Yes ☐ No
	d4.Find out information about LCGC through internet	☐ Yes ☐ No
e.	How much the maximum price that you will to pay for the LCGC types?	☐ 50 jt IDR - <70 jt IDR ☐ 70 jt IDR - <80 jt IDR ☐ 80 jt IDR - <90 jt IDR ☐ 90 jt IDR - <100 jt IDR ☐ 100 jt IDR – 120 jt IDR

III. WILLINGNESS TO USE MRT ONCE IT STARTED

22. As a planed, MRT will be started to operate by end of 2016 and end of 2018 for stage I (Lebak Bulus – Bunderan HI) and for stage II (Bunderan HI – Kampung Bandan) respectively, see the map attached. Based on the current plan, MRT will be integrated with Trans Jakarta (BRT) and Jabodetabek Railway in certain stations such as Sudirman Stations and Blok M stations. Regarding the MRT fare is not decided yet, it can be in the range between 10,000 IDR and 20,000 IDR. However, this fare is still subsidized by government. If there is no subsidy from government, based on the investment and operation cost, the fare must be about 35,000IDR.

FREQUENCY
The meaning of frequency is a measurement of the distance or time between trains in a transit system. As a plan the frequency of MRT services will be every 8 minutes in the first operation and it will reduce into every 3 minutes in two years operations.

AVERAGE SPEED
Average speed is the distance covered per unit of time and usually using kilometer per hour as a measurement. As a plan the average speed of MRT is 30 km/hour or it will take about 30 minutes from Lebak Bulus to Bunderan HI, if the MRT will stop about one minute in each station (there are 13 stations in total from Lebak Bulus to Bunderan HI), then total travel time is about 43 minutes.

PARKING FACILITIES
Until now, there is no plan to build parking facilities in all MRT stations. However, if it is demanded and makes people more convenience, it can be considered whether it is free or there is a certain charge based on the facilities equipped and the distance to the stations.

FINANCIAL BURDEN FOR THE PEOPLE
To develop MRT, DKI Jakarta government will use government budget. It means public money will spend to develop MRT, where the government budgets are mostly collected from people tax. It means indirectly all the people in Jakarta are charged to pay the MRT development investment. If there is any improvement in MRT services, such as increasing travel time, providing parking facilities, etc., and no changed in the MRT fare, it means the cost is imposed also to government budget (to people). In choice cards, the amount mentioned is only for MRT construction, not including the MRT ticket.

Regarding those conditions, then, we would like to ask questions about your willingness to use MRT once it started. The questions would deliver in some choice sets and each set has different combinations. Consider each set independently of all others.

Please indicate and select you willingness whether want to use MRT or still following current condition from three choice cards below with different combinations.

CHOICE CARD I

Select one either Status Quo, Current Plan, Option A or Option B

Attributes & Current Conditions	Status Quo (not change)	Current Plan	Option A	Option B
Frequency		Every 8 minutes	Every 8 minutes	Every 5 minutes
Average speed of MRT		30 km/hour ≈±43 minute	40 km/hour ≈±35 minutes	40 km/hour ≈±35 minutes
Parking availability in all stations		Not available	Not available	Available
Financial burden for the people	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	650,000/ person or 2,600,000/ family (assumed 4 members/ family)	780,000/ person or 3,120,000/ family (assumed 4 members/ family)
I will use MRT or not change from current condition (check only ONE)	☐	☐	☐	☐

CHOICE CARD II

Select one either Status Quo, Current Plan, Option A or Option B

Attributes & Current Conditions	Status Quo (not change)	Current Plan	Option A	Option B
Frequency		Every 8 minutes	Every 5 minutes	Every 3 minutes
Average speed of MRT		30 km/hour ≈±43 minute	50 km/hour ≈±31 minutes	50 km/hour ≈±31 minutes
Parking Facilities in all stations		Not provided	Not provided	Not provided
Financial burden for the people	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	650,000/ person or 2,600,000/ family (assumed 4 members/ family)	650,000/ person or 2,600,000/ family (assumed 4 members/ family)
I will use MRT or not change from current condition (check only ONE)	☐	☐	☐	☐

CHOICE CARD III

Select one either Status Quo, Current Plan, Option A or Option B

Attributes & Current Conditions	Status Quo (not change)	Current Plan	Option A	Option B
Frequency		Every 8 minutes	Every 5 minutes	Every 5 minutes
Average speed of MRT		30 km/hour ≈±43 minute	50 km/hour ≈±31 minutes	30 km/hour ≈±43 minutes
Parking Facilities in all stations		Not provided	Not provided	Not provided
Financial burden for the people	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	780,000/ person or 3,120,000/ family (assumed 4 members/ family)	650,000/ person or 2,600,000/ family (assumed 4 members/ family)
I will use MRT or not change from current condition (check only ONE)	☐	☐	☐	☐

IV. Respondent Profile

23. Name: _____

24. Address: _____ 25. City: _____

26. Telephone home/ mobile: _____ 27. Sex: ☐ Male ☐ Female

28. Age: _____ years-old

29. Number of persons living in the same household? _____ persons; (_____adults; _____children)

30. Occupation:
- ☐ Business person or self employed
- ☐ Public servants or organization staff
- ☐ Teacher or staff at school
- ☐ Housewife
- ☐ Part-time job
- ☐ Student
- ☐ Others_____

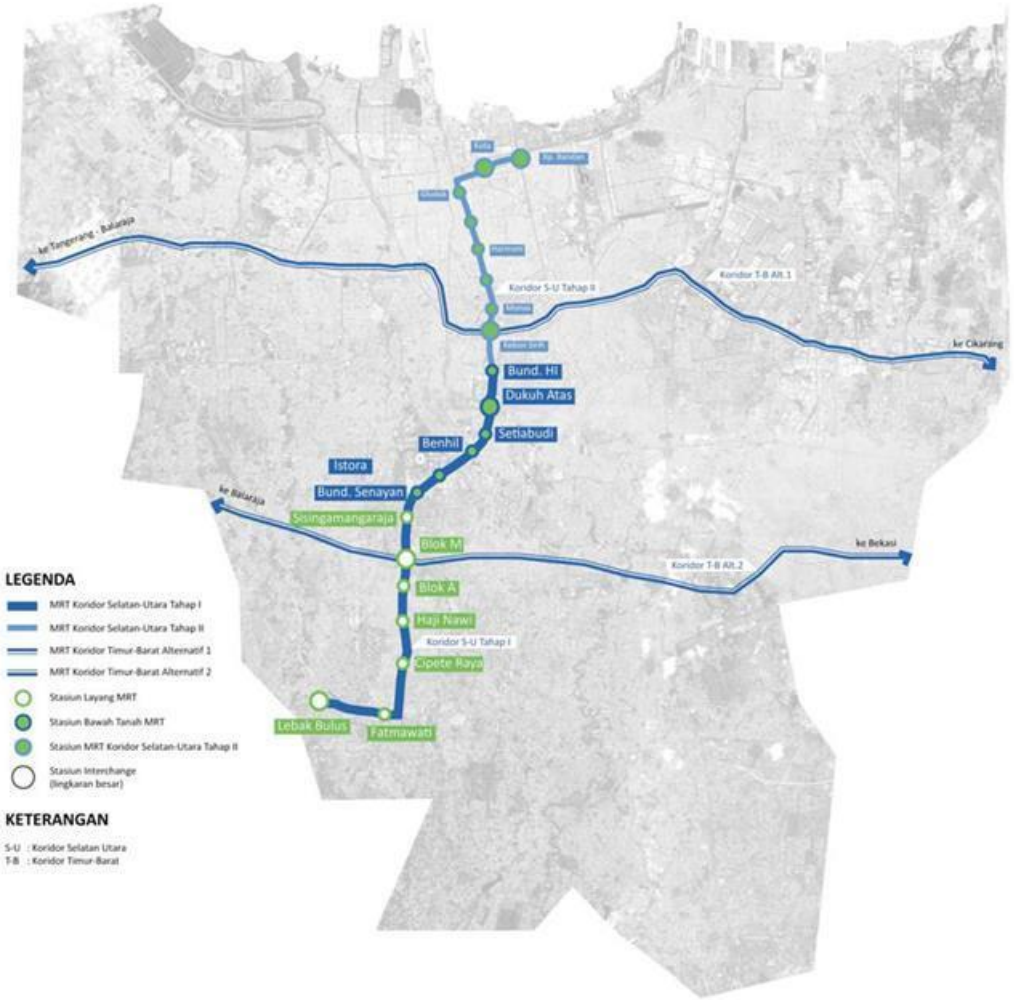
31. Education:
- ☐ Elementary school or less
- ☐ Junior high school
- ☐ Senior high school
- ☐ Vocational school
- ☐ Junior college
- ☐ University
- ☐ Graduate school
- ■ On school (please further choose one sub-category):
  - ☐ Senior high school
  - ☐ Vocational school
  - ☐ Junior college
  - ☐ University
  - ☐ Graduate school

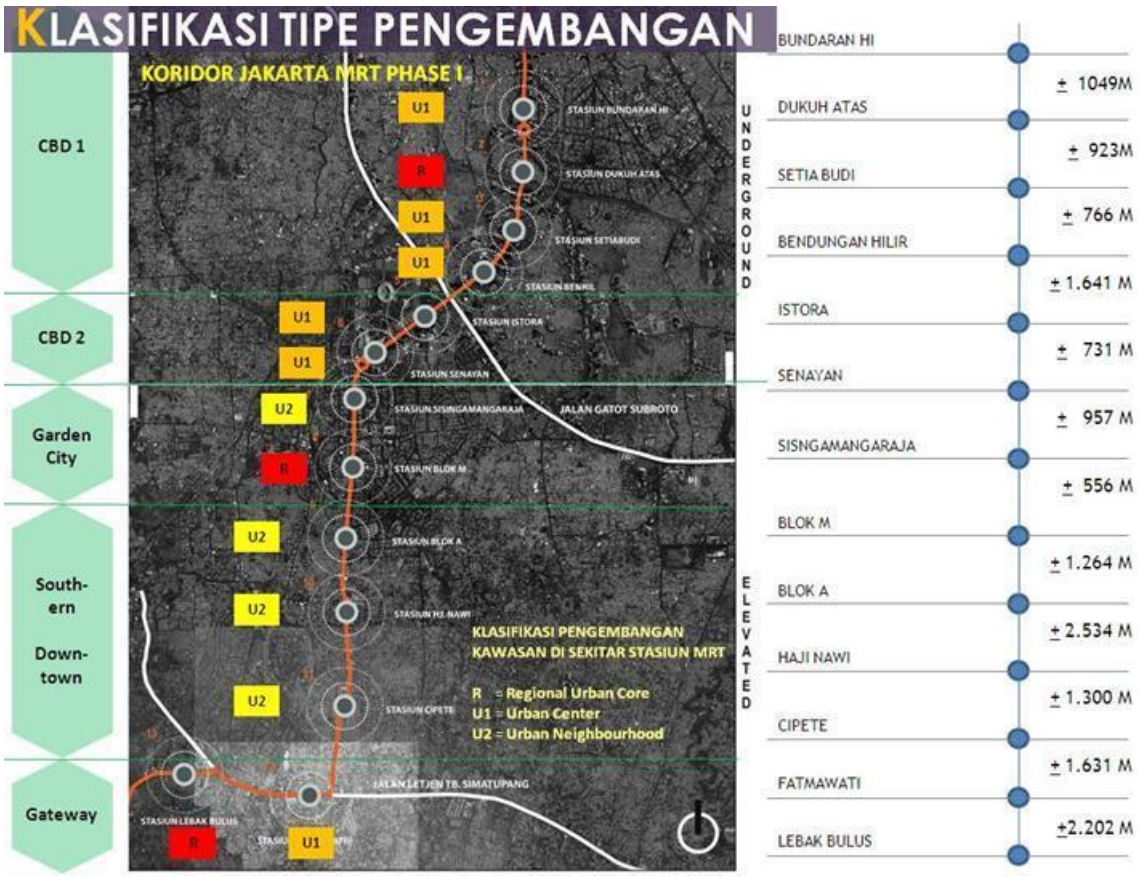
32. Which one of the range could best describe your monthly PERSONAL and HOUSEHOLD income (incomes of all family members):

	a. Monthly Personal Income	b. Monthly Household Income
< 600,000 IDR	☐	☐
600,000 – 999,999 IDR	☐	☐
1,000,000 – 1,999,999 IDR	☐	☐
2,000,000 – 2,999,999 IDR	☐	☐
3,000,000 – 3,999,999 IDR	☐	☐
4,000,000 – 4,999,999 IDR	☐	☐
5,000,000 – 6,999,999 IDR	☐	☐
7,000,000 – 8,999,999 IDR	☐	☐
9,000,000 – 11,999,999 IDR	☐	☐
>= 12,000,000 IDR	☐	☐

33. Please choose one of the ranges that could best describe your average Household Expenditure per month. Including of regularly basic needs and groceries such as food, clothes, electricity, and transportation fee. Excluding of any loans, luxurious goods (TV, Washing machine, etc) and cigarette.

< 600,000 IDR	☐
600,000 – 999,999 IDR	☐
1,000,000 – 1,999,999 IDR	☐
2,000,000 – 2,999,999 IDR	☐
3,000,000 – 3,999,999 IDR	☐
4,000,000 – 4,999,999 IDR	☐
5,000,000 – 6,999,999 IDR	☐
7,000,000 – 8,999,999 IDR	☐
9,000,000 – 11,999,999 IDR	☐
>= 12,000,000 IDR	☐





Questionnaire-8

Appendix 2. Questionnaires of Second Survey

PENGGUNA MOBIL PRIBADI
CA1_____

Name of surveyor: _____
Date of Interview _____
Start time: ____ : ____ end time: ____ : ____

QUESTIONNAIRE

Public Transportation Policies through Changes in People Behavior and Energy Consumption (Case of MRT Development in Jakarta)

Objectives:

1. To provide analytical results of future consumer's behaviors on transportation mode choices if the development of MRT would successfully completed as well as purchasing of motorcycles and passengers cars.
2. To illustrate a new approach to forecast the potential energy savings and environmental impact of promoting public transportation, especially after developing MRT.

Screening:

S3. Do you or anyone in your household work in any following sectors?

Transportation such as working at Ministry of Transportation, Transportation Agency, TransJakarta, PT. KAI, Paratransit/ Angkot, as a driver, and similar companies	1	**TERMINATE**
Company/ Manufacture/ Store of Automotive Products	2	**TERMINATE**
Others/ None of the above	99	

S4. How do you usually commute for working/ schooling? (at least 3 days in a week using the same mode)

By owned car	1	
By owned motorcycle	2	**TERMINATE**
By using public transport (e.g. bus, train, paratransit, etc.)	3	**TERMINATE**
Taxi	4	**TERMINATE**
Motorcycle taxi	5	**TERMINATE**
By bicycle	6	**TERMINATE**
Walking	7	**TERMINATE**
Others/ None of the above	99	**TERMINATE**

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e-mail: hanum_iam@yahoo.com

I. KEINGINAN MENGGUNAKAN MRT

1. As a planed, MRT will be started to operate by end of 2016 and end of 2018 for stage I (Lebak Bulus – Bunderan HI) and for stage II (Bunderan HI – Kampung Bandan) respectively, see the map attached. Based on the current plan, MRT will be integrated with Trans Jakarta (BRT) and Jabodetabek Railway in certain stations such as Sudirman Stations and Blok M stations. Regarding the MRT fare is not decided yet, it can be in the range between 10,000 IDR and 20,000 IDR. However, this fare is still subsidized by government. If there is no subsidy from government, based on the investment and operation cost, the fare must be about 35,000IDR.

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Regarding those conditions, then, we would like to ask questions about your willingness to use MRT once it started. The questions would deliver in some choice sets and each set has different combinations. Consider each set independently of all others.

Please indicate and select you willingness whether want to use MRT or still following current condition from three choice cards below with different combinations.

CHOICE CARD I

Select one either Status Quo, Current Plan, Option A or Option B

Attributes & Current Conditions	Status Quo (not change)	Current Plan	Option A	Option B
Frequency		Every 8 minutes	Every 8 minutes	Every 5 minutes
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Parking availability in all stations		Not available	Not available	Available
Financial burden for the people	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	650,000/ person or 2,600,000/ family (assumed 4 members/ family)	780,000/ person or 3,120,000/ family (assumed 4 members/ family)
I will use MRT or not change from current condition (check only ONE)	☐	☐	☐	☐

CHOICE CARD II

Select one either Status Quo, Current Plan, Option A or Option B

Attributes & Current Conditions	Status Quo (not change)	Current Plan	Option A	Option B
Frequency		Every 8 minutes	Every 5 minutes	Every 3 minutes
Average speed of MRT		30 km/hour ≈±43 minute	50 km/hour ≈±31 minutes	50 km/hour ≈±31 minutes
Parking Facilities in all stations		Not provided	Not provided	Not provided
Financial burden for the people	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	650,000/ person or 2,600,000/ family (assumed 4 members/ family)	650,000/ person or 2,600,000/ family (assumed 4 members/ family)
I will use MRT or not change from current condition (check only ONE)	☐	☐	☐	☐

CHOICE CARD III

Select one either Status Quo, Current Plan, Option A or Option B

Attributes & Current Conditions	Status Quo (not change)	Current Plan	Option A	Option B
Frequency		Every 8 minutes	Every 5 minutes	Every 5 minutes
Average speed of MRT		30 km/hour ≈±43 minute	50 km/hour ≈±31 minutes	30 km/hour ≈±43 minutes
Parking Facilities in all stations		Not provided	Not provided	Not provided
Financial burden for the people	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	520,000/ person or 2,080,000/ family (assumed 4 members/ family)	780,000/ person or 3,120,000/ family (assumed 4 members/ family)	650,000/ person or 2,600,000/ family (assumed 4 members/ family)
I will use MRT or not change from current condition (check only ONE)	☐	☐	☐	☐

II. MODA TRANSPORTASI YANG DIGUNAKAN SAAT INI

2. What is your puose to commute in regular trips?
   - ☐ Working
   - ☐ Going to school
   - ☐ Others, _____
3. The distance from home to daily activity place (office, school, etc.)? _____ km
4. Where is the address of your work/ school location? Street name: _____City: _____
5. a. How far the nearest to access public transport from your home? _____ km _____ m
   b. What kind of public transport?
   - ☐ Paratansit (angkutan kota/ angkot)
   - ☐ Big bus
   - ☐ Shuttle bus, bus school
   - ☐ Minibus (kopaja, metromini)
   - ☐ TransJakarta (busway)
   - ☐ Others _____
6. How many vehicles do you have (in your household) totally?
   - ☐ Car, number: _____ cars
   - ☐ Motorcycle, number: _____ motorcycles
   - ☐ Bicycle, number: _____ bicycles
   - ☐ Others? _____ number? _____
   - ☐ None
7. Do you have driver license?
   a. Car driver's license? ☐ Yes ☐ No
   b. Motorcycle driver's license? ☐ Yes ☐ No
8. Information of the vehicles do you have and mostly used for daily commute:

a.	Model year	
b.	Fuel type (if mixed, please check the both answers)	☐ Premium ☐ Pertamax ☐ Solar
c.	Fuel efficiency (1 liter for how many km)	____ ltr : ____ km
d.	How many person usually ride together (including driver)	Persons
e.	Driving frequency in a week	/week
f.	The distance traveled in the recent one year	km
g.	How long does it take for commuting (total) per day	____hours ____mnt
	1) To go to office/ school/ others	____hours ____mnt
	2) To go home	____hours ____mnt
h.	Parking duration	hours
i.	Cost per week:	
	1) Fuel	IDR
	2) Parking	IDR
	3) Toll road	IDR
	4) Others	IDR

9. a. First time having own car? Year_____
   b. If you have a motorcycle, since when? _____
10. Since when have you used car/motorcycle to go for working or school? _____
11. Is there the transportation mode used change after the increase of fuel price at the end of 2014?
    ☐ Yes → P.12 ☐ No → P.13
12. Before the price of fuel is increased, what kind of transport mode that you use for working/ going to school?
    - ☐ Car
    - ☐ Motorcycle
    - ☐ TransJakarta/ Busway
    - ☐ Jabodetabek Railway
    - ☐ Big Bus
    - ☐ Paratrasnit (angkot)
    - ☐ Minibus/Kopaja/ Metromini
    - ☐ Shuttle bus/ school bus
    - ☐ Taxi
    - ☐ Others, _____

13. For the transport mode used (answer no. 12), how many times do you use in a week?

- ❑ once a week
- ❑ twice a week
- ❑ three times a week
- ❑ Four times a week
- ❑ Five times a week

14. a. How long does it take on average to go to work/school before fuel price increased (last year)?

____ hour _____ minute

b. How long does it take on average to go back home before fuel price increased (last year)?

____ hour _____ minute

15. a. How much the transportation cost that you spent per day (round trip) before fuel price increased (last year)._____

b. How much the transportation cost that you spent per day (round trip) before fuel price increased (now)? Rp. _____

16. What are your three main reasons to have a car? Give rank from 1 to 3

No	Reasons	Ranking for car
a.	Don't like public transport	
b.	Helpful for carrying things	
c.	Take children to school and other activities	
d.	Public transport not available	
e.	Improves status	
f.	Personal freedom	
g.	More comfortable	
h.	Saves time	
i.	Just a habit	
j.	Disability in HH	
k.	Company car	

17. How is the necessary to have car?

- ❑ Totally necessary
- ❑ Quite necessary
- ❑ Not very necessary

18. What are the factors deterrents from driving car? Please give your responses for each question below:

No	Factors	Very much	Quite a lot	Neutral	Not very much	Not at all
a.	Traffic congestion	❑	❑	❑	❑	❑
b.	Parking costs at destination	❑	❑	❑	❑	❑
c.	Parking availability at destination	❑	❑	❑	❑	❑
d.	Unreliability of parking availability	❑	❑	❑	❑	❑
e.	Tunnel cost	❑	❑	❑	❑	❑
f.	Petrol cost	❑	❑	❑	❑	❑
g.	Route unfamiliarity	❑	❑	❑	❑	❑
h.	Stress of driving	❑	❑	❑	❑	❑

19. a. Do you drive by yourself? ❑ Yes → Q.13 ❑ No

b. Who is the driver?

- ❑ Driver paid by office
- ❑ Driver paid by myself
- ❑ Relatives (Husband/ Wife/ Parents/ Kid, Family)
- ❑ Friends
- ❑ Others _____

20. In a week, how many times do you use car/ motorcycle to goto work/school? _____ times
21. If not using the motorcycle or car to commute everyday, what is the alternative commuting travel mode do you use?

☐ Walk or Bicycle	☐ TransJakarta (Busway)	☐ Bus
☐ Train	☐ Taxi	☐ Paratransit (Angkot)
☐ Auto rickshaw (Bajaj)	☐ Ojek (motorcycle taxi)	☐ Other _____

22. If using public transport, how much does it cost totally per day (a round trip)? _____ IDR
23. a. How long does it take on average by public transport to go to work/school?_____hours _____minutes
    b. How long does it take on average by public transport to go home? _____hours _____minutes
24. How to access the public transport?
    - ☐ By walking
    - ☐ By bicycle
    - ☐ Bajaj
    - ☐ Paratransit (angkot)
    - ☐ Motorcycle taxi/ delivered by other families by using motorcycle
    - ☐ Taxi/ delivered by other families by using car
    - ☐ Driving motorcycle and park closed to the stations/ bus stop
    - ☐ Driving car and park closed to the stations/ bus stop
    - ☐ Others, _____

II. WILLINGNESS TO BUY VEHICLES

25. a. For the next twelve months, do you have any attention to buy a car? ☐ Yes →P27 ☐ No
    b. For the next two years, do you have any attention to buy a car? ☐ Yes →P27 ☐ No
    c. For the next three years, do you have any attention to buy a car? ☐ Yes →P27 ☐ No
26. a. For the next twelve months, do you have any attention to buy a motorcycle? ☐ Yes→P27 ☐ No
    b. For the next two years, do you have any attention to buy a motorcycle? ☐ Yes →P27 ☐ No
    c. For the next three years, do you have any attention to buy a motorcycle? ☐ Yes→P27 ☐ No
27. Information of the vehicles do you want to buy (If one of the answers of Q.24 and Q.25 are Yes, please fill out this table, and if all the answers from Q.24 and Q.25 are No, continue to Q.28)

No.	Information	Type of vehicles	
		Car	Motorcycle
a.	Age of vehicle (yo=years old)	☐ New vehicle ☐ <=2 yo ☐ >2 yo - <=5yo ☐ >5yo - <=10 yo ☐ > 10 yo	☐ New vehicle ☐ <=2 yo ☐ >2 yo - <=5yo ☐ >5yo - <=10 yo ☐ > 10 yo
b.	Size (small, medium, large)	☐ Small (4-5 persons) ☐ Medium (6-8 persons) ☐ Large (>8 persons)	
c.	Type of vehicles (Conventional or Electric)	☐ Conventional manual ☐ Conventional matic ☐ Electric	☐ Conventional manual ☐ Conventional matic ☐ Electric
d.	Cylinder Capacity (CC) of vehicles	CC	CC
e.	Price range (IDR)	IDR	IDR

28. How to use your new vehicles? (Multiple answers). Based on the answer of Q.27. If wanting to buy both car and motorcycle, it should be questioned both.

No.	How to use your new vehicle	Car	Motorcycle
a.	For commuting until office/ school/ other routine activities	☐	☐
b.	For commuting until certain stations and then change to use public transport	☐	☐
c.	To deliver kids to go to school	☐	☐
d.	Will be used during weekend or holiday	☐	☐
		☐	☐

e.	For shopping in certain days		
f.	Others	❑	❑

29. Information of the LCGC (Low Cost Green Car) with affordable price

a.	Have you ever seen/ heard/ read any article or promotion or campaign about LCGC?	❑ Yes ❑ No → Q22
b.	How much are you interested with the LCGC?	❑ Very interested ❑ Interested ❑ Neutral ❑ Not interested → Q22 ❑ Not interested at all → Q22
c.	Will you consider this kind of product as one of favorite cars?	❑ Yes ❑ No
d.	Do you have any below activities toward LCGC? d1. Pay attention to the LCGC advertising	❑ Yes ❑ No
	d2.Find out information about LCGC to friends	❑ Yes ❑ No
	d3.Find out information about LCGC to automotive delaers	❑ Yes ❑ No
	d4.Find out information about LCGC through internet	❑ Yes ❑ No
e.	How much the maximum price that you will to pay for the LCGC types?	❑ 50 jt IDR - <70 jt IDR ❑ 70 jt IDR - <80 jt IDR ❑ 80 jt IDR - <90 jt IDR ❑ 90 jt IDR - <100 jt IDR ❑ 100 jt IDR – 120 jt IDR

IV. PROFIL RESPONDEN

30. Name: _____

31. Address: _____ 32. City: _____

33. Telephone home/ mobile: _____34. Sex: ☐ Male ☐ Female

35. Age: _____ years-old

36. Number of persons living in the same household? _____ persons; (_____adults; _____children)

37. Occupation:
- ☐ Business person or self employed
- ☐ Public servants or organization staff
- ☐ Teacher or staff at school
- ☐ Housewife
- ☐ Part-time job
- ☐ Student
- ☐ Others_____

38. Education:
- ☐ Elementary school or less
- ☐ Junior high school
- ☐ Senior high school
- ☐ Vocational school
- ☐ Junior college
- ☐ University
- ☐ Graduate school
- ■ On school (please further choose one sub-category):
  - ☐ Senior high school
  - ☐ Vocational school
  - ☐ Junior college
  - ☐ University
  - ☐ Graduate school

39. Which one of the range could best describe your monthly PERSONAL and HOUSEHOLD income (incomes of all family members):

	a. Monthly Personal Income	b. Monthly Household Income
< 600,000 IDR	☐	☐
600,000 – 999,999 IDR	☐	☐
1,000,000 – 1,999,999 IDR	☐	☐
2,000,000 – 2,999,999 IDR	☐	☐
3,000,000 – 3,999,999 IDR	☐	☐
4,000,000 – 4,999,999 IDR	☐	☐
5,000,000 – 6,999,999 IDR	☐	☐
7,000,000 – 8,999,999 IDR	☐	☐
9,000,000 – 11,999,999 IDR	☐	☐
>= 12,000,000 IDR	☐	☐

40. Please choose one of the ranges that could best describe your average Household Expenditure per month. Including of regularly basic needs and groceries such as food, clothes, electricity, and transportation fee. Excluding of any loans, luxurious goods (TV, Washing machine, etc) and cigarette.

< 600,000 IDR	☐
600,000 – 999,999 IDR	☐
1,000,000 – 1,999,999 IDR	☐
2,000,000 – 2,999,999 IDR	☐
3,000,000 – 3,999,999 IDR	☐
4,000,000 – 4,999,999 IDR	☐
5,000,000 – 6,999,999 IDR	☐
7,000,000 – 8,999,999 IDR	☐
9,000,000 – 11,999,999 IDR	☐
>= 12,000,000 IDR	☐