PUBLIC ACCEPTANCE AND ITS DETERMINANTS TOWARD CONGESTION CHARGING REFORM IN JAKARTA

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PUBLIC ACCEPTANCE AND ITS DETERMINANTS TOWARD CONGESTION CHARGING REFORM IN JAKARTA

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Acknowledgments

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Abstract

Car ownership and car usage have continued rapid growth into the current decade in Jakarta, a capital of Indonesia. As a consequence, the areas of city center are suffering from not only heavy traffic congestion but also unmaintained externalities including travel times, air pollution, additional energy consumption, and even serious economic loss due to the extraordinary growth personal mobility. To counter negative effects of personal mobility in bad traffic congestion in Jakarta, the Government has introduced congestion charging (CC) scheme, and CC remains under consideration as an effective a way to mitigate acute private vehicle-dependence. Despite a well-established rationale for successful implementations of CC to mitigate congestion, these a potential powerful strategy remains a difficult policy to implement, due to the fact that related social and legal issues strongly depend on public acceptability rather than technical matters. Understanding this is crucial to any investigations of what might improve social acceptance for CC strategy, as it aims to design a scheme that it is not only effective in achieving the objective but also acceptable to the public. Given this a crucial issue, the aim of this dissertation focuses on public acceptance and explores the influences of its determinants to the acceptability of CC proposal in Jakarta by developing an econometric methodology to model public acceptance. The outcomes of the developed models aim to provide insights for the Government to implement and provide a more acceptable policy thereby enhancing public support.

As an initial step, **Chapter 2** presents the mechanisms, implementations and barriers of CC policy. It briefly presents an overview related to CC proposal in Jakarta, followed by detailed review for the existing successful CC strategy implementations around the world, their challenges and barriers. Next, **Chapter 3** presents the methodology necessary for empirical data collection. Two data sets are needed in this research, namely person trip (PT) data and stated preference (SP) questionnaire data. The PT data is provided by Japan International Cooperation Agency (JICA) and SP consists of survey data collection within proposed charging area in the city center of Jakarta. After data collection and processing, econometric frameworks are adopted for empirical modeling in this research.

Chapter 4 explores the share of transportation expenditures of households taking into account life stage classifications. The essential household characteristics among life stage categories are taken into consideration. The reason for doing so is under the hypothesis that the CC policy will impose additional monetary expenditures, in particular for commuters having the destination within or the commuting trip passing through to the proposed charging

area. It is presumably that certain income groups are saving the transportation expenditure attributable to their income constraints. Understanding commuter's transportation expenditure and its related factors and components could provide valuable insights into traveler's behavior under the range of CC proposal. The analysis was performed using Stochastic Frontier (SF) model and the concept of production frontier is adopted to estimate transportation expenditure frontier (TEF). TEFs are treated as unobserved production frontier that influences the actual transportation expenditures observed in transportation survey. Utilizing PT data, households which include person commuting to the target area were extracted. TEFs were estimated for each household life stage categories (i.e. single-person; childless-couple; families with pre-school children; families with college/university children; families only with adults) in order to investigate their different constraints. From the comparison analysis, it was shown that considerable differences in the average of TEFs across household categories. Particularly, larger amount of TEFs were identified for single-person and families with adult. Empirical results show that the TEF is influenced by household attributes, life stage categories and life environments.

Further, taking into account the shortcomings of CC that lead to poor public acceptability, **Chapter 5** proposes a parking deposit system (PDS) as an alternative of ordinary road pricing (ORP). This PDS is based on partial or full refunds to automobile users when they enter the charging zone. Refunds are provided only on parking fees or as discounts on purchases within the charging zone; no cash refund is given. The purpose of the PDS scheme was to reduce the number of automobiles entering the city center, but increasing the turnover rate, avoiding a decline in visitors to the city center and eventually increasing social acceptability while raising revenue. Thus, the purpose of this chapter is to conduct a preliminary analysis to investigate and search explanatory variables that influence public perceptions considering Jakarta's citizen's consciousness with respect to the proposals of ORP and PDS. Using SP questionnaire data, a bivariate binary response (BBR) model is formulated to model and investigate public response to ORP and PDS bundles. Results suggest that there is a complementary relationship between approval and consciousness, with PDS offering better improvement for the scheme's acceptance accounts for 77% compared ORP with 69% of public acceptance. Empirical results also underscore the importance of accommodating structural relationship of an endogenous ORP on the PDS acceptance. The results shed new light on the determinants of ORP and PDS acceptance.

Chapter 6 utilizes the framework of hybrid discrete choice (HDC) model to formulate a generalized ordered (GOR) model and uses proposed model to assess the effects of various factors on respondents' choice behavior with respect to a proposed CC policy considering latent variables. Aiming to capture observable preference heterogeneity across ordinal

choices and also capture latent segmentation, an innovative latent class generalized ordered (LCGOR) model is further formulated, allowing the thresholds vary across observations. In this formulation, the thresholds are parameterized as a linear function of the exogenous variables for each class membership (i.e. selfish and altruistic classes). Using SP questionnaire data, a comprehensive set of explanatory variables into four categories: charges, latent variables related to respondent's psychological motivations, mobility attributes and socio-demographic characteristics. As an initial step, latent variables were estimated using multiple-indicators multiple-causes (MIMIC) model. Then GOR and LCGOR models are estimated. The findings of GOR model reveal that the key factors influencing public acceptability include the charge level and respondent's variables such as car dependency, awareness of the problem of cars in society, frequency of visits to the city center and frequency of private mode usage. Further results from the LCGOR model obviously verify the existence of preference heterogeneity across outcomes. Sensitivity analysis confirms that the altruistic class are more sensitive to the scheme's acceptance. Finding further demonstrates that a charging level at 21,000 IDR (the initial government proposal) exceeds 51% share of probability acceptance. This is a substantially high level of acceptance at such a charge level and such a charge would not meet the objective of cutting car dependence. Charging level of 30,000-40,000 IDR, rather than the government's proposal of 21,000 IDR, would best balance acceptability with the desire to reduce car dependency.

In **Chapter 7**, causal paths among psychological determinants and their strength are measured and analyzed along with acceptability of the scheme's proposal from a cross-country perspective. Using similar context of the SP questionnaire data in Jakarta and Nagoya, a framework of hybrid discrete choice (HDC) is used. A multiple-samples multiple-indicators multiple-causes (MS-MIMIC) and binary response model are performed. The findings from analysis with MS-MIMIC model show that a number of psychological determinants provide an explanation for the acceptability of the proposed scheme in both cities. Psychological motivations including "awareness of the city's environment" and "awareness of the problem of cars in society" appear to be the most important direct determinants leading to recognition of the effects of a congestion charging scheme and they are indirect determinants of policy acceptance in both cities. However, the proposed scheme is found to be more "correct and acceptable" in Jakarta. Empirical evidence discloses that Nagoya is more "car dependent" than Jakarta even though congestion is recognized as worse in Jakarta. The effect of the specific measure indicator "trust in government policy" on perception of correct and acceptable policies is investigated, revealing a negative determinant for Nagoya and opposite for Jakarta. This indicates the important role of current government performance for achieving acceptability for these proposals. Moreover, findings

from binary response analysis further suggest that tangible determinants, such as charge scenarios and individual mobility attributes can be a barrier to acceptance in both cities, along with the intangible determinant of "inhibition of freedom of movement" (IFM). On the other hand, the key intangible determinants "recognition of the scheme's effects" (REC) and "trust in government policy" (TGP) might enhance acceptability of the scheme in Jakarta, while TGP may form a considerable barrier in the case of Nagoya.

Finally, **Chapter 8** summarizes research conclusions and provides some recommendations for future research. Empirical findings of this work should provide insight for the government as it is works to design a more acceptable policy by enhancing public acceptance of the CC proposal. This work might be a particular help in the design of a more effective policy for the promotion of a CC scheme in Jakarta. It also may provide general assistance for other big cities in Indonesia in which they are suffering from dependence on private motorized mobility. Furthermore, the econometric models proposed in this work could be used not only in Indonesia, but also other Asian developing countries perspective in order to analyze public acceptance behavior considering local individual consumer information that can be obtained from opinion survey such as SP questionnaire survey.

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Chapter 1

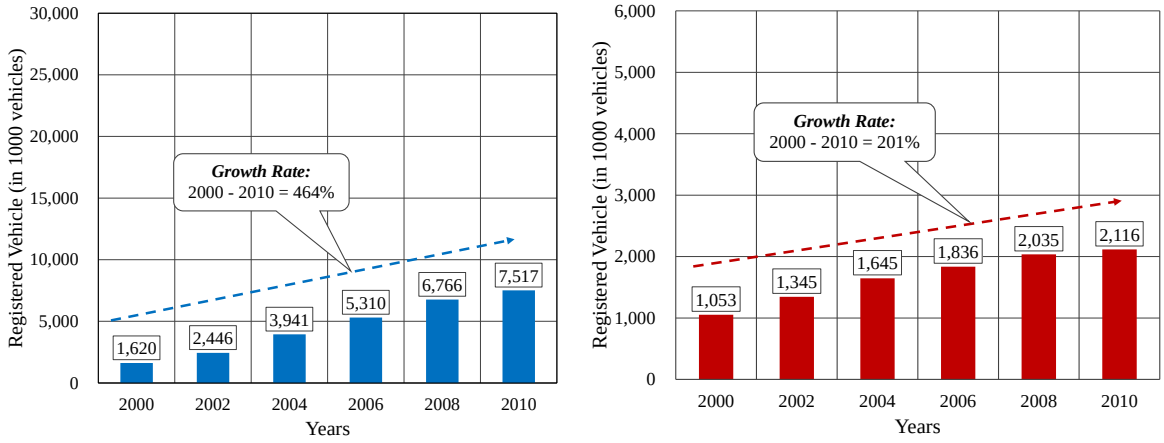
INTRODUCTION

1.1 Background

Jakarta, a capital of Indonesia, is one of the largest metropolitan areas in South Asia region. As with many metropolitan areas in the world, it has been urbanizing rapidly and has undergone substantial changes in recent years. High economic growth has led not only to rapid urbanization, but also to expansion of the metropolitan area as the suburbs absorbed much of the population influx from outside. Jakarta is the country's major population and economic center. The region's share of gross domestic product is estimated to be 19%, amounting to approximately US$ 118.7 billion (BPS, 2010). The population of Jakarta accounts for 10% of the nation's total, and it has increased 1.6 times in 20 years from 17 million in 1990 to 28 million in 2010 (JUTPI, 2012).

As larger scale of metropolitan area, private vehicle ownership and private mode usage have continued rapid growth into the current decades. Consequently, the city centers are suffering from heavy traffic congestion due to the extraordinary growth in private mobility. Accordingly, traffic congestion is substantially the most emerging as a serious hindrance to economic development in Jakarta. In addition to rapid growth of private vehicle ownership, the Jakarta police authority reported 7.5 million and 2.1 million registered motorcycles and passenger cars, respectively, in 2010. This represents an increase of 464% (motorcycles) and 201% (cars) compared to the base year (2000), as illustrated in Figure 1.1(a) and Figure 1.1(b) for motorcycle and car, respectively. The tremendous number of private vehicle ownership results in huge economic losses arising from worsening traffic congestion. To date, the city centers are suffering from unmaintained externalities such as excessive travel times, air pollution, unnecessary energy consumption, and even serious economic loss. SITRAMP (2004) reported that the huge economic losses arising from acute traffic congestion, estimates for 2002 suggest that US$300 million was lost in wasted vehicle operation costs and US$250

million in travel time. Such problems have continuously affected Jakarta particularly badly in recent years.



(a) registered motorcycles (b) registered cars

Figure 1.1 Vehicles registered in Jakarta (Polda Metro Jaya, 2010)

1.1.1 Transportation Profile in Jakarta

In fact, the apparent population of Jakarta is also influenced by the growing number of commuters from surrounding municipalities such as Bogor, Depok, Tanggerang and Bekasi. Commuting trips from peripheral municipalities to Jakarta increased by roughly 1.5 times from 2002 to 2010, as it can be seen in Figure 1.2.

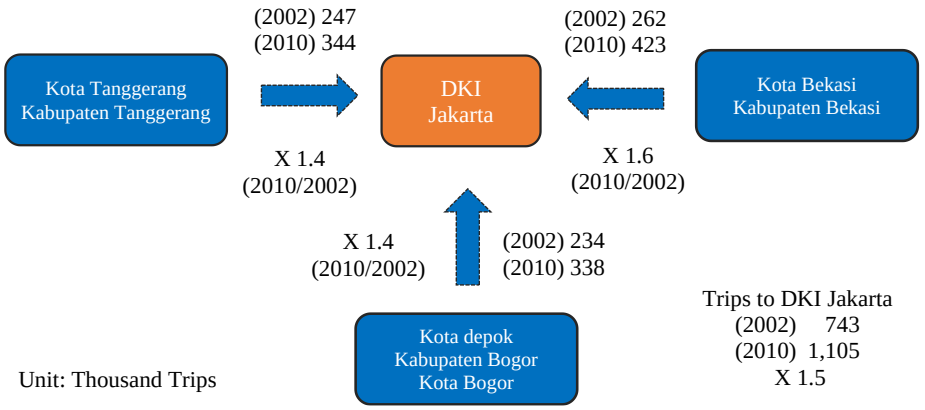


Figure 1.2 Commuting trips from peripheral municipalities to Jakarta (JUTPI, 2012)

A part of increasing number of commuting trips to Jakarta is because commuters prefer to live in surrounding cities due to very high land price in the centre of Jakarta. Furthermore, commuters rely heavily on road transportation, with private vehicles taking a mode share of closely to 80% of share (JUTPI, 2012). According to the results of JUTPI commuter survey in 2010, the number of private mode users increase is about 37% from 2002 to 2010 while

decrease in bus ridership's is accounting up to 33% from 2002 to 2010. These reveal that commuters desire to use private mode, as illustrated in Figure 1.3.

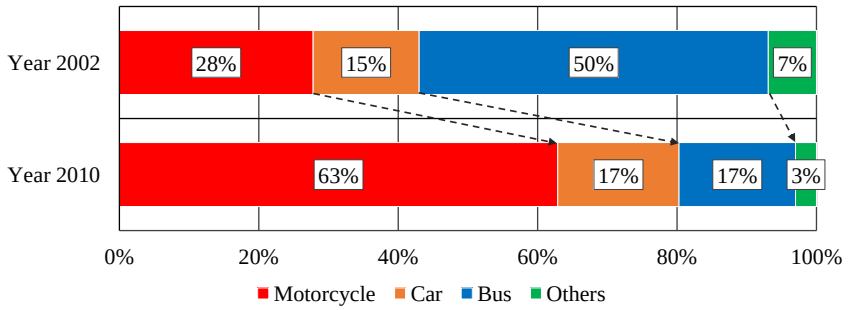


Figure 1.3 Mode share in Jakarta
Source: JUTPI Commuter Survey, 2010

1.1.2 Transportation Demand Management (TDM) in Jakarta

As aforementioned, the growing personal mobility in Jakarta leads to unmaintained externalities. These lead to particular interest in how Jakarta's government might moderate and act strategically to mitigate acute motorization-related problems. With concerning to sustainable transport strategy, Transportation Demand Management (TDM) is one of the most popular approaches, as it is mainly focuses more on the demand-oriented.

It has been long consideration since the TDM strategies was introduced as one of the approaches to reduce traffic congestion in Jakarta. In 1978, toll road system was introduced as a form of the congestion charging. Toll road was built to connect Jakarta with its neighboring municipalities. Since then, more toll roads were built for not only inter-inner urban but also the Jakarta outer ring road (JORR). With respect to public transport, the first 12.9 km corridor of bus rapid transit (Trans Jakarta BRT) began operating on January 2004. In the first year of operation (2004), 15.9 million passengers travelled by this system. It is approximately 44,000 passengers per day or 3,600 persons/hour/two directions (Prayudyanto *et al*., 2013). Thereafter, the number of BRT's corridors keep increasing, there are 12 corridors under operation in the city centers in 2014. In addition to BRT, rail-based mass rapid transit (Jakarta MRT) is planned to stretch over ±110.8 km in the main corridors of city centers. It consist of South - North Corridor (±23.8 km) and East - West Corridor (±87 km). The South-North Corridor that stretches along Lebak Bulus - Kampung Bandan is under construction and expected to be operated by 2018 (Jakarta MRT, 2015).

Another form of TDM strategy is a high occupancy vehicle (HOV) implemented in April 1992 as known as 3-in-1 HOV policy. The policy of 3-in-1 HOV is operated till recent days. The 3-in-1 HOV is a traffic restraint policy implemented on the city's most heavily trafficked corridor from 6.30 to 10.00 am and 4.30 to 7.00 pm within weekdays. During restricted period, only

vehicles with more than three passengers are permitted to enter city center corridors. Furthermore, Prayudyanto *et al*., (2013) reported that within three months after the policy has been applied. It showed a drop of 24 percent in the number of private cars entering the zone, and elevates about 150 percent in the average travel speed by private cars. However, within a decade, a rapid traffic growth has been increased dramatically in Jakarta, the 3-in-1 HOV policy has had insufficient effect in alleviating traffic congestion (JUTPI, 2012).

The 3-in-1 HOV policy was inefficient in mitigating congestion in city centers because traffic growth. Moreover, in fact, observation of the currently operating 3-in-1 HOV policy shows that a practice has emerged of youths offering to pay a small fee to ride as passengers (called "jockeys"), thereby allowing drivers to meet their occupancy requirements. In most cases, a single occupant vehicle (SOV) requires two "jockeys" to reach the requirement of three occupants in the car. For the agreement to work, a driver needs to pay IDR 10,000 to 15,000 (12,000 IDR ≅ 1 USD ≅ 100 JPY) per jockey in advance before entering the 3-in-1 HOV zone. Furthermore, SITRAMP (2004) reported that several shortcomings on implementation of the 3-in-1 HOV policy including lack of monitoring and controlling, increase of traffic demand on the parallel streets, the existence of temporary passengers (jockeys) and cost is incurred by the traffic police for enforcement while no revenue from the system.

1.2 Problem Statement

In spite of integrated TDM projects such as the Jakarta outer ring road (JORR), bus rapid transit (BRT) and the 3-in-1 HOV system implemented by Jakarta's government, congestion has increased and affected Jakarta particularly badly in recent decades, as extraordinary growth in motorization has taken place.

To deal with acutely car ownership and car usage problems, the government of Jakarta planned to implement CC policy. It is argued by the government that CC is one of the most promising strategies to reduce acute private vehicle dependence in Jakarta. The initial implementation of CC policy is planned to replace the existing 3-in-1 HOV, which has had insufficient effect in alleviating traffic congestion (JUTPI, 2012). Several efforts have been made by the government in terms of institutional and legal issues. For instance, the application of the CC proposal has been indicated on road traffic and transport government regulation (the Act No. 22 of 2009) and on traffic management, impact analysis and TDM (the government regulation No. 32 year 2011). However, to date, this potential powerful policy has not been implemented due to government regulation in terms of operational standards and regulatory mechanisms have not been defined. Furthermore, this proposal remains under consideration as an effective way to mitigate acute traffic congestion in Jakarta.

Despite of well-established rationale that CC strategy is able to combat acute auto traffic, for instances, CC scheme implementations in Singapore, London and Stockholm have successfully mitigated traffic jams (Phang *et al*., 1997; Olszewski *et al*., 2006; Eliasson *et al*., 2006; Loukopulos *et al*., 2006). For instance, implementation CC in London enabled to cut down car traffic up to 15–20% (TfL, 2004). Following this traffic reduction, there are several beneficial impacts such as improving safety (Green *et al.,* 2014) and enhancing public transport ridership (TfL, 2004; Leape, 2006). However, in the same time this policy remains difficult to implement. Public is skeptical in general about accepting such policy, significant opposition arises particularly among commuters who drive car. Several CC proposals have been dropped for lack of public support, such as a proposal in Edinburgh (Gaunt *et al*., 2007) and one in New York City (Schaller, 2010). In case of Edinburg and Manchester, the public glare of referenda were rejected charging proposals by majorities 70% to 80%. Furthermore, the extension of CC in London has also been abolished due to local opposition including genuine concern about effects on businesses in more suburban areas (Wilson, 2013). These exhibit that there are serious barriers to the pursuit of transport charging, and that the governments need clear guidance to make better use of this powerful policy.

The major challenge of the implementation of CC policy is to design a CC scheme that is both acceptable to the public and effective in achieving the objective of more sustainable mobility. This matter has been frequently discussed and debated for many decades around the world. However, the CC policy occasionally has been implemented since the institutional barriers and public acceptability are considered to be crucial matters. It is the most important to understand what might improve the public's acceptance for such a scheme. It is necessary to know how citizens or users will evaluate a CC policy and then respond to it by investigating their preferences. Furthermore, this is affected by whether they will receive benefits from the scheme or, rather, find their private mobility affected. Therefore, understanding this is a crucial to any investigations of what might improve social acceptance for CC strategy, as it aims to design a scheme that both effective in achieving the objective and acceptable to the public.

1.3 Objectives

Following aforementioned problem statement, therefore, the aim of this study focuses on public acceptance and explores the influences of its determinants to the acceptability of CC proposal in Jakarta by developing an econometric methodology to model public acceptance. The outcomes of the developed models aim to provide insights for the Government to implement and provide a more acceptable policy thereby enhancing public support. The findings of this study are expected to contribute for preparing CC implementation in Jakarta in particular to help in the design CC policy to be more effective and acceptable scheme. Furthermore, since there are a number of metropolitan cities in Indonesia besides Jakarta

which are also experiencing acute traffic congestion, this research could further contribute to elucidation of congestion through application of CC strategy in other Indonesian cities. Eventually, it is also further wanted that this study could contribute to the knowledge development of the CC policy, specifically for the preparation of implementation of CC in developing countries contexts.

1.4 Research Outline

The first step after understanding the background, problem statement and noticeably identifying the objectives of this study (**Chapter 1**), in **Chapter 2** presents the mechanisms, implementations and barriers of CC policy. It briefly presents an overview related to CC proposal in Jakarta, followed by detailed review for the existing successful CC strategy implementations around the world, their challenges and barriers. Next, **Chapter 3** presents the methodology necessary for empirical data collection. Two data sets are needed in this research including person trip (PT) data and stated preference (SP) questionnaire data. The PT data is provided by Japan International Cooperation Agency (JICA) and (SP) questionnaire consists of survey data collection within proposed charging area in the city center of Jakarta. Additionally, SP questionnaire data from Nagoya is also utilized for comparative analysis between Jakarta and Nagoya. After data collection and processing, econometric frameworks are adopted for empirical modeling in this research.

As initial step of analysis, **Chapter 4** explores the share of transportation expenditures of households considering household life stage classifications. The essential household characteristics among life stage categories are taken into consideration for explanatories model. The reason for doing so is made under the hypothesis that the CC policy will impose additional monetary expenditures, in particular for commuters having the destination within or the commuting trip passing through to the proposed charging area. It is presumably that certain income groups are saving the transportation expenditure attributable to their income constraints. Understanding commuter's transportation expenditure and its related factors and components could provide valuable insights into traveler's behavior under the range of CC proposal. The analysis was performed using Stochastic Frontier (SF) model and the concept of production frontier is adopted to estimate transportation expenditure frontier (TEF). TEFs are treated as unobserved production frontier that influences the actual transportation expenditures observed in transportation survey. Utilizing PT data, households which include person commuting to the target area were extracted. TEFs were estimated for each household

life stage categories (i.e. single-person; childless-couple; families with pre-school children; families with college/university children; families only with adults) in order to investigate their different constraints.

In **Chapter 5**, taking into account the shortcomings of CC that lead to poor public acceptability, a parking deposit system (PDS) is proposed as an alternative of ordinary road pricing (ORP). This PDS is based on partial or full refunds to automobile users when they enter the charging zone. Refunds are provided only on parking fees or as discounts on purchases within the charging zone; no cash refund is given. The purpose of the PDS scheme was to reduce the number of automobiles entering the city center, but increasing the turnover rate, avoiding a decline in visitors to the city center and eventually increasing social acceptability while raising revenue. Thus, the purpose of this chapter is to conduct a preliminary analysis to investigate and search explanatory variables that influence public perceptions considering Jakarta's citizen's consciousness with respect to the proposals of ORP and PDS. Using SP questionnaire data, a bivariate binary response (BBR) model is formulated to model and preliminary investigate public response to ORP and PDS bundles.

Chapter 6 utilizes the framework of hybrid discrete choice (HDC) model to formulate generalized ordered (GOR) model and uses proposed model to assess the effects of various factors on respondents' choice behavior with respect to a proposed CC policy by inclusion latent variables into discrete choice analysis. Aiming to capture observable preference heterogeneity across ordinal choices and also capture latent segmentation, an innovative latent class generalized ordered (LCGOR) model is further formulated in order to allow the thresholds vary across observations. In LCGOR model formulation, the thresholds are parameterized as a linear function of the exogenous variables for each class membership (i.e. selfish and altruistic classes). Initially, using SP data, latent variables are estimated utilizing the framework of multiple-indicators multiple-causes (MIMIC) model. Then, a comprehensive set of explanatory variables (i.e. charges, latent, mobility attributes and socio-demographic characteristics) are incorporated into the discrete choice analysis using framework of GOR and LCGOR models.

Chapter 7 aims primarily to investigate determinants for the acceptability of the CC proposals between Indonesia and Japan. Comparative study is conducted using similar content of

comprehensive SP questionnaire data that were collected in Jakarta and Nagoya. Causal paths among psychological determinants and their strength are measured and analyzed along with acceptability of the scheme's proposal from a cross-country perspective. Using similar context of the SP questionnaire from both countries, a multiple-samples multiple-indicators multiple-causes (MS-MIMIC) approach is utilized to examine the effects of respondents' socio-demographic attributes (causes) on the latent constructs in order to achieve better understanding of the relationship among respondents' intentions and the observed individual's perception (indicators). The discrete choice analysis is further conducted to confirm the influences of the latent constructs, combining them with charge patterns, socio-demographics and daily mobility attributes to investigate significant differences in acceptance determinants among Jakarta and Nagoya.

Finally, **Chapter 8** summarizes research conclusions and provides some recommendations for future research. Empirical findings of this work should provide insight for the government as it is works to design a more acceptable policy by enhancing public acceptance of the CC proposal. This work might be a particular help in the design of a more effective policy for the promotion of a CC scheme in Jakarta. Furthermore, the econometric models proposed in this work could be used not only in Indonesia, but also other Asian developing countries perspective in order to analyze public acceptance considering local individual consumer information that can be obtained from opinion survey such as SP questionnaire survey. Research framework of this study is illustrated in Figure 1.4. The main content of this dissertation is empirical studies which are showing in Chapter 4 to Chapter 7. Shortly, the necessity (relationship) among chapters is explained as follow. Chapter 4 has relationship to chapter 6, and chapter 5 has also correlation with chapter 6. Chapter 4 analyses the relationship between expenditure for transportation and household types while chapter 5 searches explanatory power of public acceptance considering artificial binary vote among ORP and PDS taking into account tangible and intangible variables. Further, the variable of transport expenditure, strong determinants of tangible and intangible variables obtained in chapter 5 are then comprehensively analyzed in chapter 6 using HDC model to explore public acceptance and its influencing factors. Suppose that individual's psychological intentions (intangible variables) may often culture-dependent and differ across countries. Therefore, significant contributing psychological factors acquired from chapter 6 are then further investigated from cross-country perspectives in Chapter 7.

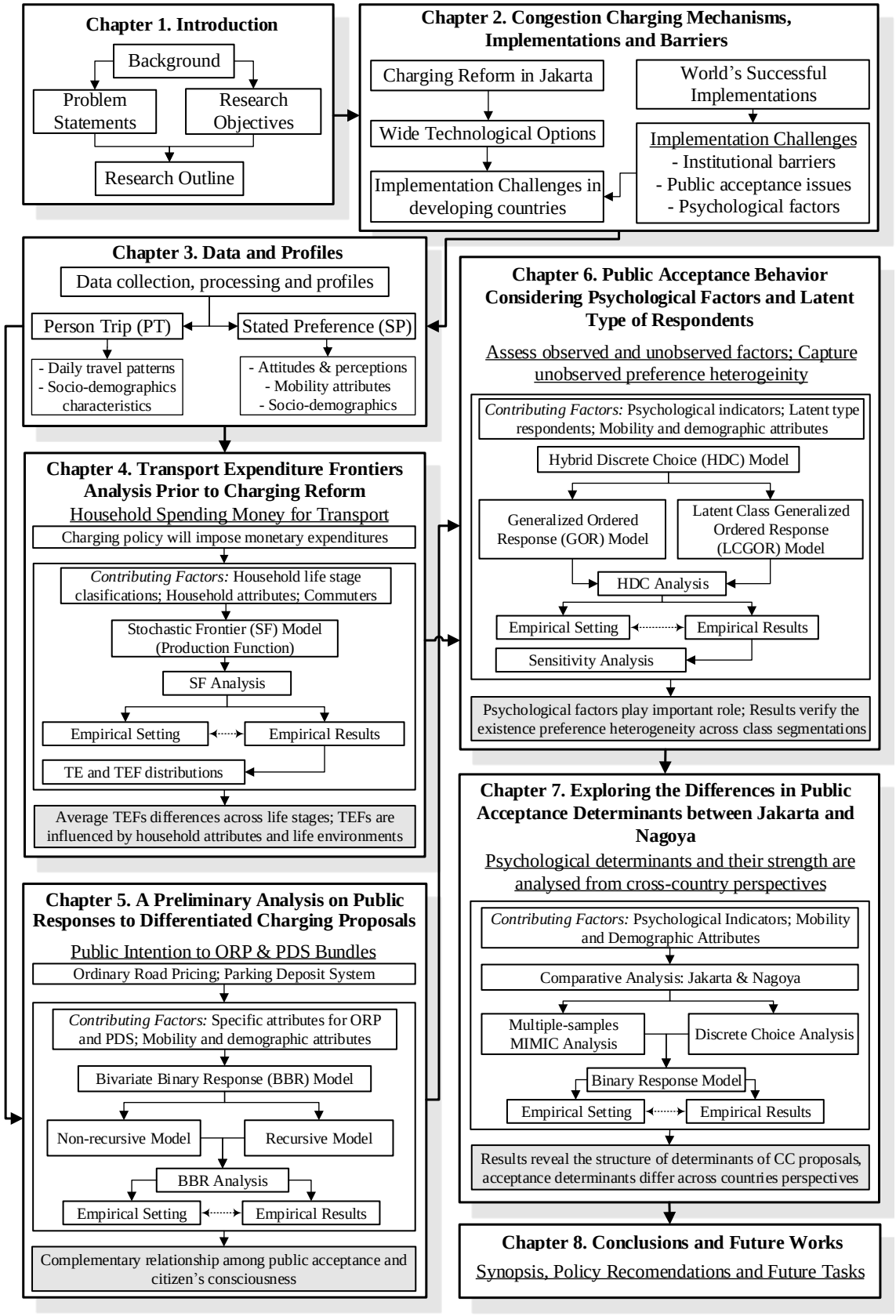


Figure 1.4 Research framework

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Chapter 2

CONGESTION CHARGING MECHANISMS, IMPLEMETATIONS AND BARRIERS

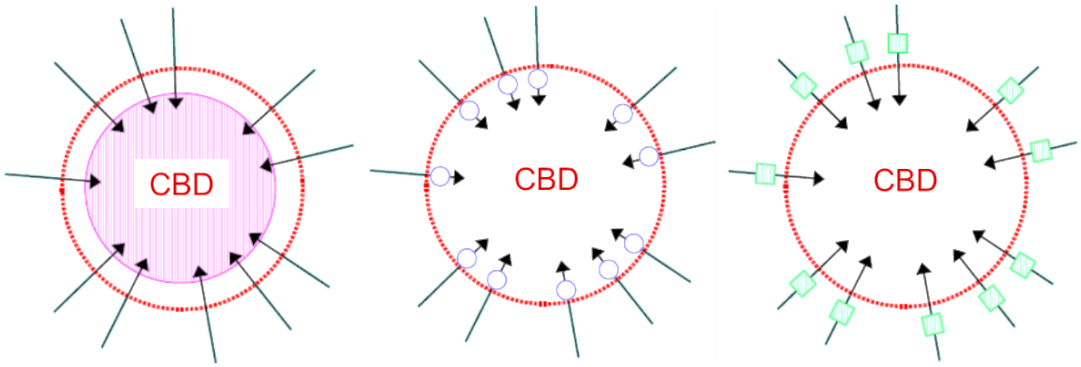
2.1 Charging Reforms in Jakarta

2.1.1 Charging Methods

Chapter 1 mentioned that the TDM policy particularly the CC strategy has been introduced and remain under consideration as a way to reduce private motorized traffic. Generally speaking, in terms of technical issues, CC policy is strongly related to the availability of technological options in order to collect charging tax appropriately. So far, two charging collection system have been successfully utilized along with CC policy implementation across the world. That is, a manual and mechanical methods. A manual method was used in early implementation CC in Singapore as known as Area Licensing Scheme (ALS). This system used displayed sticker for car entering charging zone. A mechanical method has two main approaches: one is based on camera-surveillance system (London's method) and the other is based on electronic road pricing (ERP) system (Singapore's method). The London's method requires a comprehensive electronic registered vehicles database. Unfortunately, a comprehensive electronic registered vehicles database in Jakarta and surrounding municipalities have not been established and integrated. Therefore, for Singapore's method has been considered by Government for technological option in Jakarta. Additionally, the CC scheme in Jakarta, Government has been proposed three strategies (SITRAM, 2004), as it is mentioned below:

1. Trunk roads (vehicles entering the existing 3-1n-1 area are charged).
2. Cordon charging (vehicles entering TDM area are charged).
3. Area charging (vehicles passing/driving TDM area are charged).

Trunk system will be considered for initial step of CC implementation in Jakarta. Cordon charging and Area charging techniques have been prepared for upgrading trunk system as alternatives of the scheme if trunk system does not satisfy in mitigating private motorized-dependence in Jakarta.



(a) Complete Area Charging (b) HOV + Cordon Charging (c) Cordon Charging

Figure 2.1 Alternatives of charging techniques (SITRAMP, 2004)

Table 2.1 Strength and weakness of proposed charging alternatives

Alternatives	Strength	Weakness
ALT 1: Complete Area Charging	- Reduce SOV (promote HOV indirectly) - People can share a car (fee) if necessary - People have a chance of solo-drive. - Equity among residents (inside and outside) - Encourage people to use public modes	- Allocation of policemen (running cost) - Strong opposition by the public (needs to raise public awareness of public transportation)
ALT 2: Preferential HOV + Cordon Charging	- Reduce SOV (promote HOV directly) - Encourage people to use public modes. - Strong opposition by the public (but people can avoid payment if they can always arrange HOV)	- Raise land price inside TDM area - SOV restriction may not contribute to public transportation - Violation of the rule (jockeys) - Allocation of policemen (running cost)
ALT 3: Cordon Charging	- Violation is avoided by physical gates - No policemen allocation necessary - Encourage people to use public modes	- Raise land price inside TDM area - Additional infrastructure (gates, ERP) is necessary - Traffic congestion if toll is collected manually at the gate - Allocation of toll collectors (running cost)

Source: SITRAMP (2004).

The Government through SITRAMP (2004) report has proposed three alternatives of the CC scheme for updating trunk/road system as it is shown in Figure 2.1, and summarized the strength and weakness amongst alternatives in Table 2.1. The most comprehensive alternative

is complete area charging. Meaning that all vehicle passing or driving within proposed charging area are charged. There no single vehicle has a change to avoid payment of charging either from inside or outside charging area. It looks the fair policy in terms of equity among residents living inside and outside charging area. However, preferential treatment is necessary for those who stay inside charging zone, for example discount rate. It because of they have to use routes within the charging area for their routine travels.

The second alternative is preferential HOV + cordon charging. Only a single occupant vehicle (SOV) entering area of cordon is charged. These strategy leads to a negative impact. It is predicted that there will be more car users because of allowing HOV enter CBD with free charge. If this strategy will not be efficient because of increasing HOVs entering charging zone, then the alternative of cordon charging is should be considered. In this alternative, charge is applied for all car users including SOV and HOV entering area of cordon.

In sum of three alternatives aforementioned, complete area pricing may be difficult to implement considering public acceptance particularly from resident within charging zone. Conversely, cordon pricing may also cause inequity issues between residents outside and inside charging area. In this regards, the Government attention has been paid to the fact that the CC policy may likely better to start with trunk/road charging, as a replacement and expansion of the current 3-in-1 policy. To deal with rapidly growing private mobility, for further development of trunk/road system, the second alternative (preferential HOV + cordon charging) may worth to consider.

2.1.2 Monitoring Systems

Two configuration systems have been utilized for monitoring and collecting CC tax: a manual and mechanical systems. A manual system formerly has been implemented in Singapore in 1975. According to Phang & Toh (1975) the ALS system was implemented and designed as a restricted zone during morning peak hour (7:30 to 9:30am) from Monday to Saturday. Under this system, car usage requires to pre-purchase and display a sticker of area license which is available at sale' outlets nearby approach roads. Inspectors are stationed at the gantry locations to observe whether passing vehicles display valid stickers, and violating drivers are fined by the inspectors. This manual surveillance system can be effective to keep car traffic within manageable levels. Unfortunately, if number of cars entering charging zone is too large, it is cumbersome, labor-intensive and inflexible.

To overcome the weakness of ALS system due to high car usage in Jakarta, a mechanical monitoring system is considered by government of Jakarta. However, there are two mechanical configurations have been successfully implemented, namely London's and Singapore's method. A London's method utilizes a camera-surveillance system that required

comprehensive electronic registered vehicles database. Unfortunately, a comprehensive electronic registered vehicles database in Jakarta and surrounding municipalities have not been established and integrated. Therefore, Singapore's method has been considered by Government for technological option in Jakarta. That is, an electronic road pricing (ERP), according to Phang & Toh (1975) and Christainsen (2006) under this system, car's drivers will be more aware of the true cost of driving. Charge will be applied on the number of entering basis, the more they will enter charging zone, the more charge will be paid. Thus, applying this system, car usage could be encouraged to choose their preferences either keep driving shift to public transport for entering city centers.

A configuration of ERP system has three components: an in-vehicle unit (IU), a gantry station and a central computer system (CCS). The IU is an electronic device installed in vehicle, with its function to accept an integrated circuit (IC) card. The IU deducts the appropriate ERP charges from the IC card each time the vehicle passes through gantry points. The license plates are read by the gantry's cameras and sent an information to CCS for automatically debiting a charge from IC card's balance. The license plate of vehicles making illegal entries of cars, for those without an IU and an IC card, or with an insufficient balance on the IC card, will be photographed by the gantry's cameras for subsequent enforcement actions. Systematically, ERP system operation is exhibited in Figure 2.2.

Figure 2.2 Operation of ERP system
Source: Land Transport & Authority of Singapore, (2015).

Although it is preferable to adopted ERP system in Jakarta, the charging area is not a closed area. Therefore a manual toll collection gates or manual checkpoints are also necessary to consider at some major entry points.

2.2 Wide Technological Options

Generally speaking, the implementation of CC policy requires a variety of technologies in order to achieve flexibility of scheme's implementations. According to Blythe (2005) several

technological options have been considered and utilized for CC applications. The most important technological option are described as following sub sections.

2.2.1 Dedicated Short-range Communications (DSRC)

The DSRC is for two-way communications between a gantry's beacon and on-board unit (OBU) or transponders. The system requires mounted communication beacon and enforcement camera on a gantry (see Figure 2.3), with OBUs in the vehicles that may be read-only, read–write or IC card-based. Read-only tags comprise a static identification code that, interrogated by a road-side analysis device at the point of charging, and transfers this identity to the roadside system (Blythe, 2005).

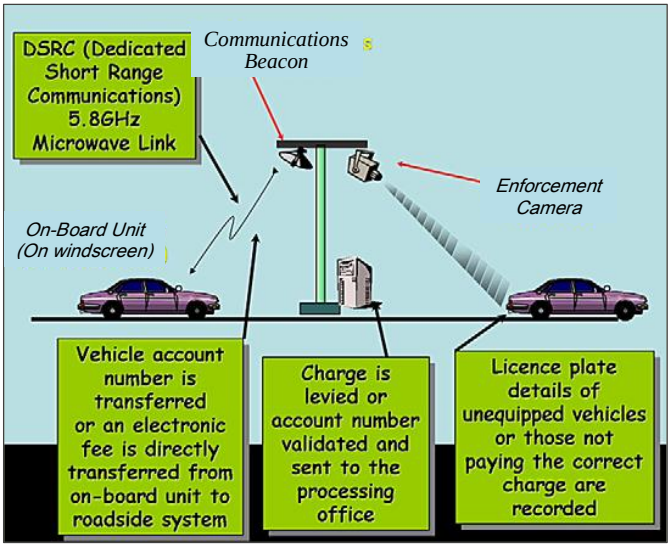


Figure 2.3 Schematic for the DSRC transponder-based system (Blythe, 2005)

2.2.2 Wide-area Communications-based (WACB).

This system uses global position system (GPS) satellites instead of communication beacon in DSRC system. A GPS is coupled with communication systems to manage and enforce the charging. This system uses combination among GPS system and cellular radio communications. The system mutually adopts two components, namely GPS based on satellites to determine vehicle location and two-way communications. Two-way communication link is based on either global system for mobile (GSM) or DSRC system. Systematically, the OBUs contain a GPS receiver, which contains a record of the locations of all charging points either pre-stored or downloaded directly via the unit's communication link. Within a charging cordon, the system will deduct the appropriate charge from the credit-units stored in its account. Schematically, WACB system is depicted in Figure 2.4.

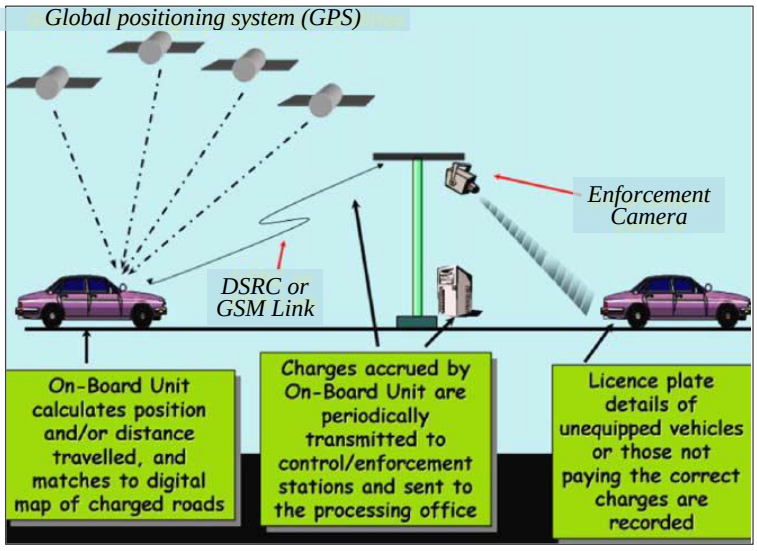


Figure 2.4 Schematic for the WACB system (Blythe, 2005)

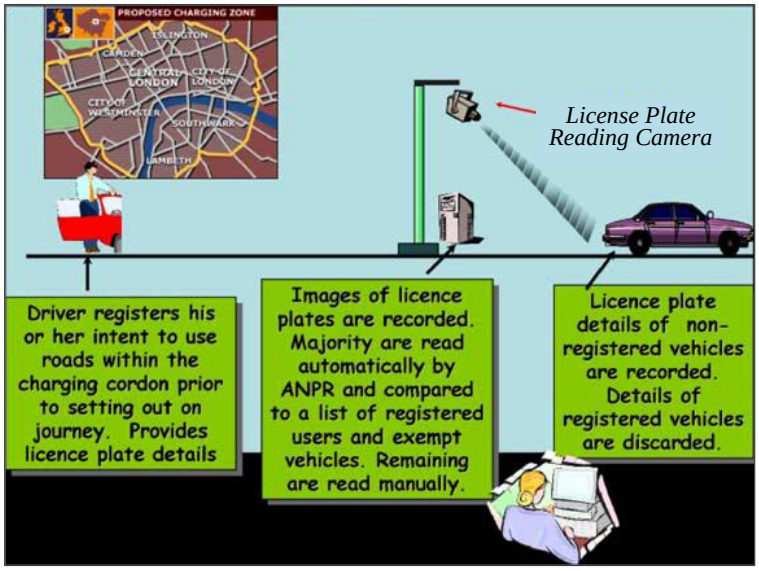


Figure 2.5 Schematic for the VLR system (Blythe, 2005)

2.2.3 Video-based License-plate Recognition (VLR)

According to Blythe (2005) automatic optical character recognition (OCR) software is used in VLR system. Cameras installed along roadside is utilized to capture licence plate of vehicles. Automatic number plate recognition (ANPR) systems process the image of video taken by roadside/gantry cameras. Then, the license plate number in the video image converts to the alphabetic (numerical characters). Schematically, the whole processes of VLPC system is depicted in Figure 2.5. The noteworthy benefit of VLPC system is that it eliminates the necessity for any in-vehicle equipment to be installed.

2.3 World's Successful Implementations

It is well-recognized that implementation of CC strategy in Singapore, London and Stockholm have successfully mitigated traffic congestion across those cities (Phang *et al*., 1997; Olszewski and Xie, 2006; Eliasson and Mattsson, 2006; Loukopulos *et al*., 2006). However, the successful of CC implementation also depends on the appropriateness in selecting scale of CC strategy. A Victoria Transport Policy Institute (VTPI, 2015) has distinguished scales of CC policy into five categories:

1. *Point*: pricing a particular point in the road network, such as a bridge or a tunnel.
2. *Facility*: pricing a roadway section.
3. *Corridor*: pricing all roadways in a corridor.
4. *Cordon*: pricing all roads in an area, such as a central business district.
5. *Regional*: pricing roadways at regional centers or throughout a region.

Further, the VTPI (2015) recommends the appropriate scale for various pricing strategies as described in Table 2.2.

Table 2.2 Appropriate scale of pricing strategies

Strategy	Spot	Facility	Corridor	Cordon	Regional
Toll Roads (fixed rates)	X	X	X		
Congestion Pricing (time-variable)	X	X	X	X	
HOT lanes	X	X			
Cordon Fees			X	X	
Distance-Based Fees					X

Source: VTPI (2015)

Table 2.2 shows congestion pricing is the most flexible strategy that can be considered for spot, facility corridor and cordon scale. This strategy has been practiced in many cities around the globe, including Singapore, London, Durham, Stockholm, New York, California, Valletta and Malta. However, policy implementations in Singapore, London and Stockholm are the most successfully implemented CC scheme among those cities (Pike, 2010).

2.3.1 Implementation in Singapore

A Singapore is the pioneer in implementing CC policy. It was in 1975, paper based system of daily licenses or Area Licensing Scheme (ALS) for car's users entering restriction zone during peak periods. According to Phang & Toh (1975), at early implementation of ALS, traffic entering the restricted zone dropped by 44 percent while travel speeds increased from 11 mph to 21 mph. However, more than a decade later, vehicle ownership has been increased 77 percent (Keong, 2002) and consequently the ALS system overhauled. Since 1998, the ALS system upgraded to ERP system by installing IU devices into vehicles. Furthermore, the

implementation cameras on gantries captured vehicle which do not have sufficient balance of IC card inside IU, or photographed vehicles without installing IU devices. The gantries are installed within a city center of Singapore as shown in Figure 2.6. Moreover, as for drivers who violate the system are fined and requested to pay through the online system.

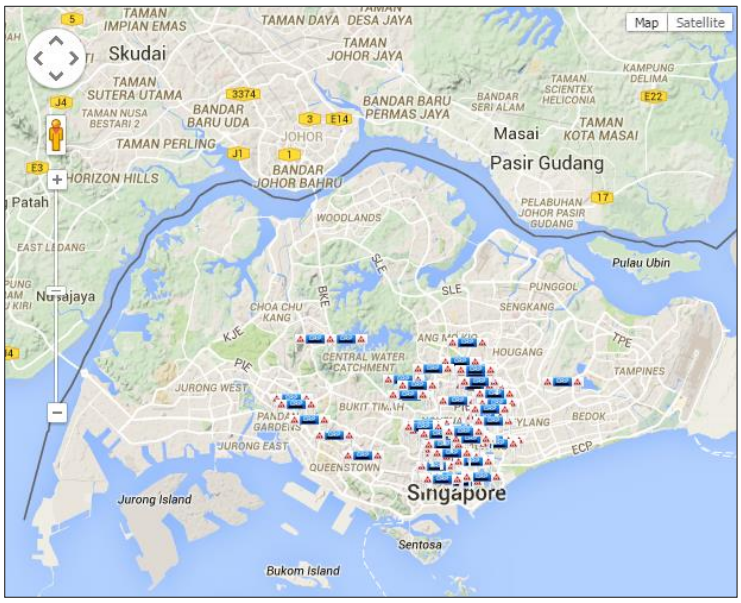


Figure 2.6 ERP gantry's locations in Singapore
Source: Land Transport & Authority of Singapore, (2015)

According to Goh (2002) the charges differ for each vehicles depending on size of vehicles, time of entering and location of gantries. Every three months charges are re-determined considering traffic levels during three months observation. Since 2008, it is an official policy to adjust fee rates at each of the 70 charging points in order to guarantee smooth traffic which target speeds at 85% reliability. For instance, if mean travel speed is below 45 km/h (observed) or above 65 km/h (observed), the rates are considerably need to adjust to be increased or decreased, respectively (Pike, 2010).

2.3.2 Implementation in London, United Kingdom

The London's charging system was initially implemented in a high congested area of 21 km^2, which is surrounded by 200,000 residents (Pike, 2010). Since there was public support for the system, with western area extension, the charging zone became doubled in 2007. The London system uses camera surveillance system or automated number plate recognition (ANPR), with overhead cameras are installed across charging cordon to capture license plates. Several payment systems are provided include online, text messaging, phone and retails.

CC policy has been implemented in London since 2003, with the strong support from the Mayor Ken Livingston (Leape, 2006). It was formerly based on the report entitled "Review of

Charging Options for London" in the year of 2000 which recommended two strategies to deal with the traffic congestion: 1) area license scheme based on camera surveillance enforcement; 2) work-place parking tax. The first strategy was chosen by Major Livingston after approximately 18 months of public consultation period. It was decided based on assumption that area license scheme could be more effective measure congestion compared to parking taxation. Since then, Major Livingstone consistently campaigned to introduce charging scheme in London. The cordon area based on the year of 2011 is illustrated in Figure 2.7 below.

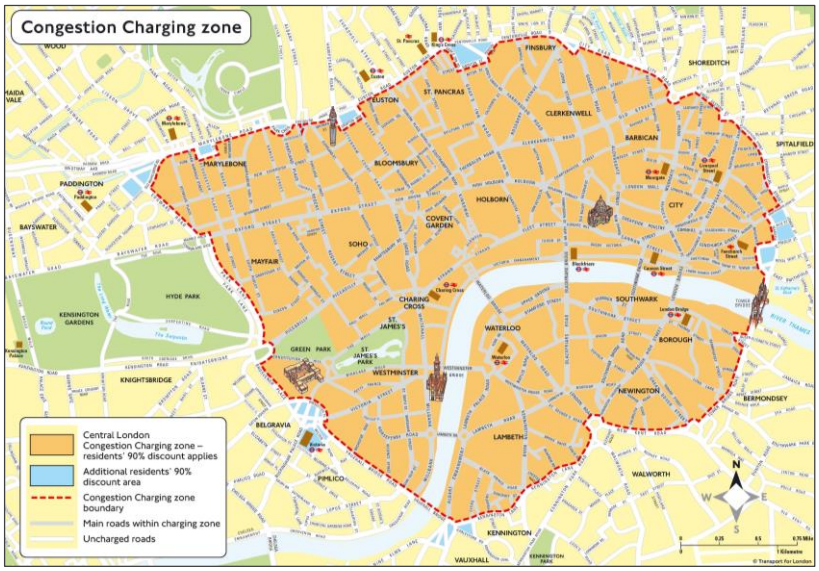


Figure 2.7 Congestion charge zone in London (TfL, 2011)

In 2004, Transport on London (TfL) reported that traffic reductions of 15% to 20% were achieved after implementation of congestion charge. Most impacts, arising from reduced traffic, will be beneficial. There could be an essentially reduction in traffic accidents due to reducing in car traffic. Further impacts of reduction in car traffic, the congestion charge sought to reallocate road space from private cars to public transport. TfL (2004) estimates that roughly half the increase is due to the improved bus service and half to the congestion charge. Furthermore, Leape (2006) reported that the rise in the number of individuals entering central London by bus exceeded predictions by almost 50% from autumn 2002 to autumn 2003, bus passengers entering the charging zone in the morning peak period rose by 29,000, an increase of 38%.

Key factors of the successful implementation in London are that the city has a comprehensive and well serving public transport system. These offer good alternatives for travellers to shift their mode from automobiles to public transit. The readiness to set-up the system for enforcement is further key aspect of successful implementation in London. Further important factor is the geographical and road geometric conditions. London has inner ring road, this is

very suitable as a borderline for the London's congestion charge scheme as illustrated Figure 2.7.

2.3.3 Implementation in Stockholm, Sweden

In the case of Stockholm, congestion charge is addressed for congestion and environmental tax. This policy was initially introduced as a trial between 3 January 2006 and 31 July 2006, and following a public referendum in September 2006. A public referendum reveals that Stockholm municipality voted agree, and 14 other municipalities voted disagree to government to permanently implement CC policy. Within a trial run, proposed system able to mitigate car traffic up to 20%, elevating travel speed and increasing public mode ridership at 6 to 9%. However, after trial ending, traffic condition within proposed charging zone returns as a similar amount as before trial (Pike, 2010).

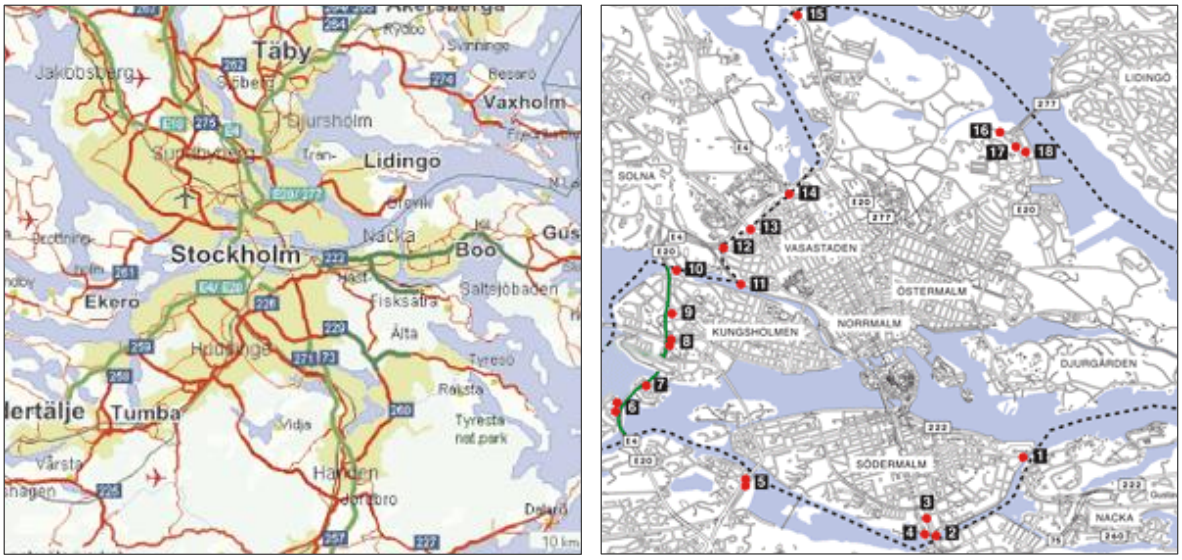


Figure 2.8 Congestion charge zone in Stockholm (IBM, 2008)

Since first half of 2007, eventually the Government of Swedish confirmed that the CC policy was implemented everlastingly. The area of charging zone is illustrated in Figure 2.8. Furthermore, the revenues obtained from Stockholm congestion charge are to be recycled for funding a new bypass road.

The amount of charge is based on the time of the day that user enter congestion and tax areas. The payment of charges directly can be paid credit card, online website or department stores within the city centers. However, charge is not applied on weekend, public holidays during 18:30 pm to 06:29 am. The technological option used in Stockholm congestion charges are gantry equipped with number plate recognition cameras to identity of vehicles entering

charging zone. Surveillance cameras of Automated Number Plate Recognition (ANPR) is used to detect and record car number plate.

2.4 Implementation Challenges

2.4.1 Institutional Barriers

Growing personal mobility leads to intolerable externalities including economic losses due to traffic congestion and leading to particular interest in how transport planning policies might moderate the pressures (Cools *et al*., 2011). A general agreement is that these issues need to be solved by encouraging changes in travel behavior. In this context, CC scheme appear to be the most effective instruments (Schade & Schlag, 2003; Steg & Schuitema, 2007). The ultimate goals of such schemes include achieving efficient infrastructure use, efficient infrastructure provision and revenue generation for other funds. (Link and Stewart-Ladewig, 2005).

Despite of well-established rationale that CC strategy able to combat bad auto traffic including several beneficial impacts such as improving safety and enhancing public transport ridership's, is difficult to implement. Public is skeptical in general about accepting a pricing policy and significant opposition arises particularly among car users. Several road pricing proposals have been dropped for lack of public support, such as a proposal in Edinburgh (Gaunt *et al*., 2007) and one in New York City (Schaller, 2010). For examples, in Edinburg and Manchester, the public glare of referenda rejected charging proposals by majorities 70% to 80%. Furthermore, the extension of CC in London has also been abolished due to local opposition including genuine concern about effects on businesses in more suburban areas (Wilson, 2013). These exhibits that there are serious barriers to the pursuit of transport charging, and that the governments need clear guidance to make better use of this powerful transport pricing policy.

The major challenge in implementing CC is to design a scheme that is both acceptable and effective in achieving the objective of more sustainable mobility (Francke & Kaniok, 2013). CC has always been a controversial and debatable concept since it involves the issue of equity. A number of authors (Ison, 2000; Goh, 2002) have pointed out that willingness to adopt road pricing depends on political will, public acceptance, budgetary constraints and the availability of alternatives. There are several perspectives that need to be balanced in order to achieve effective and fair policy, namely those of the user, traffic authority and society (Cracknell, 2000; Litman, 2002). Public acceptability and social concerns remain a major barrier to implementation (Chain, 2005; Rentziou *et al*., 2011).

2.4.2 Public Acceptance Issues

The acceptability of a CC policy reflects people's attitudes towards the scheme. For example, Schitema *et al*., (2010) defined acceptability as the tendency to evaluate a road pricing scheme with some degree of favor or disfavor before it is implemented. In addition, they examined the factors that affected acceptability judgments of pricing policy in Stockholm. They concluded that the acceptability of a scheme is well explained by determinants such as personal outcome expectations and expected effects of the policy implementation. This result is in line with Schade & Schlag (2003), who found that the degree of acceptability correlates positively with personal outcome expectations and perceived effectiveness of the policy.

Further exploration by Gehlert *et al*., (2008) demonstrated that behavioral adaptation to CC, manifested in ways such as preference for a particular revenue allocation, appears to have an influence. Moreover, public support really depends on individual constraints such as person's character, attitudes, opinions, means of transport, alternative transport modes and so forth. Citizen approval strongly corresponds to individual perceptions of the policy, such as the environmental benefits, improved freedom of movement, understanding of the charging system and allocation of scheme's revenue (Falzarano, 2009; Odioso and Smith, 2009; Jaensirisak *et al*., 2005). In particular related to revenue allocation, general agreement is that investment in public transport is one of the more preferred options for the allocation of revenues.

For instance, Farrell & Saleh (2005) investigated revenue allocation in the city of Edinburg. Respondents were asked to indicate their level of agreement for a number of revenue allocation spending options. The result has shown that overall agreement on spending the revenues on improving public transport services. This in a similar vein to the results by Thorpe *et al.*, (2000), based on survey in UK, the most popular allocation was on public transport improvements. They further found that there was little support for spending on other issues such as for reducing general taxation or funding new roads. In case of Trondheim charging policy, it was to raise revenue to improve the transport system including spending revenue consisting of 82% on road building, and 18% on public transport, safety and environmental improvements (Langmyhr & Sager, 1997).

2.4.3 Psychological Influencing Factors

There have been extensive studies attempting to understand the psychological intentions that influence public acceptability of pricing strategy. A psychological intention is expressed with some degree of favor or disfavor in defining acceptability of congestion pricing. Psychological determinants may contribute significantly to explaining the acceptability of a scheme. For instance, Eriksson *et al*., (2008) demonstrated that psychological determinants such as

problem awareness, policy fairness and perceived effectiveness are important factors affecting acceptability. Fujii (2005) and Gärling *et al*., (2008) pointed out that infringement of freedom, policy fairness, problem awareness and perceived effectiveness are psychological determinants that directly and indirectly contribute policy acceptability. Psychological attitudes are often culture-dependent.

The structure of determinants of acceptance may differ across countries. For instance, an exploration by Fujii *et al*., (2004) points out that perceptions of fairness and infringement of freedom differ between Asian and European countries including Taiwan, Japan and Sweden. They confirmed that the importance of fairness and infringement on freedom for acceptance of road pricing found in Sweden is replicated in Japan and Taiwan. They further suggest that the importance of determinants may transcend cultures. Furthermore, Schmöcker *et al*., (2012) investigated psychological factors that determine acceptability of road pricing based on a limited survey of British and Japanese students. They argued that psychological determinants are influenced by cultural background including "absolute values" based in religious belief. They found that "absolute values" are a suitable underlying distal factor to partially describe whether individuals are likely to accept a pricing policy. Additionally, Schmöcker *et al*., (2012) and Kim *et al*., (2013) proposed that trust in a government scenario is an additional specific determinant of acceptability. They confirmed that is the case based on a limited survey of British and Japanese students.

2.5 Implementation Challenges in Developing Countries

In the context of developing countries implementations, several attempts showed affords to challenge and implement CC. According to Mahendra (2004), there has been initiation to consider in implementing CC policy in Asian developing cities, namely Bangkok and Kuala Lumpur. However, local Government dropped the CC proposal because of high opposition and political conflicts. Furthermore, Jansson (2010) confirmed that CC policy could be the most promising strategy to mitigate bad car traffic in large cities. However, political resistance is the major issue and needs to be solved prior to the adaptation of such policy. According to Cracknell (2000), the major challenges of less consideration in implementing CC in the developing countries are complex problem related to the issues below:

1. Political, some public opposition.
2. Failure of transport planners to present convincing arguments.
3. Legal and institutional constraints associated with direct charging for road use.
4. Lack of legal framework dealing with offenders.
5. Institutional weakness to plan, design, implement and manage a scheme on a continuous basis.

6. A tendency to regard congestion charge as a stand-alone scheme.
7. Failure to recognize and develop integrated policies for improved, quality public transport as an alternative to car use.

Further investigation conducted by Mahendra (2004) concluded several challenges of implementing CC in Mexico City include:

1. Public resistance.
2. Political conflicts.
3. Fragmented institutions.
4. Lack of alternatives to driving.
5. Lack of funds.
6. Vandalism of traffic cameras
7. Poor enforcement.

In summary, the implementation of CC is still limited at developing countries due to several challenges. The main challenges noted by previous studies include (i.e. political conflicts; public acceptance and its related issues; legal and institutional barriers). Further experience from successfully implementation in Singapore, London and Stockholm that the key factor to support for smoothing implementation is geographical and road network conditions as well as the availability of comprehensive integrated public transit allowing road users to shift their mode.

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Chapter 3

DATA AND PROFILES

3.1 Person Trip Data

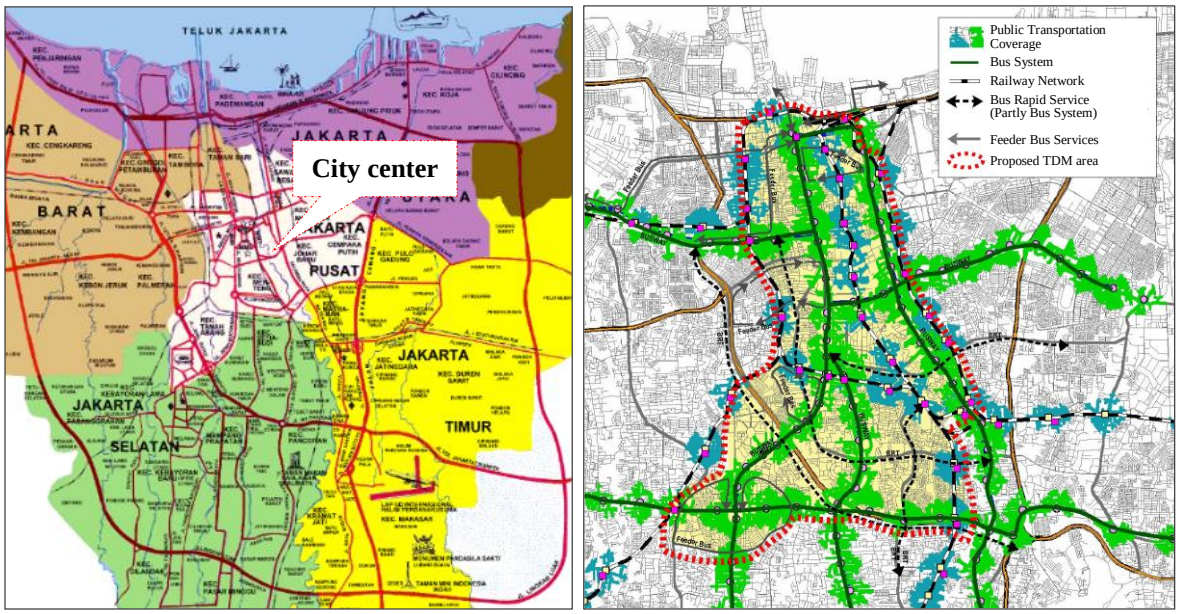
The Study on Integrated Transportation Master Plan (SITRAMP, 2004) project was conducted by Japan International Cooperation Agency (JICA). It provides detailed transportation survey both Household Transportation Survey (HTS) and Activity Dairy Survey (ADS), and utilizes this for a long run comprehensive transportation master plan in Jakarta. The surveys were carried out in 2002 to obtain large scale of data on socio-economic indicators, daily activity transportation patterns, time of the day movements, mode and destination choices. A random sampling method was adopted in HTS survey rather than a stratified sampling method. The survey was based on home interview method recorded by a questionnaire. The questionnaires include household information such as socio-economic background including residential address, income, expenditure, household member, vehicle ownership etc. The survey provides detail householder information, such as age, gender, occupation, working field, work/other activities address etc. Moreover, this survey also covers the characteristic of trip made by household member on weekday including origin and destination zone, departure and arrival times, transportation purpose, mode choice, etc. The data set provides the most comprehensive transportation data in the region, and covers as many as 166,000 households with providing daily transportation patterns on a weekday. These large data sets obtained for this study provide a unique opportunity to conduct this research.

3.2 Stated Preference Questionnaire Survey

3.2.1 Survey Location

The stated preference (SP) method (Louviere, *et al*., 2000; Li & Hensher, 2012) was used to design questionnaires in this study. This study focused on the city centers of Jakarta, as shown in Figure 3.1. The target areas are the central business districts (CBDs) of each city, which are

a dense mix of business and commercial areas. The CBDs attract many visitors and are served by urban arterial roads that experience serious congestion. The charging zone proposal is within the city center of Jakarta, as illustrated by the red lines in Figure 3.1.



(a) the area of study (b) proposed charging area

Figure 3.1 Congestion charge zone proposal in Jakarta (SITRAMP, 2004)

3.2.2 Questionnaire Outlines

The SP was used to design questionnaires, with three different charging patterns were designed and introduced to respondents in Jakarta. Target respondents were visitors to the CBD, including commuters, shoppers, commercial visitors and employees of business establishments. In this case, the proposal of charging patterns is based on the SITRAMP (2004) and JUTPI (2012) documents as recommended by the JICA. The SP questionnaires are summarized in Table 3.1, which gives the dates of the surveys, target locations, distribution methods, number of samples and charge patterns.

The SP questionnaires were designed to capture relevant information from respondents, such as mobility characteristics, recognition of the proposed scheme, approval of the proposed scheme, expectations of changes in mobility habits and socio-demographic attributes (see Table 3.2). Shortly thereafter, respondents were asked to answer a set of questions regarding the CC proposal, designed to capture their intentions with respect to such a scheme. This set of questions was related to the individual's psychological motivations corresponding to several indexes, including the appropriateness of the CC scheme, recognition of the CC scheme's ability to mitigate congestion and improve the environment, car dependency and related problems and inhibition of freedom of movement.

Table 3.1 Summary of SP questionnaire survey

Detail	Description
Date of survey	November 18th – 3rd December 2013
Target location	Central Jakarta and part of south Jakarta
Distribution methods	Direct interviews and collected by enumerator
Number of questionnaires distributed	2,100
Number of questionnaires returned	1,998 (95.1%)
Questionnaire Patterns (CC price):	
- Pattern 1	IDR 10,000
- Pattern 2	IDR 21,000
- Pattern 3	IDR 35,000
Sampling distribution	
- On weekdays (weekends)	71% (29%)

Table 3.2 Summary of SP questionnaire

No	Category	Description
1	Visitor mobility characteristics	Purpose of trip, number of accompanying persons, and mode choices
2	General opinion of CC, traffic congestion and the environment. Respondents were asked to participate on artificial vote of proposed scheme either they agree or disagree with scheme proposals. Respondents were asked to respond from a 4-point Likert as: 1. Well accepted 2. Accepted 3. Not accepted 4. Not accepted at all	Recognition, acceptability, and fairness of CC; Inhibition of freedom of movement Consequences of CC implementation Opinion on present level of urban transport services Opinion on city center transport and environment Extent of recognition of environmental issues Opinion on government policies and trust in government policy
3	Respondent's mobility responses to introduction of CC policy	Awareness of possible different visit behavior on day of survey under proposed scheme
4	Individual socio-demographic characteristics	Gender, age, driver's license, employment status, transportation expenditure and annual income
5	Daily mobility attributes	Trip purpose and frequency, mode used, frequency of using private mode, frequency of using transit

3.3 Profiles

3.3.1 Distributions of socio-demographic characteristics

Table 3.3 shows the socio-demographic characteristics of the respondents. It is noteworthy that young people (≤40 years) dominate sample set, accounting for more than 86.6% of respondents. The gender distribution is slightly skewed toward males. As regards employment status, the data set indicates 69% employed people. Surprisingly, more than 25% of the sample consists of students in Jakarta.

Looking at income, Table 3.3 exhibits household income distribution. The average monthly income in Jakarta is IDR 4.543 million. It is found that approaching three-quarters of the sample have a low to medium monthly income in Jakarta. That is, about 70.5% of the

respondents have a monthly income below IDR 5 million (BPS, 2010). Considering an annual income of 54.516 million IDR (IDR 4.543 million x 12), the daily charges of IDR 10,000-35,000 (see Table 3.1) are consequently around 0.018-0.064% of annual income in Jakarta.

Table 3.3 Summary of respondents' socio-demographics

Item	Category	Share
Gender	Male	51.9%
	Female	48.1%
Age	20 years or less	11.1%
	20-29 years	49.9%
	30-39 years	25.6%
	40-49 years	10.2%
	50-59 years	2.7%
	60-69 years	0.3%
	70 years or more	0.1%
Occupation	Working	69.0%
	Student	25.4%
	Housewife	4.1%
	Unemployed	1.4%
Monthly Income	IDR 600,000 or less*	3.1%
	IDR 600,000-1,000,000	1.0%
	IDR 1,000,000-1,500,000	6.8%
	IDR 1,500,000-2,000,000	2.1%
	IDR 2,000,000-3,000,000	24.5%
	IDR 3,000,000-4,000,000	13.6%
	IDR 4,000,000-5,000,000	19.4%
	IDR 5,000,000-7,500,000	12.1%
	more than IDR 7,500,000	17.4%

**IDR (Indonesian Rupiah) 12,000 IDR ≒ 120 JPY ≒ 1USD*

Table 3.4 Summary of respondents' mobility attributes

Item	Category	Share
Driver's license	Has driver's license	70.5%
	Has no driver's license	29.5%
Frequency of visits to the target area of the CC scheme (CBD)	5 days/week or more	46.3%
	3-4 days/week	16.7%
	1-2 days/week	12.6%
	2-3 days/month	13.0%
	1 day/month or less	11.4%
Purpose of visiting the target area of the CC scheme (CBD)	Work	48.3%
	Studying; lessons	11.5%
	Meetings; sales; trader	5.5%
	Entertainment; shopping	28.0%
	Out for a walk/drive	6.7%
Frequency of car usage in daily life	5 days/week or more	40.5%
	3-4 days/week	15.2%
	1-2 days/week	10.8%
	2-3 days/month	11.4%
	1 day/month or less	22.0%
Frequency of public transport usage in daily life	5 days/week or more	22.7%
	3-4 days/week	13.2%
	1-2 days/week	12.5%
	2-3 days/month	14.7%
	1 day/month or less	37.0%

3.3.2 Distribution of Respondent's Mobility Attributes

Table 3.4 describes the aggregation results for visits to the charging area and travel behavior. The data reveal that close to 70% of trip makers are licensed drivers in Jakarta. Turning to the frequency of CBD visits, 63% of respondents visit the CBD quite often (3-5 days/week or more). A possible reason for this is that nearly 60% of trip makers are commuters (working or studying). Surprisingly, the data reveal that a high percentage of respondents frequently use car (3-5 days/week or more), with share for about 56%. These figures indicate that respondents prefer their own mode and are car dependent. With further exploration, it is clear that 35.9% of respondents quite frequently use public transit (3-5 days/week or more). It is quite clear that respondents prefer to use their own mode compared to public transit. In the case, this may be partially because there is only one pleasant means of public transit serving the main arterial corridors, the trans-Jakarta BRT. Therefore, the public rely heavily on private modes which offer more convenience in term of flexibility.

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Chapter 4

TRANSPORT EXPENDITURE FRONTIERS ANALYSIS PRIOR TO CHARGING REFORM

4.1 Background

Generally speaking, CC reforms could induce significant influence on people's travel behavior. In this context, the amount of money or time that people spend on their activities may be affected from not only individual travel patterns but also their socio-demographic attributes such as income and expenditures. For example, a research conducted by Zahavi *et al.*, (1980) revealed that an average car owning household spends about 10-11% of its income for their travel while an average non car owning household spent about 3-5% of their income for travel. Further exploration by Gunn *et al.*, (1981) investigated the percentage of expenditure spent on the transportation among different time of the year constraints. Transport expenditure tended to be higher in the second and third quarter of the year compared to those in first and four quarters. Furthermore, Tanner (1981) stated that generalized travel expenditure per person has increased over the years and appreciably faster than their real income. Additionally, individual's travel time expenditures is strongly related to household characteristics, attribute of activities and destinations, or even the characteristics of residential areas (Mokhtarian *et al.*, 2004).

Concerning to household characteristics, Banarjee *et al.*, (2007) used the household attributes from national household travel survey in United States, India and Switzerland to explore the travel time expenditure across international contexts. They found that comparison of average travel time frontier showed quite differences. In the same international contexts, Susilo *et al.*, (2011) utilized comprehensive data set from UK National Travel Survey in 2004 to explore unseen stochastic both cost and production limit and the variations of the individual travel time overtime. They found that most of individuals may have not reached their limit yet to travel and may still be able to spend further time in travel activity. The analysis also reveals

that some groups of population (e.g. high income households, younger people etc.) have a larger needs of spending minimum travel time and also more bigger time constraints in doing their out-of-home travel and activities, whilst others (e.g. male full-time workers) need less travel time to satisfy their minimum travel needs. Further investigation by Volosin *et al.,* (2013) based on 3 years the National Household Travel Survey in the United States revealed that the variations in production frontier values as well as trends in the ratio of travel time expenditure to frontier values differ considerably across socio-demographic groups.

Compared to travel time expenditure, transport expenditures may more crucial issue because having direct burden to the individual's income constraints. Therefore, it could important to understand and evaluate how far commuters could be expected to adapt and be change their travel behavior in terms of travel expenditures given their household attributes. In accordance with the government intends to implement CC policy, therefore, the exploration of transportation expenditure is necessary to conduct in order to provide valuable insights to the planning options. It hypothesizes that the CC policy will impose monetary expenditures in particular for commuters who commutes to the respective charging zone. It is presumably that certain income groups are saving the transportation expenditure attributable to their income constraints. Understanding commuter's transportation expenditure and its factors that contributing to such expenditures could provide valuable insights into behavior travelers under range of CC proposal in Jakarta. Therefore, this chapter aims to explore how the household spends the money for transportation expenditures considering life stage aggregations. The substantial characteristics of household attributes among life stage categories are taken into consideration. The analysis was performed using Stochastic Frontier (SF) model and the concept of production frontier is adopted to estimate transportation expenditure frontier (TEF). TEFs are treated as unobserved production frontier that influences the actual transportation expenditures observed in transportation survey. The expenditures does not necessarily constitute the upper bound of the amount of money that people are dedicating to spend to travel. In this context, TEF represents an upper limit on the amount of money that people are able to dedicate to travel in a month.

4.2 Data Set and Distribution

The PT data provided by SITRAMP (2004) is utilized to model transportation expenditure frontiers in Jakarta. The PT data set provides the most comprehensive data as covers as many as 166,000 households with providing daily transportation patterns on a weekday (see chapter 3). The large data set provides a unique opportunity to conduct this analysis, and among 166,000 households 55,833 (33.6%) are aggregated and utilized in this study.

Prior to the analysis, sample aggregation is conducted as following procedures (i.e. extracting households which include person who commute to city centers (charging zone; households are augmented into several life stage structures; household related attributes are incorporating as explanatory variables). Life stage classifications were segmented by referring the works of Zimmerman (1982) and Sun (2009) with minor modification from their approaches. Life stages were classified into six groups (i.e. single-person household; childless-couple household; families with pre-school children; families with young school children; families with college/university children; and families only with adults).

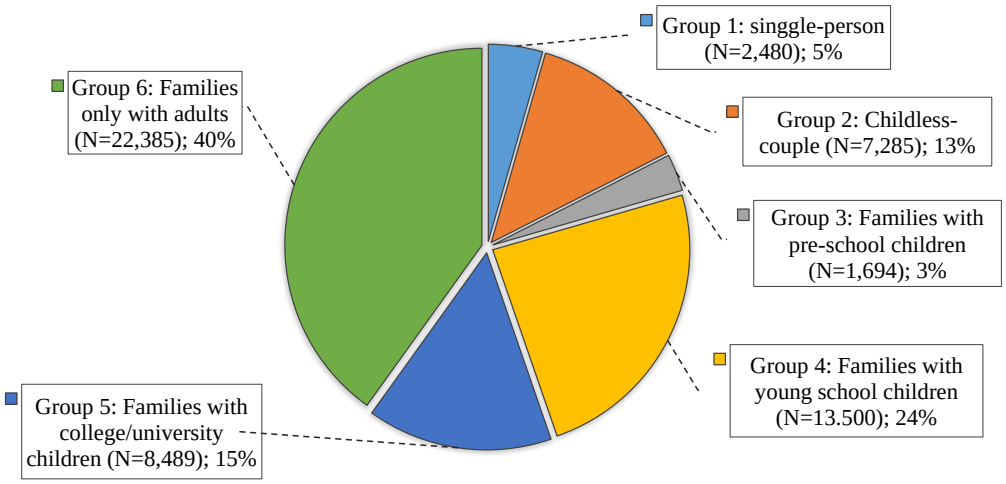

Figure 4.1 Household life stages segmentation

Figure 4.1 shows the household life stages distribution in the Jakarta. It can be seen that families only with adults substantially dominate the household distribution of commuters in Jakarta particularly. Furthermore, families with young school children also contribute nearly one fourth of the samples. The smallest portion goes back to the earliest household (i.e. single, childless-couple, and families with pre-school children). It seems that earliest households deficient in commuting to the city center because of certain prevailing conditions for instances part-time worker, unemployed, saving expenditure for transport and so forth. Overall, it implies that CBD commuters are predominated by adult and older society.

Figure 4.2 discloses that each of household life stage structures has considerably different characteristics on both income and transportation expenditure's share. In Figure 4.3, the group 1 of life stage spends less money for transportation expenditure. That is accounting for 83% of corresponding group share for less than 20% of income to their travel expenditure. Meanwhile only 65% group 6 utilizes for less than 20% of income to the transport fee. It is approximately less than 25% of the earlier households (i.e. single-person, childless-couple, and families with pre-school children) share their income above 20% for their transportation

expenditure. Furthermore, if briefly look to the income, household income for earlier household life stages also shows relatively lower income compared to the others. It is allegedly that there is a weak linear correlation between household income and transportation expenditure's share. Likely, the trend of household's income for each life stages brings significant impact on transportation expenditure's share. That is, as household's income increases it will escalate their transport fee share. It proved that high income households tend to allocate extra money for their transportation. However, it should be noted as well that some higher income households cannot expend their share of income for transportation because of other external factors such as time limitations or other nature factors.

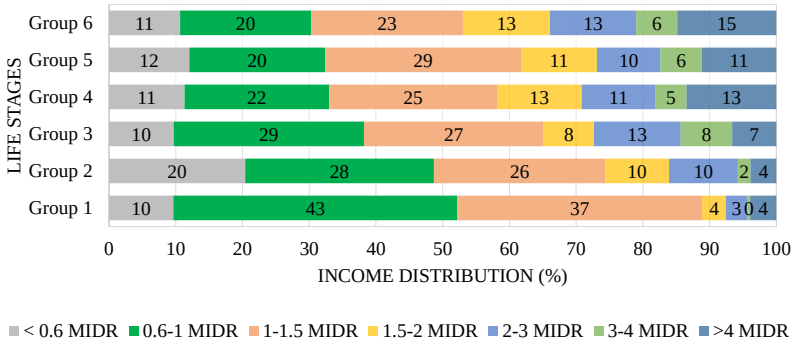

Figure 4.2 Household's income distribution

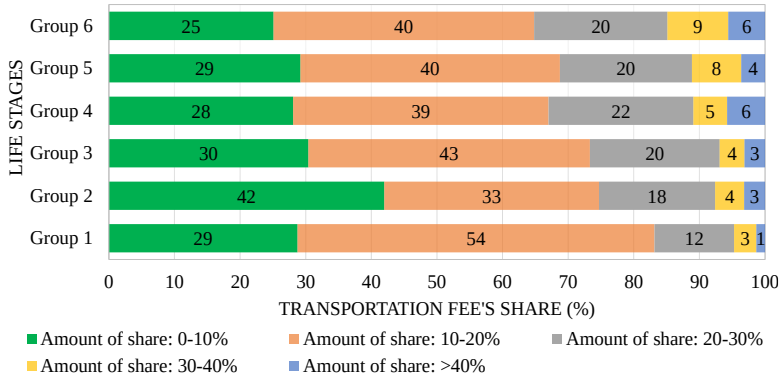

Figure 4.3 Household's transport expenditure shares

4.3 Formulation of Stochastic Frontier (SF) Model

The idea of transportation expenditure frontier (stochastic) introduced in this research has originated from the understanding that the amount of money for transportation allocated by people can be observed as result of complex interactions between the structure of household life stage and their potential attributes, and arguably it varies for each household structures. The modeling framework of stochastic frontier (SF) model was originally introduced by Aigner *et al.*, (1977). In its original SF model can fit stochastic production or cost frontier models. In this study, the concept of a production frontier is adopted and so-called

transportation expenditure frontier (TEF). TEF represents the maximum amount of money which is an individual dedicating to allocate in a month for their transportation. By considering unobserved transportation expenditure (TE) is always greater than or equal to the observed TEs. A modeling approach, therefore, is adopted in this work to estimate unobserved transportation expenditure based on inequality and non-negative terms. Owing to the highly skewed nature of the TE distribution and to ensure positive predictions, a log transformation of the dependent variable is used (see Banarjee *et al*., 2007).

$$Let\ T_i = ln(t_i), \text{ and } T_i = \tau_i - u_i \tag{4.1}$$

where i denotes the observation, t_i is observed transportation expenditure and u_i is random component that takes non-negative values. Moreover, τ_i represents an unobserved frontier for T_i, and it is always greater than or equal to T_i. Then, the production function of SF model Aigner *et al*., (1977) can be written:

$$\tau_i = \beta' X_i + v_i \tag{4.2}$$

then,

$$T_i = \beta' X_i + \varepsilon_i = \beta' X_i + v_i - u_i \tag{4.3}$$

where β' is a coefficient vector of independent variables, X_i is a vector of explanatory variables, v_i is a random error term such that $-\infty < v_i < \infty$. The random variables of v_i is typically assumed to be IID as $N(0, \sigma v^2)$, while, a half normal or truncated-normal distribution is frequently used for the error component of u_i. Assuming a half normal distribution for u_i and a normal distribution for v_i, then, the distribution of ε_i could be drawn as:

$$h(\varepsilon_i) = \frac{2}{\sqrt{2\pi\sigma}}\left\{1 - \Phi\left(\frac{\varepsilon_i \lambda}{\sigma}\right)\right\} exp\left(-\frac{{\varepsilon_i}^2}{2\sigma^2}\right) \tag{4.4}$$

where $\sigma^2 = var\ (v_i + u_i) = \sigma v^2 + \sigma u^2$, where σv and σu are mutually independent; $\lambda = \sigma v / \sigma u$, $v_i \sim N(0, \sigma v^2)$, and the density function of u_i is:

$$g(u_i) = \frac{2}{\sqrt{2\pi\sigma_i}} exp\left(-\frac{{u_i}^2}{2\sigma^2}\right), u_i \geq 0 \tag{4.5}$$

with,

$$E(u_i) = \sqrt{2/\pi}\ \ \sigma_u\ , and\ Var\ (u_i) = \left(1 - \frac{2}{\pi}\right) {\sigma_u}^2 \tag{4.6}$$

The log likelihood function (LL) for the sample of observation, then, given by:

$$LL = \sum_{i=1}^{I} ln\{h(\varepsilon_i)\} = \sum_{i=1}^{I} ln\left\{\frac{2}{\sqrt{2\pi\sigma}}\left\{1 - \Phi\left(\frac{\varepsilon_i \lambda}{\sigma}\right)\right\} exp\left(-\frac{{\varepsilon_i}^2}{2\tau^2}\right)\right\} \quad (4.7)$$

By maximizing the log likelihood function represented by Eq. 4.8, the parameters of β and σ can be obtained. Parameter estimation is written and implemented in GAUSS econometric programming version 3.2.32

Returning back $ln(t_i)$ to the basic form of SF model of T_i in Eq. 4.3 gives expected value of transport expenditure frontier E(TEF) as:

$$E(TEF_i) = E\{(exp(\beta' X_i)\, exp(v_i)\} \quad (4.8)$$

Because of $v_i \sim N(0, \sigma v^2)$, $exp\ (v_i)$ is distributed log-normal, it is, therefore $E(exp(v_i)) = exp\ (\sigma v^2/2)$ (Greene, 2002). The model specification derived above is applied for examining the relationship between dependent variable transportation expenditure and household's related socio-demographic characteristics. TEFs should exceed the actual expenditure because of the nature of half normal random error term (u_i) except it could occur to expenditure frontier with skewed and inconsistent magnitude of explanatory variables. In addition to compute TEF_i, the ratio of the observed transport expenditure (t_i) to the expected transportation expenditure frontier (TEF_i) is considered in order to gain more interest about how people actually use their frontier. The value of ratio (R) is derived as Eq.4.9.

$$R = \frac{E(t_i)}{E(TEF_i)} = E[exp(-u_i)] \quad (4.9)$$

The value of ratio implies that people are expected to spend R time of (TEF_i) for their monthly routine expenditure. R value indicates the extent to which each household are actually spending their money in terms of their frontiers. If the ratio is large enough, households may largely using their frontiers.

4.4 SF Model Analysis

4.4.1 Empirical Setting

Table 4.1 provides household's characteristics for six group of life stages. On average income for all households is approximately 1.92 million IDR/month (1 USD =12,000 IDR=100 JPY), and 70 to 80% of households have permanent housing. Group 1, 2 and 3 life stages considerably have small household members (1 to 3 members) compare with other life stages. In addition, it is found that the vehicle ownership in Jakarta is essentially lower with mean 0.26, 0.44 per household for vehicle and motorcycle ownerships respectively. However, it should be noted that number of vehicles registered has been dramatically increasing in recent

years as mentioned in the earliest section. Turning to education background, data shows that 70% to 80% of householder's are less having tertiary education level of education only few of them well educated up to tertiary educations. Moreover, approximately 20% to 40% of data sets were working as a professional occupation, measly of them are working as a self-employed. It appears that Jakarta data sets are dominated by moderate income households.

Table 4.1 Empirical data set and householder's attributes

Characteristics	Household life stages[1]					
	Group 1 Mean (Std.)	Group 2 Mean (Std.)	Group 3 Mean (Std.)	Group 4 Mean (Std.)	Group 5 Mean (Std.)	Group 6 Mean (Std.)
Sample Size	2,480	7,285	1,694	13,500	8,489	22,385
Transp. Expenditure (million IDR)	0.308 (0.409)	0.346 (0.423)	0.412 (0.351)	0.513 (0.504)	0.505 (0.567)	0.568 (0.542)
Income (million IDR)	1.471 (1.129)	1.336 (1.276)	2.006 (1.495)	2.220 (1.679)	2.100 (1.535)	2.370 (1.747)
Permanent housing dummy[2]	0.671 (0.499)	0.725 (0.446)	0.717 (0.451)	0.817 (0.386)	0.771 (0.420)	0.834 (0.373)
Household member (person)	1 (0)	2 (0)	3.818 (0.895)	4.376 (1.253)	4.415 (1.274)	3.509 (1.124)
Vehicle ownership (unit)	0.0851 (0.279)	0.218 (0.413)	0.169 (0.374)	0.220 (0.414)	0.169 (0.374)	0.222 (0.415)
Motorcycle ownership (unit)	0.496 (0.500)	0.294 (0.456)	0.396 (0.489)	0.395 (0.489)	0.391 (0.488)	0.398 (0.489)
Social status[3]:						
- Student dummy	0.221 (0.415)	0.347 (0.476)	0.900 (0.299)	0.294 (0.455)	0.324 (0.488)	0.00661 (0.0810)
- Retired/Jobless dummy	0.252 (0.434)	0.176 (0.381)	0.0997 (0.299)	0.0313 (0.174)	0.241 (0.427)	0.243 (0.429)
Tertiary education dummy[4]	0.153 (0.361)	0.180 (0.384)	0.314 (0.464)	0.259 (0.438)	0.0934 (0.291)	0.257 (0.437)
Householder's occupation						
- Professional occupation dummy	0.175 (0.380)	0.158 (0.365)	0.316 (0.465)	0.393 (0.488)	0.132 (0.338)	0.398 (0.489)
- Self-employed dummy	0.0577 (0.233)	0.0560 (0.229)	0 (0)	0.0748 (0.0861)	0.0550 (0.228)	0.129 (0.335)
O-D distance (km)	16.299 (18.109)	16.518 (18.811)	11.507 (15.986)	11.523 (15.544)	13.223 (16.668)	19.709 (21.358)

[1]life stages: 1. Single-person; 2.Childless-couple; 3. Families with pre-school children; 4. Families with young school children; 5.Families with college/university children; 6.Family only with adults.
[2]If housing type is permanent, the variable takes 1, otherwise 0.
[3]Householder's social status.
[4]If householder's education background is diploma, bachelor or master/doctor, the variable takes 1, otherwise 0.

Observed transportation expenditure is treated as dependent variable, and the unit is in MIDR. Nine explanatory variables are incorporated in the model formulation (see Table 4.1); household income (million IDR), number of household member (person), housing type of permanent housing (dummy variable), car ownership (dummy variable), motorcycle ownership (dummy variable), social status of householder (student dummy and retired/jobless dummy), householders education background (dummy variable that takes one if householder has tertiary education level, otherwise 0), householder's occupation (professional occupation dummy and self-employed dummy) and O-D distance from their housing to CBD (km).

4.4.2 Empirical Results

Table 4.2 presents the estimation results for the earliest households, there are single-person household, childless-couple household, and families with pre-school children and the remained life stages are shown in Table 4.3.

Table 4.2 Estimation result of TEF for Earliest Households

Description of explanatory variables	Single-person household		Childless-couple household		Family with pre-school children	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	2.499	134.14	2.529	26.18	2.428	32.06
Household income (MIDR)	0.524	71.91	0.217	30.32	0.398	36.04
Number of HH member	-	-	-	-	-	-
Permanent housing dummy[a]	0.242	14.72	0.466	21.49	0.0691	4.73
Car ownership dummy	-0.142	-5.19	-0.591	-24.40	0.0725	1.67
MC ownership dummy	0.255	15.81	0.161	7.83	0.0712	2.52
Social status[b]:						
Student dummy	0.190	9.67	-0.145	-6.64	0.108	2.36
Retired/Jobless dummy	0.152	8.49	-0.279	-10.71	-	-
Tertiary education dummy[c]	-0.0691	-2.39	-.0144	-5.10	-0.0205	-0.74
Householder's occupation[d]:						
Professional occ. dummy	0.289	11.41	0.241	8.22	0.0201	0.72
Self-employed dummy	0.190	6.38	0.0994	2.67	-	-
O-D distance (km)	-0.000893	-2.78	-	-	0.000422	0.53
σ_v	0.143		0.505		0.243	
σ_u	0.819		0.031		0.084	
λ	5.721		0.078		0.591	
Summary of statistics						
Sample size (N)		2,480		7,285		1,305
LL (β)		-1,192		-7,858		-1,694

[a,b,c,d]*see to table 4.1.*

Table 4.2 represents three earliest household life stages, it is implicated that car ownership has negative impact on TEFs for all life stages except families with pre-school children. A possible reason is that car ownership does not mean household disbursements in Jakarta. That is, the other transportation modes may impose daily transportation expenditure rather than car usage. Retired and jobless social status has negative impact for many life stages. It seems that less income or activities for retired or jobless tends to limit their transportation expenditure. Whereas, income and professional occupation have positive sign and effect on the TEFs. This is quite consistent with expectations as a household with high income and/or high position have many activities.

Table 4.3 shows the estimation results for three later household life stages. The income, motorcycle, and professional occupation are associated to have positive relationship with TEFs. The larger numbers of household members are impacting on amount of money for transportation expenditures in family with school children and college/university children. It is reasonable that the more member within a household the more activities are attracted by

them, and consequently the more additional money spending on their transportations. It should be noted that to some extent higher TEFs exist for householders who have a professional occupation. One possible insight is that due to greater awareness on activity opportunities or engages in activities by them. Looking to the O-D distance, the longer distance obtained by commuting generate the more TEFs in across household life stages except for childless-couple household. It brings the likelihood that the more people engage on their longer distance in transport, they need to spend more amount of the money spending for their travels.

Table 4.3 Estimation result of TEF for Latest Households

Description of explanatory variables	Families with young school children		Families with college/university children		Family only with adults	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	2.499	126.13	2.111	69.85	3.056	96.66
Household income (MIDR)	0.429	108.64	0.505	101.19	0.423	144.97
Number of HH member	0.0636	18.60	0.0742	17.17	-0.038	-6.96
Permanent housing dummy[a]	0.307	25.06	0.268	20.16	0.379	31.71
Car ownership dummy	-0.147	-10.02	-0.208	-10.15	-0.398	-32.49
MC ownership dummy	0.158	16.80	-	-	0.164	23.87
Social status[b]:						
Student dummy	0.121	12.27	-0.065	-4.47	0.0163	1.73
Retired/Jobless dummy	-0.0937	-3.57	-0.261	-16.86	-	-
Tertiary education dummy[c]	-	-	-0.182	-7.89	0.0444	4.59
Householder's occupation[d]:						
Professional occ. dummy	0.0216	2.38	0.089	4.32	0.0334	3.63
Self-employed dummy	-	-	-0.206	-8.39	0.213	20.46
O-D distance (km)	0.000373	1.32	0.000909	2.87	0.00350	2.32
σ_v	0.137		0.231		0.068	
σ_u	0.401		0.017		0.639	
λ	1.710		0.271		3.056	
Summary of statistics						
Sample size (N)		13,500		8,489		22,385
LL (β)		-10,500		-5,941		-17,411

[a,b,c,d]*see to table 4.1.*

4.5 TE and TEF Distributions

SF model can be used for estimating and generating distribution of expected TEFs as counterpart distribution to the actual transportation expenditure (TEs). The distribution of TEs and TEFs for each household life stages are plotted in Figure 4.4. The distributions of TEs and TEFs provide a concise picture of the relative differences among expenditures and expected frontiers in the different life stage structures. Furthermore, TEFs distribution are used expected value of estimated TEF for each of household life stages. It should be noted that since the variance of TEF is neglected in this study, the distribution of TEF is smaller than the true variance. More deeply analysis by considering variance of TEF remains a topic for future study.

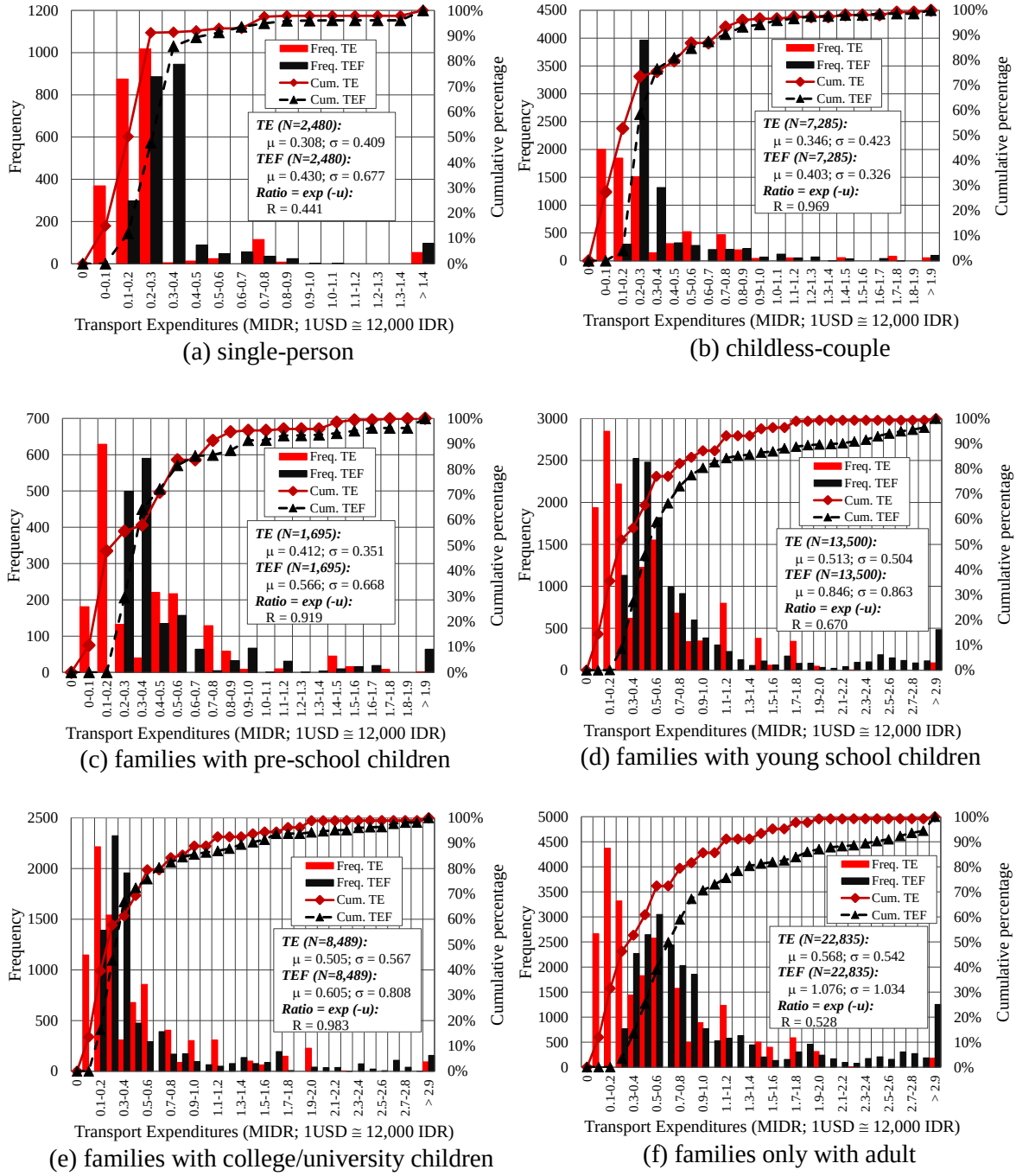

Figure 4.4 Distributions of TE and TEF (million Indonesian Rupiah, MIDR)

Figure 4.4 depicts that the overall mean of TEFs is considerably larger compared to mean value of TEs across life stages. For instance, the mean value for single-person households whose income is the smallest among all life stages is 0.308 MIDR and 0.430 MIDR for TE and TEFs respectively. The implication is that single-person households may not able to spend almost 40% of their TE for transportation fee. Similarly condition respect to other household categories, in particular for families only with adults that exhibit the greatest expected TEF compared to other life stages. The result showed the average TE and TEF for families only

with adult are about 0.568 MIDR and 1.076 MIDR respectively (see Table 4.4). That is nearly double of TEF compared to the actual transportation expenditure. Looking to other household life stages (childless-couple, families with pre-school, families with young children, and families with college children), the average value of TEFs are found to be at around 50% higher than their observed transportation expenditures.

Table 4.4 Comparison of Average TE and TEF

Life-stage categories	Monthly Income (MIDR)	TE (MIDR)	TEF (MIDR)	Half-normal random component (u)	Ratio (R)
Single-person household	1.470	0.308	0.430	0.819	0.441
Childless-couple household	1.610	0.346	0.403	0.031	0.969
Family with pre-school children	2.101	0.412	0.565	0.084	0.919
Families with young school children	2.100	0.513	0.846	0.401	0.670
Families with college/university children	2.220	0.507	0.605	0.017	0.983
Family only with adults	2.370	0.569	1.077	0.639	0.528

Table 4.4 offers a summary of household life stages comparison including average monthly incomes, transportation expenditures, average expected expenditure frontiers, value of half-normal random component u_i, and value of ratio R. The differences in average expected TEFs are rather moderate for families with young school children and family only with adults, and the remaining household life stages are quite pronounced. Moreover, the R values are shown larger for childless-couple household, family with pre-school children and family with college/university children, with accounting for about 0.969, 0.919 and 0.983, respectively. These larger R values indicate that corresponding households be may largely using their frontiers (transportation expenditure capacity). Additionally, the value of the half-normal random component u_i are quite small for childless-couple household, family with pre-school children and family with college/university children life stages. These suggest that the actual transport expenditure are closer to the frontier values for both groups. It seems corresponding life stage groups tend to be constrained by more spending money for commuting, and must allocate a higher portion of their income for their transportation. The groups of childless-couple household and family with college/university children are likely to be expending a higher fraction of their transport expenditure frontier (capacity) than other groups. These can be seen by observing R values across groups, as illustrated in Table 4.4.

As earlier noted that larger amount of TEFs is found for families with young school children and family only with adults compared to other life stages. The differences prospectively may due to the limitation of the money for their transportations or their certain life circumstances. Possible likelihood for households with only adults is that they may tend to spend much money for transportation fee because of having higher income. That is, they can possibly spend much money for transportation compared to the earliest life stage structures (i.e. for childless-couple

household, family with pre-school children and family with college/university children). The reasonable explanation is that they have limitations which restrict them to spend money for transportation, the limitations may include their time limitation. One interpretation of the findings reported by this research is that overall household life stages, on average they spend one-half of the maximum amount of the money that they are dedicating to allocate for a month of travels. Thus, by estimating upper bound of monthly transport expenditures which is accomplished in this study, it would be helpful to preliminary investigate the mechanism of commuters spending their money for transportation expenditure in Jakarta CBD area. As being expected, mean value of actual expenditure for each household life stage in Jakarta considerably less than estimated TEFs. These findings, tell us that people in Jakarta are saving their money for transportation expenditure or have limitations for spending the money for transportation expenditure. This evidences provide insight for Jakarta transport-related policy makers to consider monetary constraints across household structures in particular when government decides the levy rate for generating revenue of congestion charging policy. Government has to take account this issue to deal with varies income groups because of such policy will impose monetary expenditure for commuting to CBDs within prospective changing zone.

4.6 Conclusions

The implementation of stochastic frontier (SF) model is able to clarify how commuters in Jakarta spend their money for their travel expenditures by emphasizing the life stage structures and their substantial attributes. The empirical results are used for analyzing and comparing the behaviors of transport expenditure among household life stage structures in order to acknowledge difference constraints of them. Empirical results revealed that considerable differences in average of TEFs among household life stages. The variation of frontier values as well as the trends in the ratio of expenditure to frontier values considerably differ across life stage groups. The ratio value across life stage groups are substantially shown larger value range from 0.528 to 0.969 except for single-person household. These values suggest that the actual transport expenditure are closer to the frontier values for across life stage groups. This findings reveal that people in Jakarta are consequently facing higher expenditure pressure. Meaning that people are largely using their frontier (transport expenditure capacity) as illustrated by larger values of ratio. More specifically, the distribution of frontier depicts that larger amount of TEFs is found for childless-couple household, family with pre-school children and family with college/university children compared to other life stages. The differences prospectively may be due to the limitation of the money for their transportations or their certain life circumstances. Possible likelihood is that they may tend to spend much money for transportation fee because of having higher income. That is, they can possibly spend much money for transportation in contrast to earlier life stages (i.e. childless-couple household

and families with college/university children). The reasonable explanation is that they have limitations which restrict them to spending money for transportation, the limitations may include their time limitation. Overall findings could tell us that people in earlier life stages are saving their money for transportation expenditure and people who have higher income have limitations for spending the money for transportation expenditure. The difference of money spending behavior can be explained by the life stage categories.

With respect to the consideration to implement CC policy, understanding people's transport expenditure and its factors contributing to such expenditures could provide valuable insights into behavior of travelers under range of road pricing strategy. Empirical result shows that people in Jakarta are saving their money for transport expenditure or have limitations for spending the money for transport expenditure and considerably varies across life stage structures. This evidences provide insight for Jakarta transport-related policy makers to consider monetary constraints across household structures in particular when government decide how much of charge rate must be applied for generating revenue. Government has to consider to which income groups such policy will be imposed monetary expenditure for their commuting to CBDs inside of changing zone. Yet, this study investigates upper bound of monthly transport expenditures, the study does not consider an individual level of attributes but rather than householder's point of view. Therefore, it is contingency that transport expenditures are likely to be potentially influenced by individual's attributes and subjective judgment of their frontier, the explorations on individual level remain a topic for future development of this research.

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Chapter 5

A PRELIMINARY ANALYSIS ON PUBLIC RESPONSES TO DIFFERENTIATED CHARGING PROPOSALS

5.1 Background

Modern motorized society in Jakarta faces a number of congestion-related problems such as excessive travel times, air pollution, excessive energy consumption, and driver frustration. Such problems have affected the Jakarta particularly badly in recent decades, as extraordinary growth in motorization has taken place. This has led to the development of an integrated project for CC, which is offered to be implemented in the Jakarta government to mitigate severe traffic congestion in the city centers. It is argued that the CC policy is able to combat auto-dependent. Examples of successful implementation in Singapore, London and Stockholm have successfully mitigated autos traffic, as reported by Phang *et al*., 1997; Olszewski *et al*., (2006), Eliasson *et al*., (2006) and Loukopoulus *et al*., (2006). However, in the same time it is hard to implement. The public is skeptical about accepting a charging policy and there is significant opposition.

Considering the shortcomings of CC that lead to poor public approval, in this study proposes a parking deposit system (PDS) as an alternative. The first reports of a PDS (Miwa *et al*., 2009 and Ando *et al*., 2010) consisted of a technical description and examination of effectiveness of a PDS established in the city center of Nagoya, Japan. This PDS is based on partial or full refunds to automobile users when they enter the charging zone. Refunds are provided only on parking fees or as discounts on purchases within the charging zone; no cash refund is given. The goal of this PDS scheme was to reduce the number of automobiles entering the city while avoiding a decline in visitors to the city center, eventually leading to increased social

acceptability while raising revenue. Therefore, the purpose of this chapter is to conduct preliminary analysis with aiming to investigate and search explanatory variables of the public intentions to the scheme proposals considering Jakarta's citizen consciousness.

5.2 Outline of Parking Deposit System (PDS)

The PDS is proposed as an alternative to ordinary road pricing (ORP) in Jakarta. The RP is the original charging policy being promoted by Jakarta's government and documented in the Jakarta comprehensive transportation master plan (SITRAMP, 2004; JUTPI, 2012). Considering the shortcomings of ORP that lead to poor public approval, a parking deposit system (PDS) is proposed as an alternative.

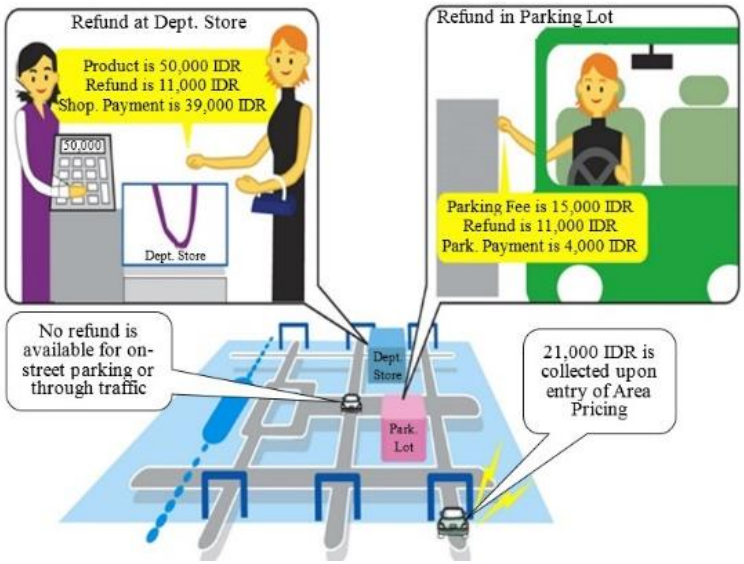


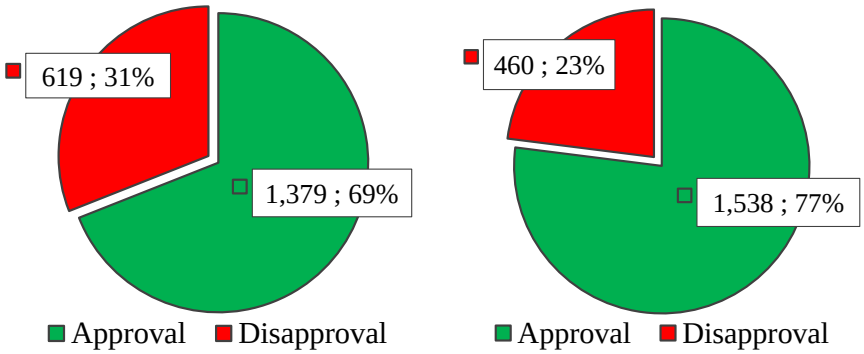
Figure 5.1 PDS outline

As described above, it formerly reports of a PDS (Miwa *et al*., 2009; Ando *et al*., 2010) consisted of a technical description and examination of effectiveness of a PDS established in the city center of Nagoya. Expecting to improve public approval, the PDS proposal has also been developed to present to Jakarta's citizens. It is thought that the PDS may gain greater approval because, along with a fixed charge, it offers refunds to motorized users. In its application, the PDS offers a refund for automobile users legally parking or shopping within the charging area. However, those who park unlawfully or who simply pass through the charging zone do not receive a refund and are therefore fully charged. Charging zone and PDS outline are illustrated in Figure 5.1. Moreover, instead of restraining overall automobile traffic, the refund offered by the PDS encourages visitors to contribute to local economic activity. Thus the PDS is expected to gain approval as well as reduce the negative impact of an ordinary ORP policy resulting from the public assumption that economic activity in the city center will decline. The tradeoff inherent in the PDS should be noted; while the refund proposal should

significantly increase public approval, there is a certain risk that it will not achieve the original aim of reducing automobile use (Miwa *et al.*, 2009). Since the PDS offers a refund, it may attract more people to the city, leading to only a minimal reduction in traffic. Hence, the charge and refund scheme should be analyzed to verify that the original goals of the PDS are met. However, in this study, the design of the charge and refund scheme is adopted from prior studies (Miwa *et al.*, 2009; Ando *et al.*, 2010). The Authors conducted a comprehensive experiment for designing pricing charge and refund scheme and PDS applicability in Nagoya city.

5.3 Data and Profiles

The data sets analyzed were collected through a stated choice survey which described in the **Chapter 3**. In total 1,998 sample were used for both voting choice of public approval each proposed schemes and inter-comparison of public approval amongst ORP and PDs.



(a) Public approval of ORP (b) Public approval of PDS

Figure 5.2 Inter-comparison of among ORP and PDS

Table 5.1 Inter-comparison of public approval amongst ORP and PDS

	Approval of PDS (%)	Disapproval of PDS (%)	Total (%)
Approval of ORP (%)	64.49	4.55	69.02
Disapproval of ORP (%)	12.51	18.47	30.98
Total (%)	76.98	23.02	100.00

Figure 5.2 shows the result of public approval on the two charging schemes and Table 5.1 depicts an inter-comparison of the rates of public approval and disapproval expressed. The rate of public approval for the schemes is quite elevated, at about 69% and 77% for ORP and PDS, respectively. Thus PDS improves the approval rate even if slightly (8%). The possible reason is that Jakarta's citizens find it quite difficult to understand and recognize the merits of PDS. This is reasonable because the concept of PDS is absolutely new to them. Inter-comparison result further depicts that nearly 65 % of citizens gravitate toward agreement with

the schemes, with surprisingly less than 23% rejecting any of scheme's bundles. The foremost reason for this is that Jakarta's citizens are tired of congestion-related collective problems, such as excessive travel times, air pollution, higher energy consumption, and driver frustration. They hunger for any breakthrough that might alleviate the problems. Thus, it does appear as if Jakarta's government has been successful in raising social acceptance of the schemes. Yet, according to the interview respondents, it is the desire for a solution to the problems that more significantly influences their decision.

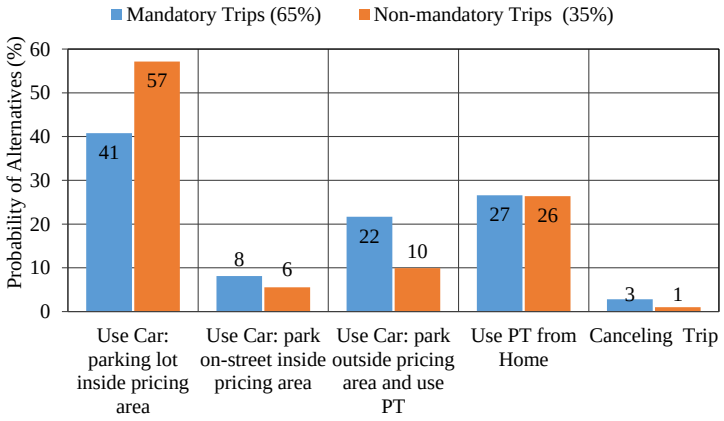


Figure 5.3 Mode and parking choice under scheme proposal

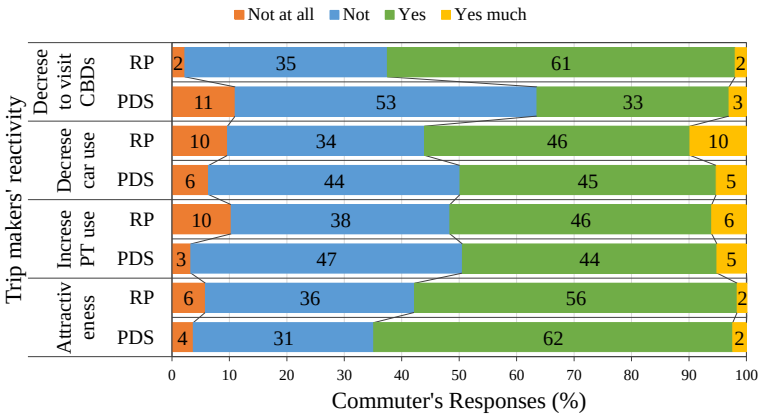


Figure 5.4 Trip makers' reaction under ORP and PDS proposals

To derive more information related to respondent's travel behaviors and their reaction toward strength and weakness of ORP and PDS strategies, among 1,998 samples in total 1,822 sample were valid and utilized for further analysis in this chapter after cleaning missing data. As initial step, travel behavior related to mode and parking choice were aggregated as illustrated in Figure 5.3. The result discloses that closely half of travelers prefer to use car and select legal parking lot inside proposed charging zone. Only few of them (less than 10%) utilize on-street parking within charging zone. Moreover, commuter and non-commuter trip makers are depicted similar tendency in using public transit mode. It shows that more than one quarter of them maintaining use public mode to enter CBD. Surprisingly, only few of them will cancel

their trip even if ORP and PDS will be implemented in Jakarta. It seems that proposed policy do not significantly affect their travel activities.

Turning to Figure 5.4, respondent intention were measured using 4-point Likert scale, aiming to measure magnitude of respondent reactions. The scale of not at all, not, yes and yes much are used to measure respondent reaction, as illustrated in Figure 5.4. A set of four measurements were selected, namely attractiveness, increase of public transport usage, decrease of car usage and decrease CBDs visitors. It reveals that respondents seemingly believe that PDS is more attractive compared to ORP. The likelihood is that PDS provides more flexible choices for visitors. It includes charges flexibility, refund for parking and discount for purchasing some goods inside pricing area. Moreover, PDS is also able to increase public transport usage and subtract car usage even if not so significantly displayed. Turning to decrease CBDs visitors, it discloses that PDS has less impact in reducing CBDs visitors compared to ordinary road pricing. It should be noted that maintain people enter to the city, leading to only a minimal reduction in traffic. Therefore, charges rate and refund patterns must be carefully analyzed to verify that the original goals of the PDS are met.

5.4 A Bivariate Binary Response (BBR) Model Analysis

5.4.1 Model Specifications

Public approval in relation to the ORP and PDS bundles prior to implementation in the Jakarta was explored by employing a bivariate binary response (BBR) model. BBR model is particularly suited to the analysis of binary responses. The model is used to describe the data-generating process for a random outcome that is one of a set of discrete, ordinal outcomes (Green & Henser, 2010). The thrust of the model is that an underlying intensity variable produces an observable counterpart that is strictly ordered by nature, such as a survey statement of the strength of one's preference. The bivariate model provides a convenient setting for estimating the effect of exogenous variables on the binary outcomes y_1 and y_2. Suppose that two latent variables are the propensities of a respondent to accept policy of ORP and PDS, respectively, and that these propensities are illustrated by two outcomes which are determined by system equations below, for BBR model without endogenous treatment:

$$y_{1,i}^{*} = \gamma_1' z_{1,i} + \beta_1' x_i + \varepsilon_{1,i} \quad (5.1)$$

$$y_{2,i}^{*} = \gamma_2' z_{2,i} + \beta_2' x_i + \varepsilon_{2,i} \quad (5.2)$$

where z_1, z_2 are vectors specific choice attributes for ORP and PDS, respectively and x is vectors of socio-demographics and mobility attributes for ORP and PDS, respectively. Then, the observed binary outcomes are given by:

$$y_1 = 1\left(y_{1,i}^{*} > 0\right), \; y_2 = 1\left(y_{2,i}^{*} > 0\right) \quad (5.3)$$

The joint distribution of y_1 and y_2 has four elements:

$$\begin{aligned} P(y_1 = 0, y_2 = 0|z_1, z_2, x) &= P(\varepsilon_{1,i} \leq -\gamma_1' z_{1,i} - \beta_1' x_i, \varepsilon_{2,i} \leq -\gamma_2' z_{2,i} - \beta_2' x_i) \\ P(y_1 = 1, y_2 = 0|z_1, z_2, x) &= P(\varepsilon_{1,i} > -\gamma_1' z_{1,i} - \beta_1' x_i, \varepsilon_{2,i} \leq -\gamma_2' z_{2,i} - \beta_2' x_i) \\ P(y_1 = 0, y_2 = 1|z_1, z_2, x) &= P(\varepsilon_{1,i} \leq -\gamma_1' z_{1,i} - \beta_1' x_i, \varepsilon_{2,i} > -\gamma_2' z_{2,i} - \beta_2' x_i) \\ P(y_1 = 1, y_2 = 1|z_1, z_2, x) &= P(\varepsilon_{1,i} > -\gamma_1' z_{1,i} - \beta_1' x_i, \varepsilon_{2,i} > -\gamma_2' z_{2,i} - \beta_2' x_i) \end{aligned} \quad (5.4)$$

In addition, the BBR model provides a convenient setting for estimating the effect of an endogenous binary regressor y_1 on binary outcome y_2, with specification written as:

$$y_{1,i}^* = \gamma_1' z_{1,i} + \beta_1' x_i + \varepsilon_{1,i} \quad (5.5)$$

$$y_{2,i}^* = y_1' \alpha_{2,i} + \gamma_2' z_{2,i} + \varepsilon_{2,i} \quad (5.6)$$

Assuming that individual's socio-demographic and mobility attributes are expected to be more contribute to multi-collinearity problem if we use in recursive model due to these variables have been introduced in non-recursive model. However, we keep using the keys of variable of congestion and environment awareness in both non-recursive and recursive model. Then, those explanatory variables are excluded in Eq. 5.6 in the recursive analysis. Following Eq. 5.5 and Eq. 5.6, the joint distribution of y_1 and y_2 can be drawn as:

$$\begin{aligned} P(y_1 = 0, y_2 = 0|z_1, z_2, x) &= P(\varepsilon_{1,i} \leq -\gamma_1' z_{1,i} - \beta_1' x_i, \varepsilon_{2,i} \leq -y_1' \alpha_{2,i} - \gamma_2' z_{2,i}) \\ P(y_1 = 1, y_2 = 0|z_1, z_2, x) &= P(\varepsilon_{1,i} > -\gamma_1' z_{1,i} - \beta_1' x_i, \varepsilon_{2,i} \leq -y_1' \alpha_{2,i} - \gamma_2' z_{2,i}) \\ P(y_1 = 0, y_2 = 1|z_1, z_2, x) &= P(\varepsilon_{1,i} \leq -\gamma_1' z_{1,i} - \beta_1' x_i, \varepsilon_{2,i} > -y_1' \alpha_{2,i} - \gamma_2' z_{2,i}) \\ P(y_1 = 1, y_2 = 1|z_1, z_2, x) &= P(\varepsilon_{1,i} > -\gamma_1' z_{1,i} - \beta_1' x_i, \varepsilon_{2,i} > -y_1' \alpha_{2,i} - \gamma_2' z_{2,i}) \end{aligned} \quad (5.7)$$

Let assume that $\varepsilon_{1,i}$ and $\varepsilon_{2,i}$ both have a bivariate normal distribution with mean zero and correlation $\rho_{\varepsilon_1 \varepsilon_2}$. Then, a standard normal bivariate cumulative density function is given by:

$$\Phi_2(y_1, y_2|z_1, z_2, x) = \Phi_2(\varepsilon_{1,i}, \varepsilon_{2,i}, \rho_{\varepsilon_1 \varepsilon_2}) \quad (5.8)$$

The joint probabilities of the BBR model have four parameters $\xi = (\gamma_1', \gamma_2', \alpha_1', \beta_1', \beta_2', \rho)$, where ρ is the correlation of the bivariate normal function. Suppose that for N observations(y_1, y_2, z_1, z_2, x) the likelihood function $L(\xi; y_1, y_2, z_1, z_2, x)$ is compactly given by:

$$L(\xi; y, z, x) = \prod_{i=1}^{N} \begin{bmatrix} P(y_{1,i} = 1, y_{2,i} = 1)^{y_{1,i} y_{2,i}} \text{x } P(y_{1,i} = 1, y_{2,i} = 0)^{y_{1,i}(1-y_{2,i})} \\ \text{x } P(y_{1,i} = 0, y_{2,i} = 1)^{(1-y_{1,i}) y_{2,i}} \text{x } P(y_{1,i} = 0, y_{2,i} = 0)^{(1-y_{1,i})(1-y_{2,i})} \end{bmatrix} \quad (5.9)$$

Transforming Eq. (5.9) into log-likelihood function:

$$LL(\xi; y, z, x) = \sum_{i=1}^{N} \begin{bmatrix} (y_{1,i} y_{2,i}) \ln[P(y_{1,i} = 1, y_{2,i} = 1)] + y_{1,i}(1 - y_{2,i}) \ln[P(y_{1,i} = 1, y_{2,i} = 0)] \\ + (1 - y_{1,i}) y_{2,i} \ln[P(y_{1,i} = 0, y_{2,i} = 1)] + (1 - y_{1,i})(1 - y_{2,i}) \ln[P(y_{1,i} = 0, y_{2,i} = 0)] \end{bmatrix} \quad (5.10)$$

where (y_1, y_2), $y_1(1-y_2)$, $(1-y_1)y_2$ and $(1-y_2)$ $(1-y_1)$ are indicator function for four binary outcomes in Eq. 5.4 and Eq.5.7, respectively. Unknown parameters in BBR model were estimated using log-likelihood function Eq. 5.10 which is written and implemented in GAUSS econometric programming version 3.2.32.

5.4.2 Empirical Setting

The observed individual contribution to ORP or PDS bundle approval is treated as an apparent endogenous variable, with the variables categorized as shown in Table 5.2. Noted that the voting results corresponding to the charging proposals are treated as dependent variable.

Table 5.2 Categories of ORP and PDS acceptability

Voting Category	ORP policy		PDS policy	
	Frequency	Percentage	Frequency	Percentage
(1) Agree	1,318	72.34	1,438	78.92
(2) Disagree	504	27.66	384	21.08

Table 5.3 Description of explanatory variables

Variable	Description	Statistics	
		Mean	Std.
Specific choice attributes for ORP policy			
Charge per car (IDR)	10,000 to 35,000 IDR	24,430	10,516
Fairness of ORP	1 if quite fair/fair, 0 otherwise	0.738	0.440
Congestion awareness	1 if quite aware/aware, 0 otherwise	0.796	0.403
Environment awareness	1 if quite aware/aware, 0 otherwise	0.769	0.422
Freedom of driving (ORP)	1 if no impedance at all/little, 0 otherwise	0.339	0.473
Consequence of driving (ORP)	1 if no impedance at all/little, 0 otherwise	0.455	0.498
Consequence of visiting CBD (ORP)	1 if no decrease at all/little, 0 otherwise	0.319	0.466
Specific choice attributes for PDS policy			
Refund per car (IDR)	7,000 to 35,000 IDR	17,791	8,172
Fairness of PDS	1 if quite fair/fair, 0 otherwise	0.738	0.440
Congestion awareness	1 if quite aware/aware, 0 otherwise	0.796	0.403
Environment awareness	1 if quite aware/aware, 0 otherwise	0.769	0.422
Freedom of driving (PDS)	1 if no impedance at all/little, 0 otherwise	0.681	0.466
Consequence of driving (PDS)	1 if no impedance at all/little, 0 otherwise	0.505	0.500
Consequence of visiting CBD (PDS)	1 if no decrease at all/little, 0 otherwise	0.375	0.484
Mobility and socio-demographics attributes			
Purpose to visit CBD	1 if mandatory trips, 0 otherwise	0.559	0.497
Licensed driver	1 if licensed driver, 0 otherwise	0.703	0.457
Mode used	1 if used car, 0 otherwise	0.584	0.493
Freq. visit CBD	1 if ≥ 3 times/week, 0 otherwise	0.390	0.488
Male dummy	1 if male, 0 otherwise	0.521	0.500
Young Dummy	1 if ≤ 35 years	0.385	0.487
Low income dummy	1 if ≤ 4,000,000 IDR/month	0.131	0.337

A total of 1,822 samples are used in the study. This data set offers a variety of information including charging and refund patterns, recognition, fairness, awareness, impedance of the schemes, expectation of charging policy consequences, person mobility attributes, and

personal socio-demographic characteristics. These variables, which are summarized in Table 5.3, are incorporated in the analysis.

5.4.3 Empirical Results

The BBR model estimation results for without endogenous treatment (BBR model-1) and with endogenous treatment (BBR model-2) are presented in Table 5.4.

Table 5.4 Estimation results of BBR models

Variable	BBR model-1 without endogenous treatment		BBR model-2 with endogenous treatment	
	Coefficient	t-value	Coefficient	t-value
Acceptability of ORP policy				
Constant	-0.067	-0.35	-0.121	-0.62
Charge per car (IDR)	-0.092	-2.46	-0.095	-2.51
Fairness of RP	0.765	8.07	0.764	8.04
Congestion awareness	1.288	10.07	1.302	10.09
Environment awareness	0.363	3.03	0.372	3.09
Freedom of driving	-0.361	-4.17	-0.360	-3.95
Consequence of driving	-0.147	-1.70	-0.149	-1.68
Consequence of visiting CBD	-0.347	-3.95	-0.364	-3.99
Purpose to visit CBD	-0.308	-3.41	-0.218	-2.06
Licensed driver	-0.148	-1.47	-0.149	-1.52
Mode used	-0.166	-1.81	-0.169	-1.89
Freq. visit CBD	-0.125	-1.36	-0.097	-1.08
Male dummy	-0.036	-0.42	-0.077	-0.90
Young Dummy	-0.137	-1.64	-0.119	-1.40
Low income dummy	-0.227	-2.00	-0.225	-2.01
Acceptability of PDS policy				
Constant	-0.765	-4.24	-1.073	-7.84
Vote of RP	-	-	0.277	3.56
Refund per car (IDR)	0.130	2.61	0.1197	2.34
Fairness of PDS	0.404	4.05	0.3492	2.18
Congestion awareness	0.763	5.96	0.6521	2.84
Environment awareness	0.442	3.66	0.433	3.45
Freedom of driving	0.599	6.95	0.627	7.14
Consequence of driving	0.196	2.55	0.203	2.52
Consequence of visiting CBD	0.173	2.04	0.212	2.40
Purpose to visit CBD	-0.397	-4.31	-	-
Licensed driver	-0.013	-0.12	-	-
Mode used	-0.007	-0.08	-	-
Freq. visit CBD	-0.108	-1.15	-	-
Male dummy	0.177	2.07	-	-
Young Dummy	-0.123	-1.46	-	-
Low income dummy	-0.072	-0.61	-	-
Rho	0.614	14.62	0.4769	1.94
Sample size (N)	1,822		1,822	
LL(initial)	-2,521.67		-2,521.67	
LL(β)	-1,196.75		-1,207.45	
$\bar{\rho}^2$	0.514		0.511	
AIC	2,455.51		2,464.91	

The variable of charge has a negative sign for acceptance of both ORP and PDS. This hints at the role charge plays in acceptability; that is, the higher the charge, the fewer people will feel

accepting about ORP and the likely they are to oppose the schemes. On the other hand, the refund variable has the opposite sign to the charge variable. While a refund variable has a significant positive sign, it is arguable that the refund scheme helps gain public approval. Importantly, in the BBR model-2 with endogenous treatment (recursive), a structurally acceptance of ORP has a significantly contribution on the acceptance of PDS. This may partially because of PDS offering refund and likely that respondents are able to recognize the superiority of PDS compared to ORP.

Concerning to respondent's intentions, the fairness of ORP and PDS schemes also have a positive effect on approval of ORP. It seems that respondents are prone to accept ORP if they have sufficient feeling of fairness to the proposed scheme. The awareness variables (for both congestion and environmental awareness) have a positive sign. The likelihood is that respondents are weary of encountering the collective problem of congestion, which is manifested in the form of noise and emissions resulting from traffic jams. Respondents probably look forward to any promise of a breakthrough that will cut down traffic congestion and eventually reduce these collective problems.

In respect to the impedance variables, namely freedom of driving, consequence of driving and visiting city center if ORP or PDS bundles implemented have a negative sign for ORP policy acceptance whereas a positive contribution are alerted for PDS acceptance. That is, respondents think that the schemes will limit their freedom of driving and visiting. These perceived obstacles to mobility may contribute considerably to reasons for rejecting the schemes. On the other hand, the ORP scheme has a negative acceptability sign while PDS has positive acceptability. It is likely that respondents tend to reject ORP because they do not want to reduce car usage while they are more accepting of PDS because it offers them a refund. That is, the refund appears to elevate approval of the charging scheme.

Looking at personal mobility attributes, purpose to visit city center, licensed respondents and those who frequency visit the CBD have a good fit with ORP and PDS acceptability. Both variables have a negative effect on ORP approval. The more licensed drivers there are or the more frequently respondents visit the CBD, the more they are likely to oppose the scheme. Furthermore, the more frequently respondents use a private transportation mode to enter the CBD, the less chance that they will approve of the ORP and PDS schemes. Since there is a lack of adequate public transport in the charging zone (with a heavy reliance on Jakarta's BRT), it is unlikely that people will change to a public transport mode. Consequently, private car users tend to oppose ORP policy and are unlikely to reduce use of their cars after the implementation of charges. Turning to personal socio-demographic attributes, a dummy male has a negative sign to fit ORP acceptability while a positive alert for PDS acceptability.

However, both of young dummy ages and incomes have a negative contribution for both RP and PDS.

5.5 Conclusions

This preliminary study offers some useful indications for the improvement of ORP policy, in the form of empirical evidence of the focus required. In particular, it indicates which stakeholders should be approached and the extent to which policy can solve the problem. The main highlight of the study is that recognition, fairness, awareness, and impedance have the most significant influence on the public approval rate for both the ORP and PDS bundles. With Jakarta's government planning ongoing measures to gain acceptance of this transportation policy, this finding should prove useful information in improving the public approval rate. A positive sign is attributed to the public's perception of congestion problems and environment awareness. Awareness is the crucial factor concerning public support. And since Jakarta's citizens are exhausted by congestion-related problems, they are ready for any move that promises to alleviate the congestion. That is, they are aware of the collective problems and are willing to look for solutions for the community.

Barriers to acceptance are the desire for freedom of movement and the ability to make transportation mode choices. People do not want to change from the private mode to the public mode, indicating that there is as yet insufficient public transport serving the charging corridors. Thus, the Jakarta government should provide alternative public transit modes or increase the capacity of the existing BRT system before implementing ORP. Finally, the PDS proposal offers considerable promise as an alternative of ORP, since it leads to improved public approval while avoiding any declining visitors to the city center. Thus, introduction of the outline PDS is highly recommended even empirical results show that public approval improves slightly. Therefore, deeper investigations are needed to verify the goodness of PDS compared to ORP across users in order to prove that PDS is a consistent policy to cut down cars traffic.

To conclude, the results confirm that there is a complementary relationship between approval and consciousness. The empirical evidence suggests that the characteristics of recognition, fairness, awareness and impedance of freedom have the most significant influence on public approval rate. Although this study empirically reveals several important approaches for gaining public approval, it does not take into account in deeply unobservable (psychological factors) into the analysis, such contexts could have significant influence to the individual choice behavior in respecting policy acceptance. More exploration on individual choice behavior considering unobserved (latent psychological intentions) is suggested. Furthermore, this chapter also assumes that heterogeneous type of respondents hold in the acceptance choice

analysis. Taking into consideration group type of respondents could provide more valuable insight into individual's choice behavior in determining the acceptance of the scheme's proposal.

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Chapter 6

PUBLIC ACCEPTANCE BEHAVIOR CONSIDERING PSYCHOLOGICAL FACTORS AND LATENT TYPE OF RESPONDENTS

6.1 Background

Extensive psychological studies have been considered to identify individual factors that affect public support, indicating that the acceptability of transport pricing appears to be explained by a wide range of psychological motivations. Policy acceptance strongly corresponds to individual perceptions of the policy, such as perceived environmental benefits, improved freedom of movement and knowledge of the charging system (Falzarano, 2009; Odioso & Smith, 2009; Jaensirisak *et al*., 2005). These indicators can contribute significantly to the evaluation of various unobservable factors and can be used to enhance public support.

A preliminary result in **Chapter 5** reveals that public acceptance is strongly correlated to not only observable variables (tangible) but also unobservable factors (intangible) such as individual psychological perceptions. Searching to explanatory power has been carried out in **Chapter 5**, it found that recognition, fairness, awareness, and impedance of freedom of movements have the most significant influence on the public approval of CC proposal. Although, empirically result indicated several important determinants of psychological perceptions in effecting public approval, it does not comprehensively take into account individual's psychological factors. That is, simply treating a 4-point Likert scale (ordered responses) from psychometric data into dummy variables. Meaning that the behavioral explanation from the psychometric data could not comprehensively reveal by converting four ordered response into dummy variables. Therefore, in this chapter, more exploration of psychological factors will be carried out using latent variable modeling approach. This

contexts could enhance significant explanatory power to the individual choice behavior in discrete choice model in order to gain more pronounced valuable insight from psychological factors. In addition, the result in **Chapter 4**, findings revealed that considerable differences in average of TEFs among household life stages. The variation of frontier values as well as the trends in the ratio of expenditure to frontier values considerably differ across life stage groups. Results further suggest that the actual transport expenditure are closer to the frontier values for across life stage groups. This findings reveal that people in Jakarta are consequently facing higher expenditure pressure. Meaning that people are largely using their frontier (transport expenditure capacity). Therefore, in this chapter, transportation expenditure will be considered as additional measures for investigating public response behavior toward CC proposal.

This chapter attempt to use latent variables representing psychological motivations to explore individual's intentions with respect to CC proposal in Jakarta. Additionally, further analysis is conducted to capture observable preference heterogeneity across respondents by considering decision making protocol such as latent segmentation of type of respondents.

6.2 Data

Using SP survey data that was described in **Chapter 3**, this chapter incorporate the influence of comprehensive set of explanatory variables into four categories: the level of charges, latent variables related to respondent's psychological motivations, mobility attributes and socio-demographic characteristics. In total 1,641 samples were valid and utilized as data set in this analysis after cleaning up missing data.

6.3 Modeling Frameworks

This this section describes the research methodology used in this chapter. It has been well-established in recent years that attitudes and perceptions also influence individual behavior. Traditional discrete choice models have considered only measurable attributes from the alternatives (Yanez *et al*., 2010). To capture the impact of subjective factors on the decision process, the hybrid discrete choice (HDC) model was proposed by Walker & Ben-Akiva, (2002). The HDC model allows not only tangible attributes to be measured but also intangible exogenous attributes that are unmeasurable directly (intangible). These are, rather, associated with an individual's attitudes and perceptions. The HDC model is formally used to improve behavioral representations and to obtain more explanatory power in choice models by inclusion of latent variables in the utility function (see Walker and Ben-Akiva, 2002; Bierlaire *et al*., 2010). Two approaches to HDC model are now widely available, one based on the sequential approach (see for example Yanez *et al*., 2010; Raveau *et al*., 2010) and the other a simultaneous framework (see for instances Bolduc et al., 2008; Raveau *et al*., 2010). The second approach offers efficient and consistent estimators of parameters but has been used

less because of it is more complex and computationally cumbersome particularly when larger number of latent constructs are introduced. Further noted by Temme *et al*., (2008) mentioned that sequential approach is deficient in the sense both inconsistent estimates random utility part and does not allow direct relationship among latent predictors and revealed choice. Overcoming this deficient leads to full information estimation (simultaneously). However, increasing number of latent variables, the computational complexity may rise exponentially. For this reason, in this chapter uses the sequential approach in order to reduce the complexity and computational problems, the same approach will be used in Chapter 7. Noted that the shortcomings of sequential method are less efficient and consistent estimated parameters. In the sequential method, estimations are dealt with in two stages: latent variable estimation and the discrete choice model, as illustrated in Figure 6.1. The framework comprises three components: 1) a latent variable model; 2) a latent variable ordered response model; 3) a latent class ordered response model. In particular for the latent class ordered response model is a bi-level model with class membership selection in the upper level and class specific (conditional) choice in the lower level.

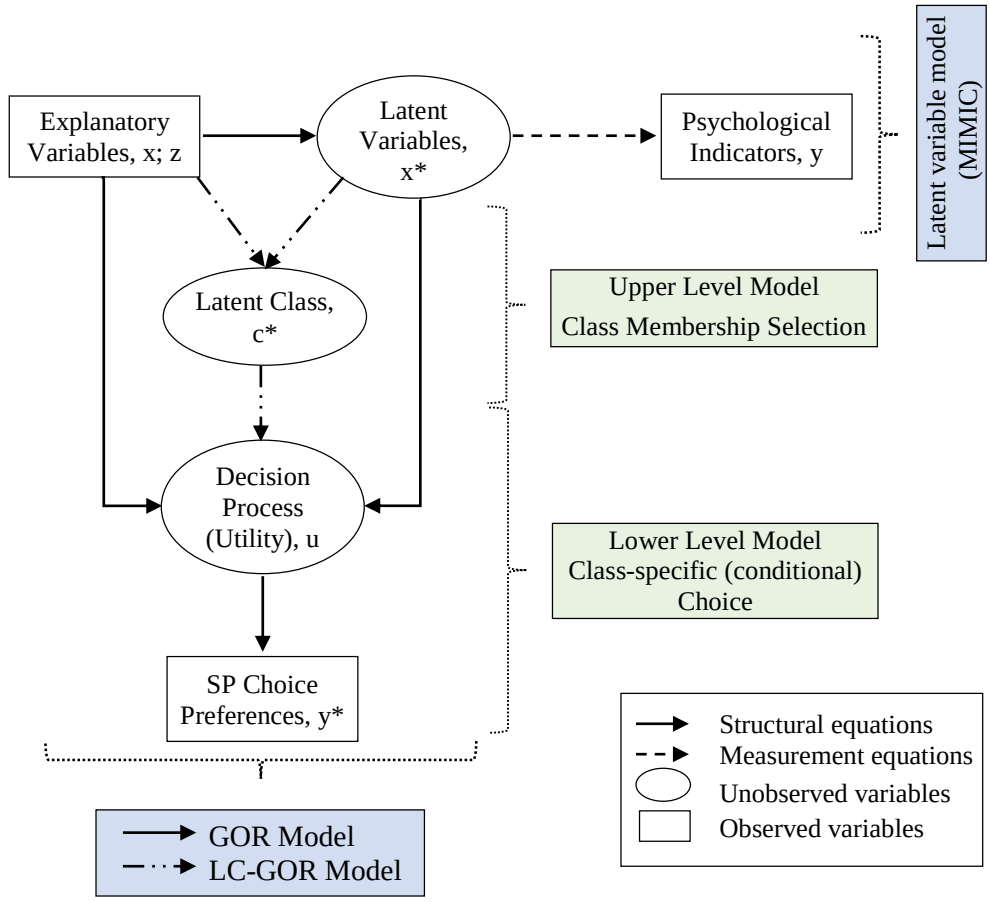


Figure 6.1. Latent variable and class modeling framework

6.3.1 Multiple-Indicators Multiple-Causes (MIMIC) Model

Prior to the discrete ordered response procedure, we estimate latent variables from psychometric data that we obtained from SP questionnaire. The approach used is a common one: confirmatory factor analysis with covariates, formerly known as the multiple-indicators multiple-causes (MIMIC) model (Joreskog & Goldberger., 1975). The model explains inter-relations between observed variables and latent variables by minimizing the distance between the sample covariance matrix and a covariance matrix predicted by the model (Buehn & Schneider, 2008). Systematically, the MIMIC model consists of a structural equation model and a measurement model, respectively given by:

$$\eta_i = B\,\eta_i + \Gamma x_i + \zeta_i \quad (6.1)$$

$$y_i = \Lambda\,\eta_i + \varepsilon_i \quad (6.2)$$

where y_i is a vector of observable psychological indicators variables, x_i is a vector of explanatory variables that cause η_i, B, Γ and Λ are matrices of unknown parameters to be estimated, and the terms ζ_i and ε_i are measurement errors. Parameters in this study were estimated using LISREL 9.1. Prior to parameters estimation, variable of indicators and dummy variables of causes were formatted as ordinal data in order to estimate ACM. Noted that the estimation of an asymptotic covariance matrix (ACM) can be directly estimate using LISREL 9.1. It is no longer necessary to estimate an ACM with PRELIS (Joreskoq and Sorbom, 2012).

Concerning to psychological scenarios, six psychological scenarios are constructed corresponding to nineteen psychological perceptions (indicator). As mentioned in **Chapter 2**, the degree of acceptability correlates positively with personal outcome expectations and perceived effectiveness of proposed policy (Schade & Schlag, 2003). Thus, two latent variables including appropriateness of CC adoption (APR) and recognition of scheme's effect (REC) were constructed to deal with in order to personal outcome expectations and perceived effectiveness of proposed policy. Moreover, acceptability of a scheme is well explained by determinants expected effects of the policy implementation (Schitema *et al*., 2010), environmental benefits and improved freedom of movement (Falzarano, 2009; Odioso & Smith, 2009; Jaensirisak *et al*., 2005). Therefore, three more latent variables namely doubt about the ability of CC policy (DEC), Car dependency (CDC) and Inhabitation freedom of movements (IFM) were measured. Additionally, special measures of awareness of problem car in society (APC) is proposed to investigate the perception of respondents concerning traffic condition and environment for pedestrian in city center of Jakarta. Causal paths among structural equations and measurement equations were hypothesized and constructed as shown in Figure 6.2.

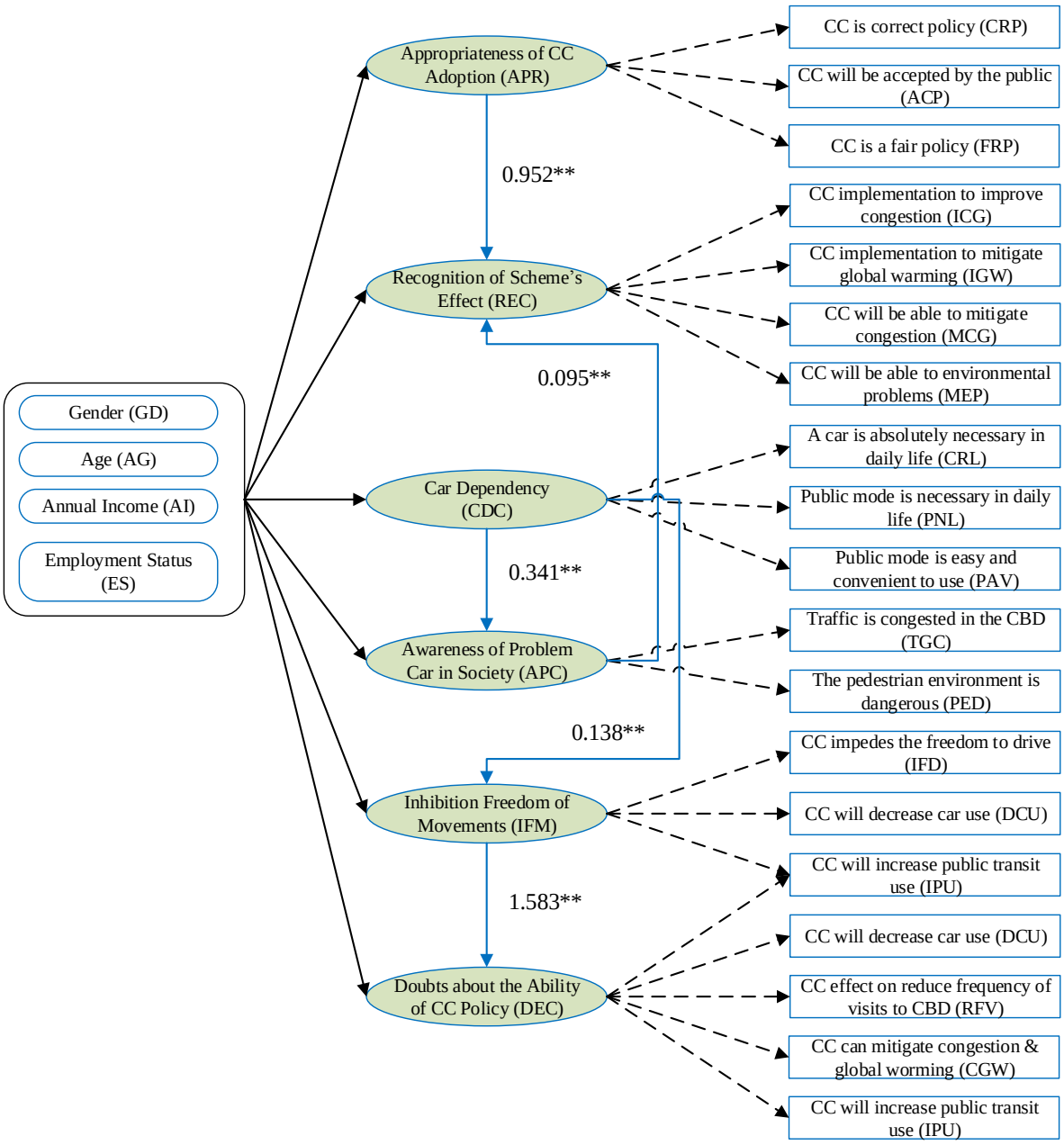


Figure 6.2. Structural hypothesis of MIMIC model Framework

6.3.2 Generalized Ordered Response (GOR) Model

Public acceptance in relation to the CC scheme is explored by employing the generalized ordered response (GOR) model framework. The model is used to describe the data-generating process for a random outcome that is one of a set of discrete, ordered outcomes (Greene & Hensher, 2010). The thrust of the model is that an underlying intensity variable produces an observable counterpart that is strictly ordered by nature, such as a survey statement of the strength of one's preference.

Let *i* (*i*=1,2,….., *I*) be an index representing the observation unit and let *j* (*j*=1,2,..,*J*) be an index representing the ordinal value *j* of an ordered-response variable. The system equation for the standard ordered response (SOR) model is determined by system equation as follows:

$$y_i^* = \beta x'_i + \lambda \eta'_i + \varepsilon_i \ , y_i = j \quad \text{if } \mu_{j-1} < y_i^* \leq \mu_j \tag{6.3}$$

where x_i and η_i are a vector of the observed and latent exogenous variables, β and α are a vector of the unknown parameters, representing the individual observations, and *j* represents ordinal preferences. The random error term is assumed independent and identically distributed (IID) across individual observations with a standard normal distribution. Then, the individual contribution to the likelihood function can be drawn as:

$$\mathrm{P_r}(y = j) = \Phi\left(\mu_j - \beta x'_i - \lambda \eta'_i\right) - \Phi(\mu_{j-1} - \beta x'_i - \lambda \eta'_i) \tag{6.4}$$

where Φ(.) represents a standard normal cumulative density function, and μ_j and μ_{j+1} represent the upper and lower thresholds for outcome *j*. In the SOR model of Eq. 6.3, the thresholds μ are assumed to be fixed across individuals. One obstacle to the appropriate implementation of SOR model is the single index or parallel line assumption (see e.g. Long, 1997; Winkelmann & Baes, 2009; Castro *et al*., 2012). Moreover, SOR model treats the coefficient λ, β as the same for all ordinal preferences *J*. That is, by increasing an independent variable, the accumulated distribution shifts to the left or right. However, the slope of the distribution remains unchanged. Rejecting this assumption of a constant threshold and allowing flexibility of the threshold across all outcomes lead to a generalized ordered response (GOR) model. The basic idea of GOR model is to make the threshold parameter a linear function of the covariates (Maddala, 1983; Winkelmann & Baes, 2009):

$$\mu_j = \tilde{\mu}_j + (x'_i + \eta'_i)\gamma_j \qquad j = 1, \dots\dots, J \tag{6.5}$$

Substitution of Eq. 6.5 in Eq. 6.4 yields:

$$\mathrm{P_r}(y = j) = \Phi\left(\tilde{\mu}_j - \beta_j x'_i - \lambda_j \eta'_i\right) - \Phi(\tilde{\mu}_{j-1} - \beta_{j-1} x'_i - \lambda_{j-1} \eta'_i) \tag{6.6}$$

where β_j=β-γ_j and λ_j=λ -γ_j since λ,β and γ_j cannot be identified separately, and it is understood that $\tilde{\mu}_0$=-∞ and $\tilde{\mu}_j$=∞ such that $\Phi(-\infty) = 0$ and $\Phi(\infty) = 1$. In order to proceed with a maximum likelihood estimation of the parameter vector α, β and the *J-1* threshold parameter $\tilde{\mu}_1, \dots\dots, \tilde{\mu}_{j-1}$, we rewrite the general probability in Eq. 6.6 into a conditional probability function as below:

$$L(\beta, \lambda, \mu; y, x, \eta) = \prod_{i=1}^{I} \prod_{j=1}^{J} \left[\begin{matrix} \Phi\left(\tilde{\mu}_j - \beta_j x'_i - \lambda_j \eta'_i\right) \\ - \Phi(\tilde{\mu}_{j-1} - \beta_{j-1} x'_i - \lambda_{j-1} \eta'_i) \end{matrix} \right]^{h_{ij}} \tag{6.7}$$

where h_{ij} is the indicator function, with a value of 1 if respondent *i* chooses outcome j, and 0 otherwise. Then, rewriting Eq. 6.7 into the log likelihood form over the population of *I* observations, we obtain:

$$\log L(\beta, \lambda, \tilde{\mu}; y, x, \eta) = \sum_{i=1}^{I} \sum_{j=1}^{J} h_{ij} \log \begin{bmatrix} \Phi\left(\tilde{\mu}_j - \beta_j x'_i - \lambda_j \eta'_i\right) \\ -\Phi(\tilde{\mu}_{j-1} - \beta_{j-1} x'_i - \lambda_{j-1} \eta'_i) \end{bmatrix} \tag{6.8}$$

By maximizing the log likelihood function represented by Eq. 6.8, the unknown parameters can be obtained. Parameter estimation is distinguished by using SOR model and the GOR model which are both written and implemented in GAUSS 3.2.32.

6.3.3 Latent Class Generalized Ordered Response (LCGOR) Model

Applications of latent class (segment) modeling have been used to improve behavioral representations and to obtain explanatory power in choice models (see e.g. Ben-Akiva & Boccara, 1995; Swait, 2001; Walker & Ben-Akiva, 2002; Bierlaire *et al.*, 2010). An innovative framework using a latent class based generalized ordered response (LCGOR) model is used for modeling public acceptance. The LCGOR model is a form of bi-level modeling as described in the following subsections.

Upper level model: class membership selection

The modeling concept is based on the assumption that there may be discrete classes of decision makers that are not immediately identifiable from the data set (that is, they are latently identified). A CC policy may stimulate a feeling of infringement. That is, a people might psychologically perceive that their freedom will be limited to some extent, leading to negative feelings on becoming conscious of the policy. Formally, we define a latent variable *c** which determines latent class membership. Suppose that the population of respondents consist of different behavioral classes: the class 1 ("s") and the class 2 ("a"). Different classes may exhibit different choice behavior. Yet, respondents in the same class use the same behavior in making their choices. Then, the utility function for individual *i* belonging to class *s* is as:

$$U_{i|c=1} = \alpha z'_i + u_i \tag{6.9}$$

The probability of respondent *i* belonging to the class membership *s* or *a* is given by:

$$P_r(c = 1|z_i) = \Phi(\alpha z'_i) \tag{6.10}$$

$$P_r(c = 2|z_i) = 1 - P_r(c = 1|z_i) = 1 - \Phi(\alpha z'_i) \tag{6.11}$$

where z_i is a vector of the respondent's characteristics, α is a vector of the unknown parameters, and u_i is a class-specific idiosyncratic random disturbance term assumed to be identically and independently following a standard normal distribution.

Lower level model: class specific (conditional) choice

The latent class framework here states that conditional on being class 1 or 2, outcomes are then determined by using ordered response model. A common disaggregate approach with ordered outcomes is the SOR model. Hence, the SOR model imposes a restrictive and monotonic impact for the exogenous attributes on each outcome alternative as it is discussed in the previous section. To maintain the ordering conditions and allow the thresholds to vary across respondents within class memberships. Eluru *et al.*, (2012) and Yasmin *et al.*, (2014) propose a non-linear parameterization of the thresholds for the logit model. Here, the parameterization is assumed to be a linear function of the covariates (Maddala, 1983) and it recovers to GOR model in Eq. 6.6. In the previous section, it explained the SOR model and GOR model by incusing latent variables into discrete choice model. In this section, we derive LCSOR model and LCGOR model based on Eq. 6.4 and Eq. 6.6.

Following specification in Eq. 6.4, the overall conditional probability of choice preferences *j* is the sum of those from the two respective class memberships. Combining Eq. 6.4 and Eq. 6.10 & 6.11 final choice probabilities for LCSOR model yields:

$$\begin{aligned} & P_r(y_i = j|z_i, x_i) \\ &= P_r(c = 1|z_i)P_r(y_i = j|x_i, c = 1) + \big(1 - P_r(c = 1|z_i)\big)P_r(y_i = j|x_i, c = 2) \\ &= \Phi(\alpha z'_i)\{\Phi\left(\mu_{1,j} - \beta_1 x'_i - \lambda_1 \eta'_i\right) - \Phi\big(\mu_{1,j-1} - \beta_1 x'_i - \lambda_1 \eta'_i\big)\} \\ &+ (1 - \Phi(\alpha z'_i))\{\Phi\left(\mu_{2,j} - \beta_2 x'_i - \lambda_2 \eta'_i\right)\Phi\left(\mu_{2,j} - \beta_2 x'_i - \lambda_2 \eta'_i\right)\} \end{aligned} \tag{6.12}$$

and compounding Eq. 6.6 and Eq. 6.10 & 6.11 yields the final choice probabilities for the LCGOR model:

$$\begin{aligned} & P_r(y_i = j|z_i, x_i) \\ &= P_r(c = 1|z_i)P_r(y_i = j|x_i, c = 1) + \big(1 - P_r(c = 1|z_i)\big)P_r(y_i = j|x_i, c = 2) \\ &= \Phi(\alpha z'_i)\{\Phi\big(\tilde{\mu}_{1,j} - \beta_{1,j} x'_i - \lambda_{1,j} \eta'_i\big) - \Phi(\tilde{\mu}_{1,j-1} - \beta_{1,j-1} x'_i - \lambda_{1,j-1} \eta'_i\} \\ &+ (1 - \Phi(\alpha z'_i))\{\Phi\big(\tilde{\mu}_{2,j} - \beta_{2,j} x'_i - \lambda_{2,j} \eta'_i\big) - \Phi(\tilde{\mu}_{2,j-1} - \beta_{2,j-1} x'_i - \lambda_{2,j-1} \eta'_i\} \end{aligned} \tag{6.13}$$

Eventually, taking Eq. 6.12 and Eq. 6.13 into the likelihood function for the entire set of observations can be written as:

$$L(\gamma, \lambda, \beta, \mu; z, y, x, \eta) = \prod_{i=1}^{I} \prod_{j=1}^{J} \big[P_r(y_i = j|z_i, x_i)^{h_{ij}}\big] \tag{6.14}$$

$$L(\gamma, \lambda, \beta, \tilde{\mu}; z, y, x, \eta) = \prod_{i=1}^{I} \prod_{j=1}^{J} \big[P_r(y_i = j|z_i, x_i)^{h_{ij}}\big] \tag{6.15}$$

Rewriting Eq. 6.14 and Eq. 6.14 into the log likelihood formulation over *I* observations, we obtain:

$$LL(\gamma, \lambda, \beta, \mu; z, y, x, \eta) = \sum_{i=1}^{I} \sum_{j=1}^{J} h_{ij} \log[P_r(y_i = j|z_i, x_i)] = \sum_{i=1}^{I} \sum_{j=1}^{J} h_{ij} \log \left[\sum_{c=1}^{C} P_{r\,ij|P_c} \right] \quad (6.16)$$

$$LL(\gamma, \lambda, \beta, \mu; z, y, x, \eta) = \sum_{i=1}^{I} \sum_{j=1}^{J} h_{ij} \log[P_r(y_i = j|z_i, x_i)] = \sum_{i=1}^{I} \sum_{j=1}^{J} h_{ij} \log \left[\sum_{c=1}^{C} P_{r\,ij|P_c} \right] \quad (6.17)$$

where h_{ij} is the indicator function, with a value of 1 if respondent *i* chooses outcome j, and 0 otherwise. $Pr_{ij|c}$ are the choice probabilities of respondent *i* being in choice outcome *j* conditional on class membership *c*. In this study, the log-likelihood function is written and implemented in GAUSS econometric programming version 3.2.32.

6.4 Result and Analysis

6.4.1 MIMIC Model Result and Analysis

The ordinal psychological-related questions included in the stated preference experiments transform into latent variables representing constructs of psychological indicators using a 4-point Likert scale.

Table 6.1 Empirical setting and path loading for indicators (measured equation)

Variables				Path coefficients	
Latent		Indicator*		Coeff.	t-value
APR	Appropriateness of CC adoption	CRP	CC is correct policy	1.000	-
		ACP	CC will be accepted by the public	0.893	39.32
		FRP	CC is a fair policy	0.878	38.13
REC	Recognition of scheme's effects	ICG	CC implementation to improve congestion	1.000	-
		IGW	CC implementation to mitigate global warming	0.996	56.47
		MCG	CC will be able to mitigate congestion	0.866	42.13
		MEP	CC will be able to mitigate environmental problems	0.852	40.95
CDC	Car dependency	CNL	A car is absolutely necessary in daily life	1.000	-
		PNL	Public mode is necessary in daily life	0.783	7.14
		PAV	Public mode is easy and convenient to use	-1.072	-8.59
APC	Awareness of the problem of cars in society	TGC	Traffic is congested in the CBD	1.000	-
		PED	The pedestrian environment is dangerous	0.723	12.81
IFM	Inhibition of freedom of movements	IFD	CC impedes the freedom to drive	1.000	-
		DCU	CC will decrease car use	-0.667	-7.53
		IPU	CC will increase public transit use	-0.996	-11.68
DEC	Doubts about the ability of CC policy	DCU	CC will decrease car use	1.000	-
		RFV	CC reduces frequency of visits to CBD	0.385	11.03
		CGW	CC can mitigate congestion & global worming	0.525	12.97
		IPU	CC will increase public transit use	0.951	11.94

*Note: * using ordinal responses of 4-point Likert scale 1=strongly supported/agreed, 4=strongly opposed/disaggreed.*

Variables notation, definition and empirical setting for both indicators and causes are summarized in Table 6.1 and Table 6.2. Table 6.1 and Table 6.2 give the estimation results of the MIMIC model. The factors loading for indicators and causes into latent variables are listed in Table 6.1 and Table 6.2, respectively. A number of indices were computed to explain the fit of the model in the model fitting process. The fit indicators include the comparative fit index (CFI=0.92), the root mean square error of approximation (RMSEA=0.09) and the standardized root mean square residual (SRMR=0.07) likewise exhibit moderate acceptable fits (Hooper *et al*., 2008).

Table 6.1 displays that the validity of CC adoption (APR, REC and APC) have similarly a positive tendency of contribution for scheme proposal. Concerning to CDC, it appears that transit and its availability have negative scores for the CDC. A negative sign of transit availability may partially indicator of the car dependency in Jakarta. Interestingly, IFM contributes as barrier for correct and acceptable scheme while doubts about the ability of CC policy in mitigate congestion has a positive sign.

Table 6.2 Empirical setting and path loading for causes (structural equation)

Variables		Path coefficients					
Causes		APR	REC	CDC	APC	IFM	DEC
GD	Gender (1 male, 0 otherwise)	0.065	-	0.064	0.070	0.079	0.059
AG	Age (1≥40 years, 0 otherwise)	0.285	-	0.030	0.094	0.043	0.048
AI	Income (million IDR)	-	0.014	0.274	0.160	-	0.085
ES	Employment status (1 employed, 0 otherwise)	0.074	-	-	-	-	0.098

Note: all path coefficients are significant at the 5% level.

Concerning to respondent's socio-demographic attributes, Table 6.2 displays the gender variable of males have a positive marks on the latent variables of car dependency (CDC) and inhibition freedom of movement (IFM). It seems that male respondents are more dependent on private car use. Consequently they will perceive CC implementation as inhibiting their freedom of movement. Interestingly, we found that respondents over 40 years old are more concerned with the appropriateness of CC adoption and have more positive awareness of the problems of cars in society (APC). One possible reason for this is that elderly respondents have relatively greater awareness of the congestion and environmental damage caused by bad autos traffic. This gives them greater expectations for the effect of CC in mitigating congestion and environmental problems.

Looking at the variable of annual income, we find that it has a positive correlation with recognition of the effects of CC in mitigating congestion and environmental problems (REC), car dependency (CDC) and awareness of the problems of cars in society (APC). This means that respondents with higher income are more concerned with the problems manifested by motorization while, on the contrary, path coefficient between annual income

(AI) and car dependency (CDC) displays 0.274. It discloses that they are automobile dependent. This might mean that respondents with higher income live in surrounding municipalities where public transit services are inadequate and likely prefer to use private mode. Moreover, as expected, employed respondents are unlikely to endorse the appropriateness of CC adoption in Jakarta. This may be partially because they need to enter city center more frequently as compared to non-commuter.

6.4.2 GOR Model Result and Analysis

The observed individual response to CC is treated as an apparent endogenous variable, with variables categorized as shown in Table 6.3. Latent variables estimated using MIMIC model are then treated as exogenous variables. Together with latent variables, charge patterns, mobility attributes and socio-demographics are incorporated into discrete choice models. Description and empirical setting of exogenous variables are summarized in Table 6.3.

Table 6.3 Empirical and description of endogenous and explanatory variables

Variable	Description	Mean	Std.
Endogenous variable: ordinal preferences of public acceptance to CC reform			
ACC	(1) Well accepted (N=153; 9.32%) (2) Accepted (N=880; 53.63%) (3) Not accepted (N=545; 33.23%) (4) Not accepted at all (N=63; 3.84%)	2.316	0.693
Exogenous variables			
CG	Charge scenarios; numerical (10,000 IDR)	1.811	1.064
APR	Appropriateness of CC adoption; numerical	0.0	0.297
REC	Recognition effect of CC; numerical	0.0	0.280
CDC	Car dependency; numerical	0.0	0.174
APC	Awareness of problem of cars in society; numerical	0.0	0.289
IFM	Inhabitation of freedom of movement	0.0	0.086
DEC	Doubts about effect of CC; numerical	0.0	0.163
LD	Dummy; 1 if licensed driver, 0 otherwise	0.713	0.453
PV	Dummy; 1 if used private mode (besides car) ≥ 3days/week	0.239	0.427
FV	Frequency of visiting CBDs (days/week)	2.227	1.422
MU	Dummy, 1 used private mode, 0 otherwise	2.590	1.617
FC	Frequency of using car to enter city centers (days/week)	3.321	1.605
AG	Age, dummy variable with 1 ≥ 40 years, 0 otherwise	0.135	0.342
PE	Professional employment, dummy 1 if professional, 0 otherwise	0.697	0.460
TE	Monthly transport expenditure (million IDR)	0.988	0.783

In this section, we report estimation result of the relationship among CC approval and exogenous variables (i.e. charge, latent constructs, and daily mobility habits). Two different models of CC acceptance have been estimated. Initially, we begin estimating parameters with a SOR model. Then, GOR model is performed. Table 6.4 displays the estimation results separately for SOR model and GOR model. In the GOR model coefficient of parameters considerably vary across the outcome' thresholds, while some parameters have insignificant coefficient below 10% level. However, χ^2 based on the log likelihood ratio test (LR χ^2) of the SOR model against GOR model shows an improvement from 152 to 226. Moreover, the log

likelihood and AIC values show an improvement in GOR model compared to SOR model approach.

Variables in Table 6.4 are all expected to have valuable contribution on the public acceptance of the CC proposal for Jakarta even if some parameters have significant below 10% level. We may keep those attributes for getting more evidences in revealing implication of the empirical results. Since the independent variables have four categories, we obtained three dependent threshold parameters in SOR model and three independent threshold parameters in GOR model. Looking at the estimation results, some variables (e.g. CG, PV, and FV) do not differ much between outcome alternatives in GOR model, whereas the remaining variables are considerably different in GOR model. Strictly speaking, Table 6.4 shows that the magnitude of the coefficients (including the t-statistic) vary across outcome categories. Moreover, as we are aiming to assess the observable individual heterogeneity across all outcomes, we utilize the empirical evidence obtained using GOR model in the discussions that follow.

Table 6.4 Estimation results of SOR and GOR Models

Variable	SOR Model		GOR Model					
	Coeff.	t-value	1		2		3	
			Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Charge Patterns								
CG	-0.458	-1.67	-0.503	-1.18	-0.437	-1.40	-0.100	-0.17
Latent Variables								
APR	-41.245	-2.33	-16.762	-0.55	-42.923	-2.05	-49.844	-1.59
REC	41.693	2.37	14.200	0.47	44.912	2.15	50.018	1.60
CDC	-6.589	-2.28	-8.813	-1.74	-2.937	-0.86	-9.267	-1.73
APC	10.345	2.39	8.877	1.17	7.219	1.41	14.280	1.80
IFM	-2.973	-2.11	-3.336	-1.38	-5.936	-3.53	-3.940	-1.12
Daily Mobility Habits								
LD	-0.240	-3.46	-0.161	-1.53	-0.247	-2.96	-0.532	-2.38
PV	-0.179	-2.27	-0.086	-0.73	-0.225	-2.36	-0.059	-0.3
FV	-0.099	-4.55	-0.028	-0.78	-0.122	-4.76	-0.159	-2.63
MU	-0.178	-3.07	-0.506	-5.29	-0.077	-1.13	0.088	-0.65
FC	-0.084	-3.75	-0.056	-1.66	-0.092	-3.42	-0.116	-1.78
Thresholds								
cut 1	-2.1786		-2.117					
cut 2	-0.4448				-0.450			
cut 3	1.1005						1.130	
Summary of Statistics								
Sample size (N)		1,641						1,641
LL(initial)		-2,275						-2,275
LL(β)		-1,642						-1,605
$\bar{\rho}^2$		0.272						0.279
AIC		1,656.15						1,640.85

The charge variable has a negative correlation with public acceptance of the CC proposal. This indicates that the level of charge plays an important role in gaining public acceptability; that is, the higher the charge, the fewer people will agree with adoption of the CC and the more likely they are to reject the scheme's proposal. Moreover, the appropriateness of CC adoption

(APR) also correlates negatively with approval. It seems that Jakarta citizens are not prone to accept congestion charging, yet recognition of the effect (REC) on mitigating traffic-related problems (i.e. congestion and environmental damage) has a positive effect. There is a hint that respondents who understand the scheme will approve of it. That is, respondents who recognize what effects the scheme may have are more likely to understand its advantages; there is expectation that they believe the congestion-related problems experienced by motorists can be mitigated through implementation of road pricing. Generally speaking, respondents who lack a clear understanding of the scheme are unlikely to support it.

In respect of the car dependency (CDC) variable, this has a negative sign with respect to approval of the CC scheme. The more frequently a respondent uses a private car to enter the CBD, the less chance that they will approve of the policy. Part of the reason for this is that, since there is a lack of adequate public transit into the charging zone (with a heavy reliance on Jakarta's BRT), it is unlikely that people will change to a public transit mode. Consequently, private car users tend to oppose CC policy and are unlikely to reduce use of their cars. In addition, the variable for awareness of the problem of cars in society (APC) (i.e. awareness of congestion and environmental problems) has a positive sign. The likelihood is that respondents are weary of encountering the collective problem of congestion, which is manifested in the form of noise and emissions resulting from traffic jams. Respondents probably look forward to any promise of a breakthrough that will cut down traffic congestion and eventually reduce these collective problems. Moreover, the variable for inhibition of freedom of movement (IFM) has a negative sign. That is, respondents think that the scheme will limit their freedom of driving and movement. These perceived obstacles to mobility may contribute considerably to reasons for rejecting the scheme. It is likely that respondents tend to reject CC because they do not want to limit their mobility habits.

Turning to individual daily mobility attributes, all of them (LD, PV, FV, MU, and FC) have a negative effect on CC approval. The more licensed drivers (LD) there are or the more frequently respondents visit the CBD (FV), the more likely they are to oppose the scheme. In particular, this applies to commuters who enter the CBD by private car (PV). Opposition also arises from respondents who regularly drive a private car into the CBD. Moreover, the more frequently respondents use a private car to enter the CBD, the more chance that they are set to oppose the scheme. That is, respondents think that the scheme will limit their freedom of mobility which is in line with the variable for inhibition of freedom of movement (IFM) after CC adoption. This may be because of the complementarity between daily mobility attributes and the latent inhibition of freedom of movement variable.

6.4.3 LCGOR Model Result and Analysis

Prior to the LCGOR model estimation, we combined outcome 3 (not accepted) with outcome 4 to reduce dimension and complexity in estimation procedures. Thus, we set three ordinal outcomes (i.e. 1. well accepted; 2. accepted; 3. combined not accepted) to be apparent endogenous for LCGOR model estimation. In advance to the discussion of the modeling results, we compare the performance of the LCSOR model and LCGOR model specifications using AIC. The AIC is defined as $-2LL + 2K$. Table 6.6 displays the AIC of LCSOR and LCGOR models are 2,890.72 and 2,888.91, respectively and the lower value of AIC is considerably superior.

Table 6.5 Estimation result for LCSOR and LCGOR models

Variable	LCSOR		LCGOR	
	Coefficient	t-value	Selfish class	
			Coefficient	t-value
Class-membership selection model: selfish class				
Constant	-0.722	-4.48	-0.478	-1.65
APR	57.517	3.01	71.918	3.17
REC	-57.742	-2.99	-74.926	-3.19
AG	1.173	2.11	-	-
PE	-0.204	-1.82	-0.208	-1.45
TE	-0.229	-3.06	-0.256	-2.87
Class-specific (conditional) choice				
Variable	Coefficient	t-value	Threshold 1	
			Coefficient	t-value
Model 1: selfish class				
CG	-0.216	-2.12	-0.137	-1.47
CDC	-16.437	-4.86	-9.666	-2.81
APC	29.274	4.82	19.407	3.24
DEC	-6.214	-2.18	-7.860	-2.64
LD	-0.755	-2.80	-0.396	-1.61
PV	-0.043	-0.17	0.484	1.58
FV	-0.265	-2.36	-0.091	-0.99
MU	-0.272	-1.61	-0.209	-1.34
FC	-0.168	-2.12	-0.229	-3.13
Model 2: altruistic class				
CG	-0.089	-2.39	0.082	0.36
CDC	-6.640	-2.97	-	-
APC	7.179	2.26	-	-
DEC	1.896	2.32	-1.355	-0.22
LD	-0.229	-2.45	-0.890	-1.82
PV	-0.269	-2.43	-	-
FV	-0.119	-4.10	-0.246	-0.90
MU	-0.138	-2.31	0.108	0.36
FC	-0.081	-2.65	-	-
cut selfish 1	-1.273		-1.433	
cut selfish 2	0.534		-0.343	
cut altruistic 1	-6.345		-	
cut altruistic 2	-0.625		-	
Sample size (N)	1,641			
LL(initial)	-1,802.82			
LL(β)	-1,417.36			
$\bar{\rho}^2$	0.198			
AIC	2,890.72			

Variable	Threshold 2	
	Coefficient	t-value
Model 1: selfish class		
CG	-0.191	-2.22
CDC	-8.983	-2.74
APC	15.563	2.90
DEC	0.099	0.05
LD	-0.479	-1.64
PV	-0.065	-0.25
FV	-0.209	-2.88
MU	-0.072	-0.48
FC	-0.153	-1.87
Model 2: altruistic class		
CG	-0.067	-1.61
CDC	-7.739	-2.98
APC	8.610	2.29
DEC	1.261	1.30
LD	-0.214	-2.09
PV	-0.306	-2.52
FV	-0.108	-3.26
MU	-0.152	-2.27
FC	-0.066	-1.95
cut selfish 1	-	
cut selfish 2	-	
cut altruistic 1	-0.839	
cut altruistic 2	-0.546	
Sample size (N)	1,641	
LL(initial)	-1,802.82	
LL(β)	-1,401.48	
$\bar{\rho}^2$	0.201	
AIC	2,888.91	

Class membership selections

Prior to the discussion the effects of various coefficients on the class-specific (conditional) choice, it is necessary to look after estimation result in the class-membership selections. We used estimated LCGOR model for generating several information as shown in Table 6.6. Table 6.7 displays the likelihood of respondents probabilistically being assigned into selfish and altruistic classes. It reveals that the respondents consigned to class selfish are less (28%) whereas respondents assigned to altruistic class are predominant (72%). Selfish respondents unlikely to prone the CC policy mounting for approximately 42.8% while altruistic respondents considerably offer significant contribution (48.8%) being proved well accepted. The results clearly demonstrate that individuals involved in each segment have significantly different contribution to the scheme's acceptance and the modeling framework by considering latent class reveals that each class exhibits different choice behavior.

Table 6.6 Segmentations of class-memberships based LCGOR model

Class memberships	Estimated respondents' share	Probability of acceptance within each segments		
		Well accepted	Accepted	Combined not accepted
Selfish	0.280	0.021	0.551	0.428
Altruistic	0.720	0.488	0.285	0.227

Table 6.6 (upper part model), estimated parameters correspond to the probability being selected as selfish class. Constant term displays a negative effect. It seems that the more people perceived the sense of injustice (unfair) the more people would not prone the policy is suggesting. Appropriateness of scheme adoption (APR) significantly has a positive contribution to the class selfish. It seems that the more respondents recognize the appropriateness or benefit of such scheme the more people likely would favor CC policy. However, recognition of CC (REC) confirms a negative alert. The possible reason is that insufficient understanding of scheme contributes more appearance of selfish. That is, respondents who lack a clear understanding of the schemes are unlikely to support by selfish class. However, it should be noted that the coefficient of APR and REC have shown almost equal values. A potential problem of larger value of coefficient APR and REC due to high correlation among them. However, in this study correlation among APR and REC has not investigated. If there is really correlated among APR and REC, It may better to exclude one of them in the class membership selection model. Yet, this study assumes that person who have sufficient knowledge about appropriateness scheme adoption (APR) would be likely to have more believe in recognizing the scheme effect (REC). Therefore, in the latent constructs we allow structural correlation among APR and REC. Looking at personal attributes, the variable of dummy professional employee (PE) and transport expenditure (TE), both variables

have a negative effect on determining selfish class. The more person professionally employed there are or the more transport cost be required, the less selfish likely will be.

Class-specific (conditional) choice membership

In the conditional choice models, most of the variables differ much between two classes. Empirically, Table 6.6 (see middle and lower models) shows that the magnitude of the coefficients (including the t-statistic) varies across outcome categories. These evidences tell that there exists an individual preference heterogeneity over ordinal preferences. That is, all significant coefficient parameters in the LCSOR model are not maintained to have same magnitude in the LCGOR model rather distributed over thresholds as it parameterizes to be linear function of the covariates. It seems that the distribution of heterogeneity estimated parameters have the same tendency with parameters resulting from LCSOR model and LCGOR model in previous section. For instance, the charges (CG) has significant parameter with t-values about -2.12 and -2.39 for selfish and altruistic classes in the LCSOR model, respectively. Whereas in the LCGOR model, CG confirms better fit (t-value -2.22) for selfish, while quite dropped significantly (t-value -1.61) for altruistic within threshold 2. By allowing flexibility of thresholds, it confirms that threshold 2 holds more significant parameters. These evidence discloses that threshold 2 clearly offers superior estimation parameters and carries more meaning concerning respondent's choice behavior compared to threshold 1.

Investigating of charge (CG), parameters show more significant negative sign for selfish class compared to altruistic. It unveils that the more charges are purposing, the more selfish respondent would oppose the scheme. This could tell us that selfish are more sensitive on scheme's rejection compared to altruistic segment. In respecting to latent variables, car dependency (CDC) and problem of awareness (APC) substantially have similar sign and significant parameters for each classes except for altruistic class holding by threshold 1. It found that less significant for variable doubt the effect of CC (DEC) over class memberships. Investigating of car dependency (CDC) variable, it has a negative sign for each segments. The more they are autos dependent the more probably they uses auto to enter the CBD. Part of the reason for this is that, since there is a lack of adequate public transit into the charging zone (with a heavy reliance on Jakarta's BRT), it is likely that people prefer to use their car in terms of its flexibility. Without doubt, auto users tend to oppose proposed policy and are unlikely to reduce use of their cars. However, the variable for awareness of the problem of cars in society (APC) has a positive sign. The likelihood is that respondents are weary of encountering the collective problem of congestion, which is badly manifested in the form of noise and emissions in recent years. They probably look forward to the policy that expected will cut congestion and its externalities.

Concerning to respondent's mobility attributes, it shows that parameters vary across segments. For instances, selfish class has significant negative parameters for frequency visiting city centers (FV) and frequency used car (FC) while all of them (LD, PV, FV, MU, and FC) have significant negative effect on conditional probability for altruistic class. For both classes, the more frequency visiting CBD (FV) the more likely they are to oppose the scheme. Particularly, this applies to traveler who enter city centers frequently and car users (FC). As for altruistic class, opposition significantly arises from respondents who have driver license (LD) and regularly used a private mode (MU) to visit city centers. Presumably, they think that the scheme will limit their freedom of using private vehicles.

Sensitivity Measures

Sensitivity analysis is conducted in order to provide several insights into implication of the estimation results. We focus in investigating sensitivity of acceptance and rejection of the proposed policy with respect to variable charges (CG). In doing so, we examine several charge scenarios while remaining attributes in the LCGOR model keeps at mean values. The charge scenarios include the initial set by government at 21,000 IDR and additionally we demonstrate 10,000 IDR (the lower bound) and 50,000 IDR (the upper bound) of charges.

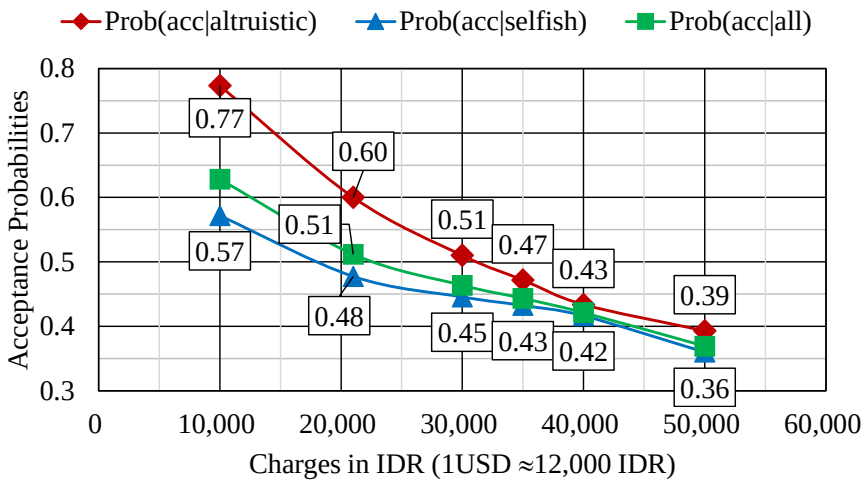


Figure 6.3 Acceptance conditional probabilities for each segment

Figure 6.3 demonstrates the sensitivity of acceptance by individuals over class memberships. It shows a declining probability of acceptance as proposed charges increase. It is apparent that acceptability among the altruistic class falls from 34% to 30% as the charge rise from 21,000 IDR to 40,000 IDR (an increase of 19,000 IDR). It is also clear that the acceptance curve depicts that the altruistic class is more sensitive compared to selfish class. Furthermore, it can be seen that the average probability of acceptance at a given charge level of 21,000 IDR (the initial government proposal) is in excess of 51%. This is a surprisingly high level of acceptance

at such a charge level. It presumably means that such a charge would not meet the objective of cutting dependence on the car. One of the consequences of the current 3-in-1 HOV policy might indicate why this is so. With a requirement of three people in a vehicle, a practice has emerged of youths offering to accept a certain fee to ride as passengers (called "jockeys"), thereby allowing drivers to meet their occupancy requirements.

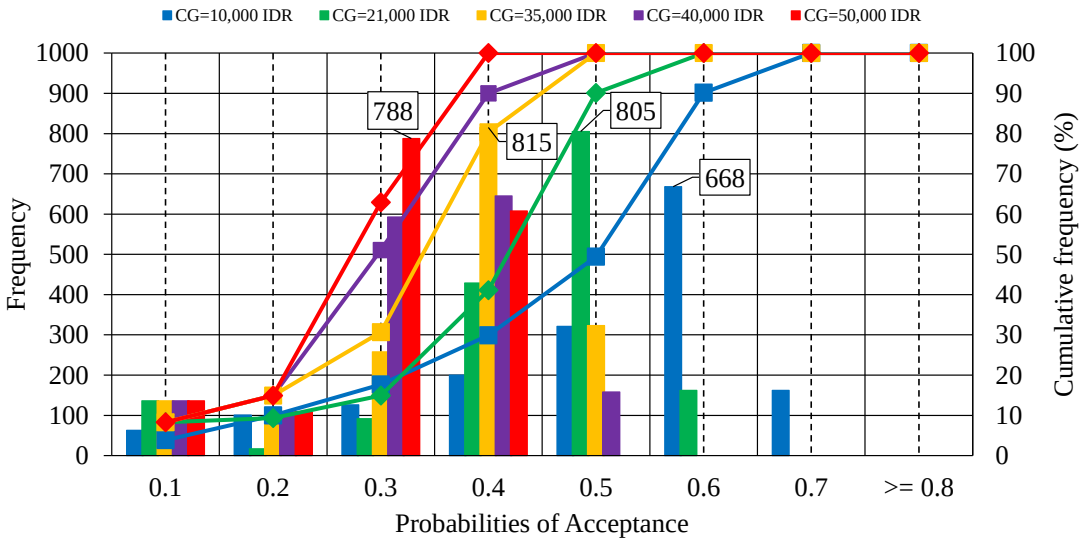
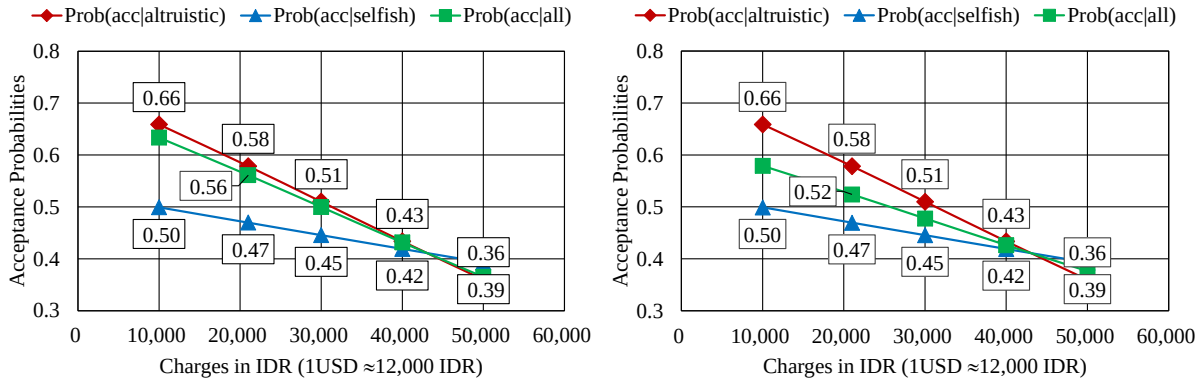


Figure 6.4 Distribution of scheme's acceptance for given charges

A single occupant vehicle (SOV) requires two "jockeys" to reach the minimum requirement of three occupants. For the agreement to work, a driver needs to pay about 10,000 IDR per jockey in advance before entering the 3-in-1 HOV zone. This demonstrates drivers' willingness to spend about 20,000 IDR (to pay two "jockeys") in order to enter the CBD, an amount nearly equal to the government's proposed charge. So in some way a 21,000 IDR charge comes with a certain risk. That is, car users might be willing to pay 21,000 IDR or higher, resulting in the scheme failing to meet its goal to mitigate congestion. This means that charges of over 30,000 IDR are presumably more appropriate as initial set of charge in terms of public acceptability. Figure 6.4 further illustrates the distributions of scheme's acceptance for given charges. From the figure, the distributions of proposed charges at 10,000 and 21,000 IDR are skewed to the left with modes at 60% and 50% probabilities, respectively. It confirms that the initial charge proposed by Government has mode 50%. This result is closed to the values that shown in Figure 6.3 as exhibited the average share of probability acceptance is about 51% at given charge 21,000 IDR. Furthermore, the distributions of charges at 35,000 and 40,000 IDR are likely more normally distributed, with modes at 40% probabilities for both charges. It seems that the charges between 30,000 and 40,000 IDR are presumably more appropriate as boundary of charges in terms of both public acceptability and effective to mitigate congestion.

Further, we demonstrate the elasticity of acceptance probabilities for each segment according to household's transportation expenditure (TE). According to the empirical evidences in Chapter 4 that earliest household has average TE ≤ 0.5 million IDR/month, and latest household has average TE > 0.5 million IDR/month. Then, initially, we set two groups of household's TE based on their observed average TE. That is, earliest household group if TE ≤ 0.5 million IDR/month, otherwise latest household group (TE > 0.5 million IDR/month).



(a) latest household group (b) earliest household group

Figure 6.5 Acceptance probabilities for each segment according to household's transportation expenditure

Examining Figure 6.5a and Figure 6.5b disclose that acceptance rate corresponding to altruistic and selfish classes have shown the same values across given charge increases. For example, with regards to government initial charge 21,000 IDR, Figure 6.5a (latest household) shows 0.58 and 0.47 for altruistic and selfish, respectively. The same value of acceptance has exhibited in Figure 6.5b (earliest household) at the same level of charge 21,000 IDR. However, the average probability acceptance (green curves) has depicted different values between latest household and earliest household. The latest household group depicts that share of altruistic respondents become higher (0.82) as green curve getting close to red curve (altruistic class). While earliest household exhibits the same shares (0.50) between altruistic and selfish classes as illustrated in Figure 6.5b (green curve in the middle of altruistic and selfish classes). This evidences conclude that sensitivity based on the TE only reveals the changes of average share of acceptance (green curve) and share of type classes. Result shows that the more household's TE are, they are more likely to be altruistic class. However, conditional probability of acceptance for each class of respondents remain the same given charge increments. This potentially due to variable TE is introduced in upper model (class membership selections) in latent class modelling (see Table 6.5). Thus sensitivity will more explain changing share of type class at given charge increases. Eventually, taking into consideration of average acceptance probabilities (green curves) between latest and earliest households. It discloses that latest household are likely more sensitive compared to earliest household.

6.5 Conclusions

The aim of this chapter is to assess the effects of various factors on respondent's choice behavior with respect to a congestion charging proposal for Jakarta, Indonesia. Using an innovative formulation designated a generalized ordered response (GOR) model and a latent class based generalized ordered response (LCGOR) model.

The findings from GOR model reveals that the latent variables and mobility attributes play more important role in the public acceptance of the CC proposal compared to charge proposals. Elasticity values shows that latent construct attributes have more sensitive values compared to charges or even daily mobility attributes. Results further show that the latent variables (appropriateness of CC adoption, recognition of the congestion-mitigating and environment-improving effects CC, car dependency, awareness of the problems of cars in society, inhibition of freedom movement caused by CC, and doubts about the ability of CC to mitigate congestion and environment problems) have a very significant influence on the public acceptability of the CC proposal. Additionally, observable variables (such as charges and individual mobility attributes) also strongly explain public support for the scheme. Barriers to acceptance are the desire for charge, freedom of movement and the ability to make transportation mode choices. It is found that people rather do not want change from the private mode to the public mode, indicating that there is as yet insufficient public transport serving the charging corridors. They desire for a solution to the congestion problems but more significantly influences their decisions regarding improvement public transit, such enhancing the capacity of Jakarta's BRT and speeding Jakarta's MRT construction. These systems prerequisite must be done prior to the implementation of CC, and eventually public would be able to shift their mode from automobiles to public mode conveniently.

Further findings from LCGOR model suggest that the exogenous attributes including the perceived appropriateness and recognition of the scheme, employment status and transportation expenditure, contribute significantly to defining the selfish class. Probabilistically, it is found that fewer respondents are assigned as selfish (28%) than as altruistic (72%). The findings also demonstrate that selfish respondents are unlikely to favor the policy while altruistic respondents contribute considerably to the favorable response. The results from LCGOR model clearly demonstrate that proposed model is able to elucidate the existence of preference heterogeneity over ordinal preferences. Moreover, the findings confirm that the altruistic class is more sensitive with respect to acceptance of the scheme, while the selfish class is more sensitive with respect to rejection.

Sensitivity analysis of the estimation results is conducted, offering several insights into the implications of the scheme. The focus is on how sensitive the probability of acceptance and

rejection is with respect to the level of charges (CG). Sensitivity analysis shows that the altruistic class is more sensitive compared to selfish class. Furthermore, the average probability of acceptance at a given charge level of 21,000 IDR (the initial government proposal) is in excess of 51%. This is a surprisingly high level of acceptance at such a charge level. This presumably means that such a charge would not meet the objective of cutting car dependence. On the other hand, scheme acceptability falls from approximately 51% to 47% when the charges are increased to 30,000 IDR. Charges of between 40,000 IDR and 50,000 IDR appear to be a possible option, offering the possibility of solving the problem of car dependency while maintaining sufficient acceptability.

In summary, based on the GOR model and LCGOR model findings, the key factors influencing public acceptance of the CC scheme include the level of charges, car dependency, awareness of the problems of cars in society, frequency of city center visits and frequency of private mode usage. These empirical findings of this work should provide insight for the government as it works to design a more acceptable policy in respect to the charge level and the public response. It is possible that a gradual explanation of the scheme to the public may be needed to enhance the perception of fairness among citizens; by helping people gain more understanding of the scheme, acceptability will improve.

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Chapter 7

EXPLORING THE DIFFERENCES IN PUBLIC ACCEPTANCE DETERMINANTS BETWEEN JAKARTA AND NAGOYA

7.1 Background

Previous chapters have been extensive studies attempting to understand the psychological intentions including observable attributes (tangible factors) that influence policy acceptance. For instances, **Chapter 5** and **Chapter 6** found that psychological factors such as recognition, fairness, awareness of congestion problems and inhibition of freedom of movement have the most significant influence on determining acceptability. They further confirm that there is strong correlation between latent psychological motivations and the level of public acceptance for the CC proposal in Jakarta. Empirical results demonstrate that latent variables play more substantial role in determining scheme's acceptance. Further exploration in **Chapter 6** by proposed latent class modeling to accommodate unobserved type of respondents on individual's acceptance choice behavior. Moreover, in terms of explanatory acceptance, they further approve that psychological determinants (intangible factors) are significantly influencing public acceptability along with tangible factors such the charge level and individuals mobility attributes.

Concerning with psychological determinants, it is argued that individual's psychological attitudes are often culture-dependent. The structure of determinants of policy acceptance may differ across countries perspective. For example, an exploration by Fujii *et al*., (2004) points out that perceptions of fairness and infringement of freedom differ between Asian and European countries including Taiwan, Japan and Sweden. They confirmed that the importance of fairness and infringement on freedom for acceptance of road pricing found in Sweden is

replicated in Japan and Taiwan. They further suggest that the importance of determinants may transcend cultures. Furthermore, Schmocker *et al*., (2012) investigated psychological factors that determine acceptability of road pricing based on a limited survey of British and Japanese students. They argued that psychological determinants are influenced by cultural background including "absolute values" based in religious belief. They found that "absolute values" are a suitable underlying distal factor to partially describe whether individuals are likely to accept a pricing policy. Additionally, Schmöcker *et al*., (2012) and Kim *et al*., (2013) proposed that trust in a government scenario is an additional specific determinant of acceptability. They confirmed that is the case based on a limited survey of British and Japanese students.

Given an assumption that the structure of determinants of policy acceptance may differ across countries perspective, therefore, this chapter focuses on inter-country comparisons. Our research aims primarily to investigate determinants for the acceptability of the CC proposal in Jakarta and compare this to acceptability in Nagoya. The main focus is on psychological determinants. With this specific aim of exploring the influences of psychological indicators on psychological constructs, latent psychological scenarios are constructed and organized into seven categories: "awareness of the city's environment" (ACE), "awareness of the problem of cars in society" (APC), "recognition of the scheme's effects" (REC), "car dependency" (CDC), "inhibition of freedom of movement" (IFM), "trust in government policy" (TGP) and "correct and acceptable policy" (CAP). With a specific research question is, do the determinants of acceptability link with awareness of the problem of cars in society and awareness of environmental issues? Or, are they linked to perceived inhibition of freedom of movement. Further, we clarify the role of trust in government policy as a specific indicator of acceptability.

We hypothesize that psychological determinants might be linked to cultural values that differ across countries. That is, differences in cultural values might cause people to have different perceptions as to the acceptability of the proposed policies. Therefore, the aims of this study is to explore and explain acceptance determinants in these two Asian countries, Indonesia and Japan, with characteristic differences in developmental status in order to understand possible differences in the way these determinants affect acceptance.

Figure 7.1 hypothesizes causal paths among the psychological constructs investigated in this study. It is hypothesized that an "awareness of the city's environment" (ACE) and an "awareness of the problem of cars in society" (APC) will directly influence "recognition of the scheme's effects" (REC) and indirectly affect agreement with "correct and acceptable policy" (CAP). At the same time, "car dependency" (CDC) is hypothesized to influence implementation intention on whether individuals will gain "awareness of problem car in society" (APC) or find their "inhibition freedom of movements" (IFM) affected. Above

mentioned latent constructs were specified based on our justification in **Chapter 6**. Those latent constructs are hypothesized to influence the individual's decision on the "correct and acceptable policy" (CAP). In addition, the specific measure "trust in government policy" (TGP) is further introduced based on the rationale that acceptance may depend partly on whether the government in general is trusted. As mentioned in **Chapter 2**, according to Schmöcker *et al*., (2012) and Kim *et al*., (2013) the variable of trust in a government policy is strong determinant of scheme's acceptability. Assuming that those who trust in government may be more likely to trust that its proposed policies are effective and this may have a direct effect on acceptance of the scheme.

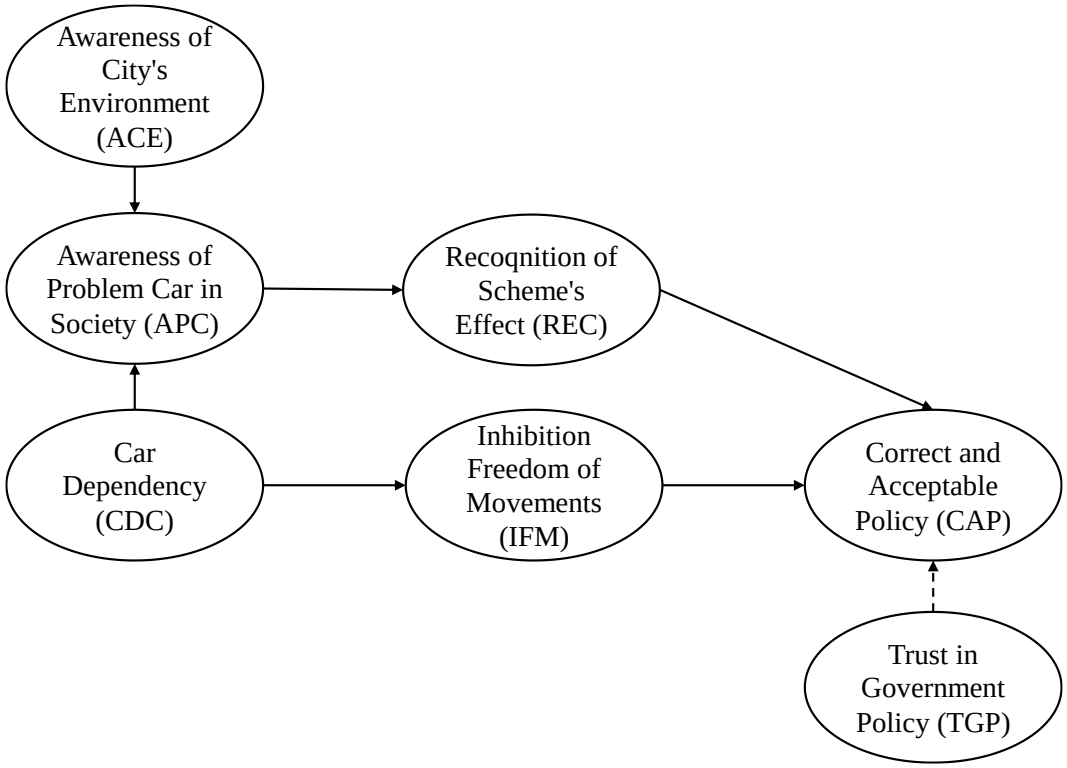


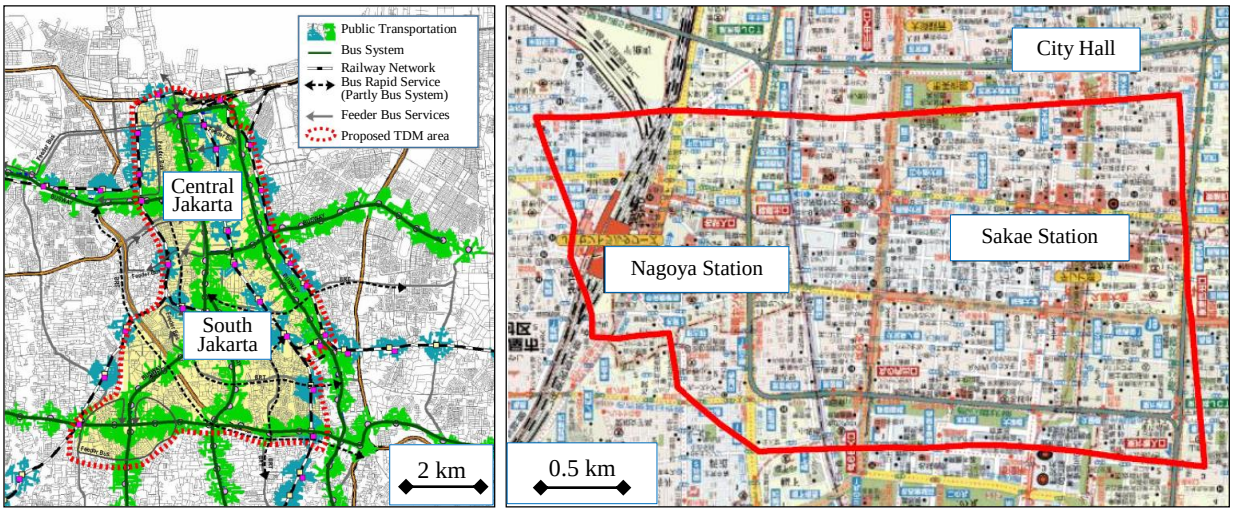
Figure 7.1 Hypothetical structural modeling framework (ellipses: psychological scenarios; thick arrows: significant paths; dotted arrow: negative path)

The hybrid discrete choice (HDC) model is further applied to capture the impact of tangible and intangible factors during process of deciding among acceptance choices. This model offers a convenient framework to improve behavioral representations through the inclusion of latent determinants, which are established from our structural relationship hypothesis in Figure 7.1. We incorporate three latent determinants (REC, TGP, and IFM) along with tangible attributes (i.e. charge scenarios, socio-demographics, mobility attributes) in the discrete choice analysis. A detailed discussion of this methodology is given in section 7.3.4.

7.2 Stated Preference Comparison

7.2.1 Stated Preference Survey Comparison

SP questionnaire were focused on the city centers of Jakarta and Nagoya, with target areas are the central business districts (CBDs) of each city, which are a dense mix of business and commercial areas. The charging zone proposals are within the city center in both cities, as illustrated by the red lines in Figure 7.2(a) and Figure 7.2(b) for Jakarta and Nagoya, respectively.



(a) Charging zone in Jakarta (b) Charging zone in Nagoya

Figure 7.2 Study area and the area proposed for charging zone

Table 7.1 Summary of SP surveys

Detail	Jakarta	Nagoya
Date of survey	18thNovember – 3rdDecember 2013	November 2006
Target location	Central Jakarta and part of south Jakarta	Nagoya city center (Nagoya Station, Sakae district)
Distribution methods	Direct interviews and collected by enumerator	Distributed by enumerators Indirect interviews, return by mail
Number of questionnaires distributed	2,100	6,000
Number of questionnaires returned	1,998 (95.1%)	1,248 (20.8%)
Questionnaire Patterns (CC price):		
- Pattern 1	IDR 10,000 (JPY 100)	JPY300
- Pattern 2	IDR 21,000 (JPY 210)	JPY 700
- Pattern 3	IDR 35,000 (JPY 350)	JPY 1,500
Sampling distribution		
- On weekdays (weekends)	71% (29%)	76% (24%)

Three charging proposal with different charging patterns were designed and introduced to respondents in each city. Target respondents were visitors to the CBD, including commuters,

shoppers, commercial visitors and employees of business establishments. In the case of Nagoya, the proposal is for charging patterns based on the London and Singapore experiences, while in Jakarta they are based on the SITRAMP (2004) and JUTPI (2012) documents as recommended by JICA (see **Chapter 3**). The SP questionnaire are summarized in Table 7.1, which gives the dates of the surveys, target locations, distribution methods, number of samples and charge patterns. The SP questionnaires were designed to capture relevant information from respondents as it is described more detail in **Chapter 3 (**see Table 3.2), with the same content of SP used in Nagoya's questionnaire.

7.2.2 Comparison on Socio-demographic and Mobility Attributes

Table 7.2 shows the socio-demographics characteristics of the respondents. It is noteworthy that young people (≤40 years) dominate the Jakarta sample set, accounting for more than 86.6% of respondents, while Nagoya is dominated by older people (≥40 years), who account for approximately 60.6% of the sample. The gender distribution is slightly skewed toward males in both cities. As regards employment status, the data set indicates 69% employed people. Surprisingly, more than 25% of the sample consists of students in Jakarta but there are far fewer students in Nagoya (3.1%). In Nagoya, substantially more respondents are workers, 81.3%, with less than 15% being housewives or unemployed.

Table 7.2. Summary of respondents' socio-demographics comparison

Item	Category	Jakarta	Nagoya
Gender	Male	51.9%	60.0%
	Female	48.1%	40.0%
Age	20 years or less	11.1%	0.8%
	20-29 years	49.9%	14.8%
	30-39 years	25.6%	23.8%
	40-49 years	10.2%	22.1%
	50-59 years	2.7%	22.6%
	60-69 years	0.3%	11.9%
	70 years or more	0.1%	4.0%
Occupation	Working	69.0%	81.3%
	Student	25.4%	3.1%
	Housewife	4.1%	9.6%
	Unemployed	1.4%	6.0%

Looking at income, Table 7.3 exhibits household income distribution. The average monthly income in Jakarta is IDR 4.543 million, while the annual income in Nagoya is about JPY 5.841 million. It is found that approaching three-quarters of the sample have a low monthly income in Jakarta. That is, about 70.5% of the respondents have a monthly income below IDR 5 million (BPS, 2010). Considering an annual income of 54.516 million IDR (IDR 4.543 million x 12), the daily charges of IDR 10,000-35,000 are consequently around 0.018-0.064% of annual income in Jakarta. As for Nagoya, with respect to an annual income of JPY 5.841, the daily charges of JPY 300-1500 are correspondingly about 0.005-0.026% of income.

Percentage-wise, the proposed Jakarta charges are substantially higher than those set for Nagoya.

Table 7.3. Household income distribution comparison

Jakarta (monthly income)		Nagoya (annual income)	
Category	Percentage	Category	Percentage
IDR 600,000 or less*	3.1%	JPY 2,000,000 or less*	10.6%
IDR 600,000-1,000,000	1.0%	JPY 2,000,000-3,000,000	9.2%
IDR 1,000,000-1,500,000	6.8%	JPY 3,000,000-4,000,000	15.2%
IDR 1,500,000-2,000,000	2.1%	JPY 4,000,000-5,000,000	13.9%
IDR 2,000,000-3,000,000	24.5%	JPY 5,000,000-6,000,000	12.7%
IDR 3,000,000-4,000,000	13.6%	JPY 6,000,000-7,000,000	8.3%
IDR 4,000,000-5,000,000	19.4%	JPY 7,000,000-8,000,000	5.5%
IDR 5,000,000-7,500,000	12.1%	JPY 8,000,000-10,000,000	11.5%
more than IDR 7,500,000	17.4%	JPY 10,000,000-15,000,000	9.1%
		more than JPY 15,000,000	3.9%

**IDR (Indonesian Rupiah) 12,000 IDR ≅ 100 JPY ≅ 1USD*

Table 7.4. Summary of respondents' mobility attributes comparison

Item	Category	Jakarta	Nagoya
Driver's license	Has driver's license	70.5%	96.9%
	Has no driver's license	29.5%	3.1%
Frequency of visits to the target area of the CC scheme (CBD)	5 days/week or more	46.3%	22.6%
	3-4 days/week	16.7%	10.2%
	1-2 days/week	12.6%	15.0%
	2-3 days/month	13.0%	28.9%
	1 day/month or less	11.4%	23.3%
Frequency of car usage in daily life	5 days/week or more	40.5%	66.1%
	3-4 days/week	15.2%	11.6%
	1-2 days/week	10.8%	13.5%
	2-3 days/month	11.4%	3.6%
	1 day/month or less	22.0%	5.2%
Frequency of public transport usage in daily life	5 days/week or more	22.7%	19.7%
	3-4 days/week	13.2%	7.0%
	1-2 days/week	12.5%	8.9%
	2-3 days/month	14.7%	24.6%
	1 day/month or less	37.0%	39.9%

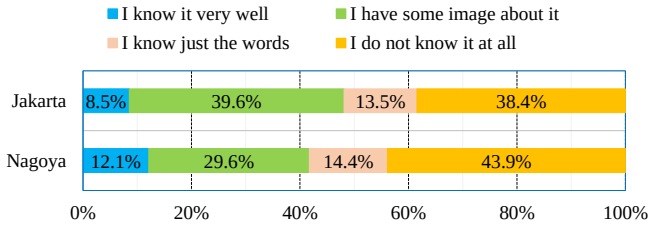
Table 7.4 describes the aggregation results for visits to the charging area and travel behavior. The data reveal that close to 70% and 96.9% of trip makers are licensed drivers in Jakarta and Nagoya, respectively. Turning to the frequency of CBD visits, 63% of respondents visit the CBD quite often (3-5 days/week or more) in Jakarta. However, the figure is substantially lower in Nagoya, at around 33%. In Jakarta, a possible reason for this is that nearly 69% of trip makers are commuters (working or studying), but it is rather hard to explain in Nagoya. Surprisingly, the data reveal that a high percentage of respondents frequently use car (3-5 days/week or more) not only in Jakarta (55.7%) but also in Nagoya (77.7%). These figures indicate that respondents in Nagoya prefer their own mode and are more car dependent than people in Jakarta. With further exploration, it is clear that 35.9% and 26.7% of respondents quite frequently use public transit (3-5 days/week or more) in Jakarta and Nagoya, respectively. It is quite clear that respondents prefer to use their own mode compared to public

transit in both cities. In the case of Jakarta, this may be partially because there is only one pleasant means of public transit serving the main arterial corridors, the trans-Jakarta BRT. Therefore, the public rely heavily on private modes which offer more convenience in term of flexibility. However, there is sufficient public transit along the charging corridors in Nagoya, yet we find that respondents in Nagoya more frequently use car instead of public transport.

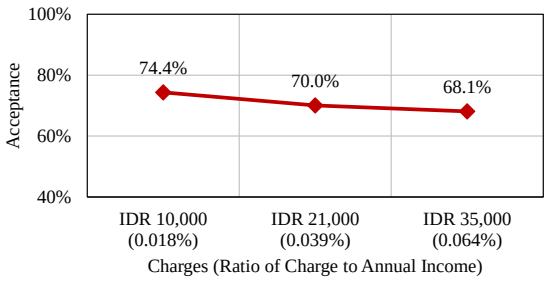
7.3 Result and Analysis

7.3.1 Distribution of psychological indicators

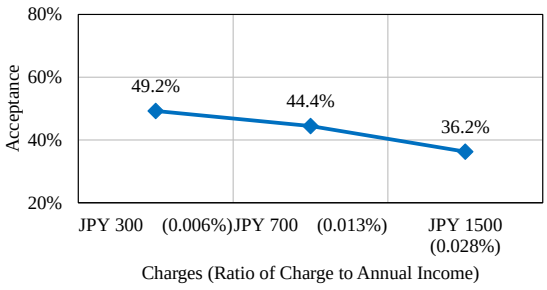
In our SP questionnaire, prior to the 'virtual vote' on the acceptability of the proposed scheme, respondents were posed questions about their recognition of the schemes. Figure 7.3(a) gives the results for this part of the questionnaire on their recognition of the CC schemes. It is found that respondents in Nagoya were aware of the scheme (56.1%). Further, in Nagoya there were also more respondents who were completely unaware of the CC scheme than in Jakarta. Substantially, the findings tell us that Jakarta's respondents have better awareness of the proposed scheme (61.6%) as compared to Nagoya's respondents.



(a) Respondents' awareness of the CC scheme



(b) Charges and public acceptance rate for Jakarta

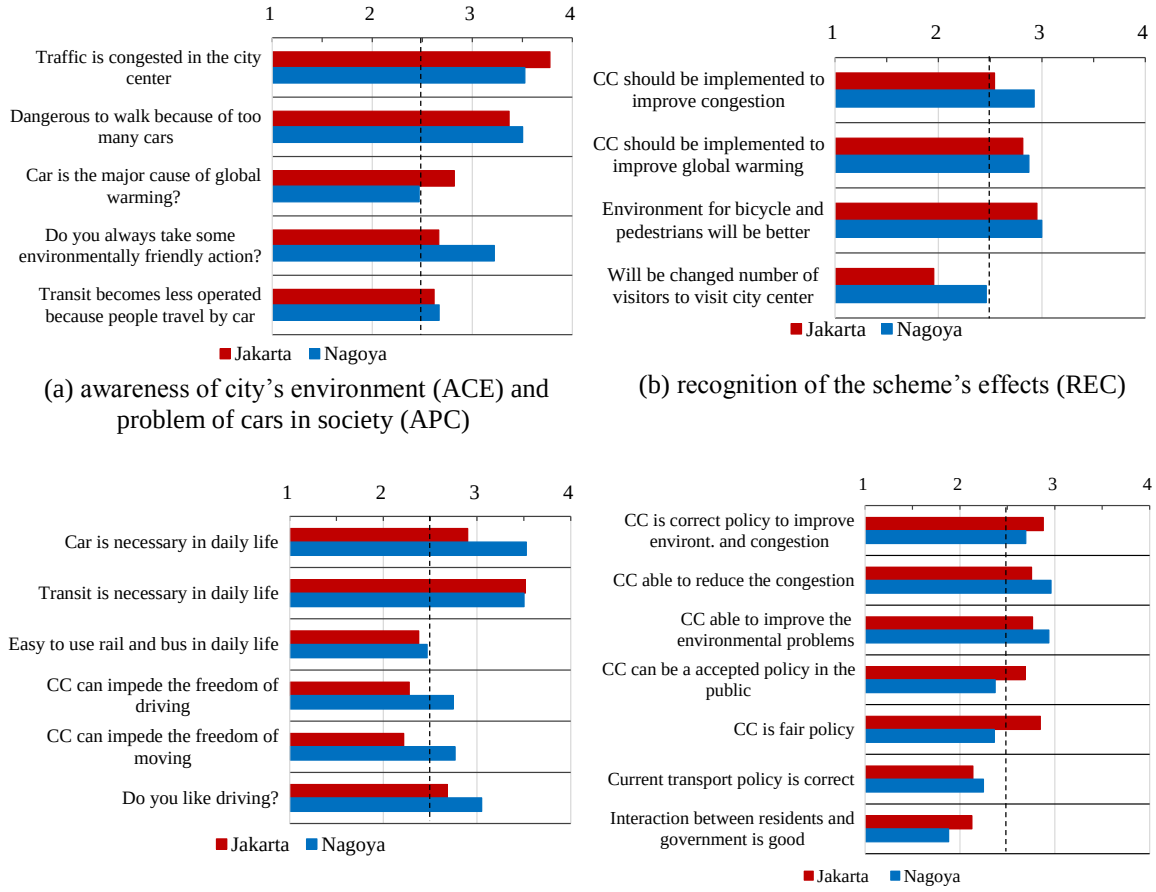


(c) Charges and public acceptance rate for Nagoya

Figure 7.3 Distribution of respondents' awareness and acceptability of the scheme

Further investigation, Figure 7.3(b) and Figure 7.3(c) demonstrate respondents' willingness to accept CC scheme given the three patterns of charge proposals. Note that the government of Jakarta plan to set the initial charge at IDR 21,000. We do not compare acceptance rates among Jakarta and Nagoya in Figure 7.3(b) and Figure 7.3(c) since the proposed charges are not comparable across the countries. That is, the ratio of charges to annual income is essentially

different in the two cases, and the IDR currency rate is also incomparable to JPY. Thus, Figure 7.3(b) and Figure 7.3(c) are shown for illustration purposes only. As can be seen, however, the acceptability rate is substantially high (70%) corresponding to a charge of IDR 21,000 or about 0.039% of income in Jakarta. On the other hand, modest acceptance (44.4%) is found at JPY 700 (0.013% of annual income) in Nagoya. Furthermore, looking at the relationship between acceptance rate and charge proposals, this indicates that the higher the proposed charge, the less favorable the response in both Jakarta and Nagoya.



(a) awareness of city's environment (ACE) and problem of cars in society (APC)

(b) recognition of the scheme's effects (REC)

(c) car dependency (CDC) and inhabitation of the scheme's implementation (IFM)

(d) correct/acceptable scheme (CAP) and trust to the government policy (TGP)

Ordinal responses of 4-point Likert scale 1=strongly opposed/disaggreed to 4=strongly supported/agreed.

Figure 7.4 Comparison distribution of psychological-related questions representing psychological motivations

Psychological-related questions are used to observe respondents' intentions related to seven psychological determinants constructs. The ordinal psychological-related questions included in the SP questionnaire transform into latent variables representing constructs of psychological indicators. The set of twenty-two psychology-related questions had ordinal responses, with respondents choosing a response from a 4-point Likert scale, as characterized in Table 7.5. A

set of psychological scenarios in the seven categories is constructed, as already mentioned: ACE, APC, REC, CDC, IFM, TGP and CAP.

Figure 7.4(a) displays the results of measuring ACE and APC. These are addressed with a set of five psychological questions, with a score above 2.5 (on average) for all questions in Jakarta while only one question is below 2.5 which is related to the question of "car is the major cause of global warming?". Serious concern was expressed about traffic congestion and pedestrian safety issues within the city center in both cities. It is found that traffic congestion and global warming issues are considered severer in Jakarta compared to Nagoya. Yet, people in Nagoya are more concerned about environmental matters in their daily life. With regard to recognition of the scheme's effects, Figure 7.4(b) renders REC. Respondents' expectations of CC policy in improving congestion in the CBD rank higher for Nagoya, though they are of equal magnitude for both cities, representing respondents' belief that a CC scheme will reduce global warming and create a better environment for pedestrians and bicycle users. Moreover, people in Nagoya are more prone to believe that the CC scheme will change the number of visitors to the CBD compared to people in Jakarta.

Figure 7.4(c) aggregates respondents' intentions related to CDC and IFM. It can be seen that, the people of Nagoya are more car dependent than those of Jakarta, although tendencies related to the need for public transit in their daily life are similar. This may be partially because people in Nagoya are more like driving. Moreover, similar tendencies are shown related to restrictions that the scheme's implementation would impose. Nagoya respondents tend to believe that the CC scheme would impede their freedom of driving and moving. Without doubt, this is also perceived by respondents in Jakarta, although to a considerably less degree. Shifting to Figure 7.4(d), this is a summary of respondents' intentions related to TGP and CAP. Comparing Jakarta and Nagoya, it seems that the proposed scheme is seen as more fair and acceptable by people in Jakarta. Furthermore, the feeling of good interaction between government and citizens is more keenly felt by people in Jakarta. On other hand, current transport policy is seen to be better in Nagoya, where respondents also believe the CC scheme has the ability to reduce congestion and improve environmental problems.

7.3.2 Descriptive Analysis of Psychological Indicator Responses

The χ^2-test is used to determine whether or not there is a significant difference associated with each psychological indicator between the Jakarta and Nagoya samples. The results disclose that all psychological indicators listed in Table 7.5 are significantly different at the 1% significant level except for the psychological indicators "lack of public transit because people travel by car" and "public transit is necessary for daily life", which exhibit no difference across the samples (see bold t-test values).

Table 7.5 Means, standard deviations, t-Test and χ^2-Test values of psychological indicators

Var	Psychological Indicators	Jakarta		Nagoya		t-Test	χ^2-Test
		Mean	Std.	Mean	Std.		
ACE	Traffic is congested in the city center	3.77	0.22	3.23	0.38	-26.71**	701.17**
	Dangerous to walk because of too many cars	3.37	0.37	2.61	0.45	-31.93**	835.35**
	Always take some environmentally friendly action?	2.67	0.42	2.78	0.38	5.07**	55.81**
APC	Cars are the major cause of global warming?	2.82	0.46	3.22	0.40	16.79**	261.03**
	Lack of public transit because people travel by car	2.62	0.46	2.67	0.67	**1.77**	86.12**
REC	CC should be able to improve congestion	2.93	0.46	2.54	0.67	-13.69**	213.81**
	CC should be able to reduce global warming	2.87	0.48	2.82	0.65	-2.07*	36.84**
	Environment for bicycles/pedestrians will be better	3.00	0.37	2.95	0.37	-2.10*	24.39**
	Number of visitors to CBD will change	2.46	0.42	1.95	0.27	-23.89**	466.11**
CDC	A car is necessary in daily life	2.90	0.46	3.53	0.42	25.76**	629.11**
	Public transit is necessary in daily life	3.52	0.31	3.50	0.47	**-0.59**	107.80**
	Easy to use rail and bus is necessary in daily life	2.38	0.63	2.47	0.58	3.19**	12.62**
IFM	CC can impede freedom to drive	2.28	0.54	2.75	0.69	16.12**	288.02**
	CC can impede the freedom of movement	2.22	0.51	2.77	0.74	18.57**	410.53**
	Do you like driving?	2.68	0.55	3.05	0.54	13.54**	193.03**
TGP	Current transport policy is correct	2.14	0.46	2.25	0.40	4.60**	57.00**
	Interaction between residents and government is good	2.13	0.40	1.88	0.37	-10.63**	109.05**
ACP	CC is correct policy to improve environment & congestion	2.88	0.42	2.69	0.54	-7.23**	87.53**
	CC is able to reduce congestion	2.96	0.45	2.75	0.38	8.67**	97.15**
	CC is able to improve environmental problems	2.77	0.39	2.94	0.50	6.89**	87.69**
	CC can be accepted by the public	2.69	0.48	2.37	0.47	-12.63**	169.95**
	CC is a fair policy	2.85	0.47	2.36	0.63	-17.61**	311.76**

*&**significant at 5% and 1% levels*

7.3.3 Multiple Sample MIMIC (MS-MIMIC) Analysis

To delve more information on the respondent's psychological intentions, a set of seven latent variables obtained from SP questionnaire experiments is estimated. The approach used is a common one: confirmatory factor analysis with covariates, formerly known as the multiple-indicators multiple-causes (MIMIC) model, by Joreskog & Goldberger (1975). Systematically, the MIMIC model consists of two system equations and the structural equation models. Under MS-MIMIC model (see Lomax, 1983), the structural equation model given by:

$$\eta_i = B^{(g)}\eta_i + \Gamma^{(g)}\xi_i + \zeta_i \tag{7.1}$$

where η_i and ξ_i be random vectors of latent dependent and independent variables. B and Γ are matrices of structure coefficient and ζ_i is a random vector of residual. The measurement model represents the link between the latent variables and its observed indicators. Since η_i and ξ_i are unobservable, let y_i and x_i be vectors of the observable indicators and causes, respectively, so that:

$$y_i = \Lambda_{y_i}{}^{(g)}\,\eta_i + \varepsilon_i \text{ and } x_i = \Lambda_{x_i}{}^{(g)}\,\eta_i + \delta_i \tag{7.2}$$

where the terms ε_i and δ_i are measurement errors in y_i and x_i, respectively, and g=1,…,G identifies the sample of interest. In our analysis sample of interest consists two samples g=1

for Jakarta and g=2 for Nagoya. In this study, parameter estimation was performed in LISREL 9.1 using the SIMPLIS common language (Joreskoq & Sorbom, 2013a; Joreskoq & Sorbom, 2013b). To estimate asymptotic covariance matrix (ACM), we used same approach that used in **Chapter 6**. The variable of indicators and dummy variables of causes were formatted as ordinal data before estimating ACM. It should be noted that the estimation of ACM and the model parameters can be done in LISREL 9.1. It is no longer necessary to estimate an asymptotic covariance matrix with PRELIS and read this into LISREL (Joreskoq & Sorbom, 2012).

Initially, causal paths among structural equations and measurement equations are hypothesized and constructed as illustrated in Figure 7.4. Concerning to psychological scenarios, we construct seven psychological scenarios investigated corresponding to eighteen psychological perceptions (indicator). Causal paths among psychological scenarios were hypothesized as explained in section 7.1 and illustrated in Figure 7.1.

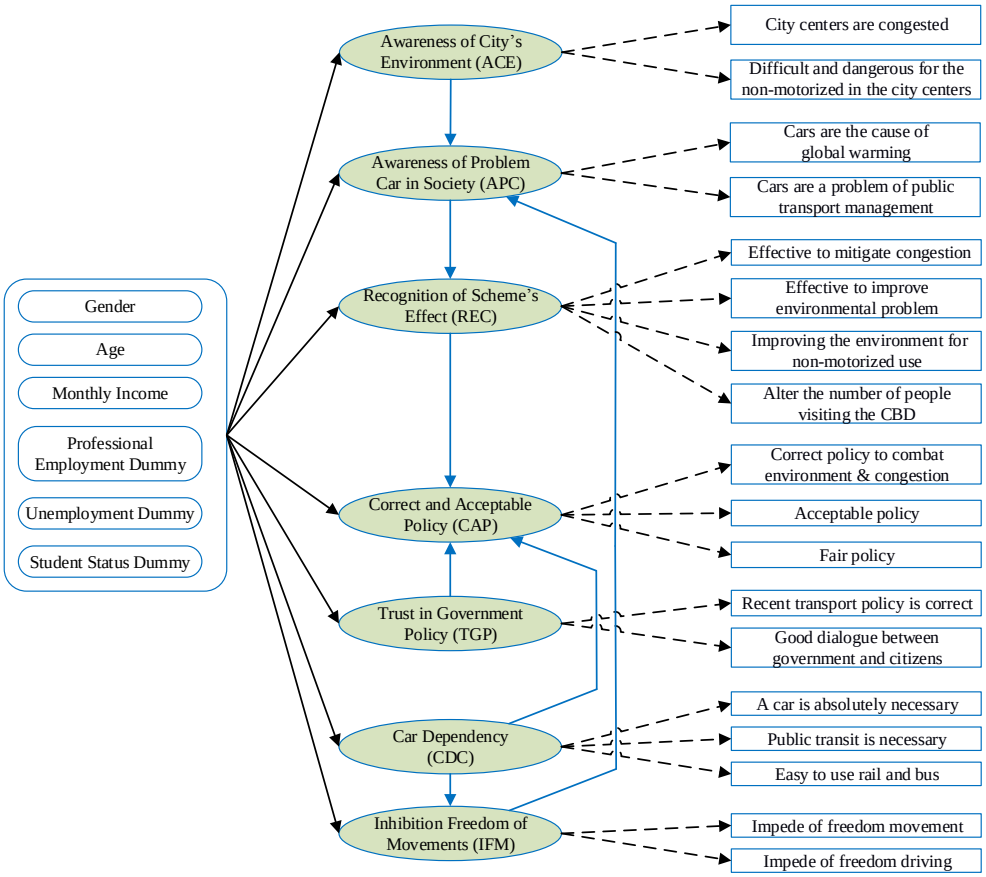


Figure 7.5 Structural hypothesize of MS-MIMIC Model Framework

Table 7.6, Table 7.7, Figure 7.6 and Figure 7.7 give the estimation results from the MS-MIMIC model. The factor loadings for the indicators and causes in the latent variables are shown in Table 7.6 and Table 7.7, respectively. The path coefficients among psychological scenarios are depicted in Figure 7.6 and Figure 7.7 for Jakarta and Nagoya, respectively. A number of

indices were computed to explain the fit of the model in the model fitting process. Several of the indices used, including the Comparative Fit Index (CFI=0.915), the Root Mean Square Error of Approximation (RMSEA=0.064), the Standard Root Mean Squared Residual (SRMR=0.069) and the Adjusted Goodness of Fit Index (ΔGFI=0.913), exhibit essentially acceptable models (Hooper *et al.*, 2008; Kim *et al*., 2013).

Table 7.6 Indicators and path coefficients (measured equation)

Variables			Paths Loading	
Latent		Indicator	Jakarta	Nagoya
ACE	Awareness of city's environment	City centers are congested	1.000	1.000
		Difficult and dangerous for the non-motorized in the city	5.697**	6.227**
APC	Awareness of the problem of cars in society	Cars are the cause of global warming	1.000	1.000
		Cars are a problem of public transportation management	0.823**	1.130**
REC	Recognition of scheme's effects	Effective to mitigate congestion	1.000	1.000
		Effective to improve environmental problem	0.969**	1.139**
		Improving the environment for non-motorized use	0.681**	0.566**
		Alter the number of people visiting the CBD	0.364**	0.297**
CDC	Car dependency	A car is absolutely necessary in everyday life	1.000	1.000
		Public transit is absolutely necessary in everyday life	-0.203**	-0.795**
		Easy to use rail and bus	-0.856**	-0.868**
IFM	Inhibition of freedom of movement	Impede of freedom movement	1.000	1.000
		Impede of freedom driving	0.950**	1.075**
TGP	Trust in government policy	Recent transport policy is correct	1.000	1.000
		Good dialogue between government and citizens	0.395**	0.370**
CAP	Correct and acceptable policy	Correct policy to combat environment problems & congestion	1.000	1.000
		Acceptable policy	0.956**	-0.869**
		Fair policy	0.925**	-1.167**

*&**significant at 5% and 1% level*

With respect to the relationship among psychological indicators and latent determinant constructs, Table 7.6 shows that latent variables representing the validity of the CC scheme, such as ACE, APC and REC appear to have a similar tendency in both Jakarta and Nagoya. These emerge as psychological determinants contributing a positive correlation with enhancement of public acceptance in both cities. Looking then at the determinant CDC, the indicator "A car is absolutely necessary in everyday life" has a positive value in both cities. However, indicators of "Public transit is absolutely necessary in everyday life" and "Easy to use rail and bus" give a negative correlation. It is presumed that these determinants would act as barriers to acceptance of the proposed schemes. Furthermore, the indicators for freedom of driving and movement are significantly positively signed in both Jakarta and Nagoya. These signs representing the determinant of IFM would diminish acceptance of the schemes. Finally, respondents' position with respect to TGP, as shown by the indicator "Good dialogue between government and citizens", is positive in both cities. On the other hand, in respect to CAP, the path coefficients for the acceptable and fair policy indicators have a positive sign for Jakarta

but there is a negative correlation for Nagoya. This may partially indicate the inappropriateness of CC implementation in Nagoya.

Concerning respondents' socio-demographics, Table 7.7 shows that the gender variable "Male" has a negative coefficient for all latent variables in Jakarta except IFM and CAP, while its sign is negative for all latent variables in Nagoya. It seems that male respondents are more car-dependent in both cities. Consequently they perceive implementation of a CC policy as inhibiting their freedom of movement. Interestingly, it is found that older respondents are more concerned with ACE and have a more positive awareness the problems caused by cars, as shown by the APC coefficient, in both Jakarta and Nagoya. One possible reason for this is that elderly respondents have relatively greater awareness of the congestion and environmental damage caused by bad vehicle traffic. This gives them greater expectations for the effect of CC in mitigating congestion and environmental problems.

Table 7.7 Socio-demographic causes and path coefficients (structural equation)

Variables	Path coefficients						
Causes	ACE	APC	REC	CDC	IFM	TGP	CAP
Jakarta Samples							
Male dummy: 1 is male.	-	-0.005	-	-0.091	0.404	-0.010	0.029
Age: 1 is teenager, 2 is 20-29,....,8 is ≥ 80	0.001	-	-	0.099	-0.354	-0.057	-
Monthly income (IDR)	0.002	-	0.011	-0.050	-0.205	-0.016	-0.001
Work Dummy: 1 is worker.	-	0.023	-	0.006	0.061	0.002	0.041
Student dummy: 1 is a student.	-	0.177	-0.041	0.140	-0.380	-	-
Unemployment dummy: 1 is unemployed	0.005	-	0.167	-	-	0.150	-
Nagoya Samples							
Male dummy: 1 is male.	-	-0.049	-	-0.017	-0.108	-0.109	-0.029
Age: 1 is teenager, 2 is 20-29,....,8 is ≥ 80	0.001	-	-	-0.038	-0.003	0.001	-
Annual income (JPY)	0.003	-	0.006	-0.005	-0.004	-0.004	-0.014
Work Dummy: 1 is worker.	-	0.026	-	0.044	0.115	0.118	-
Self-employed dummy: 1 is a student.	-	-0.058	0.061	0.139	-	-	0.004
Unemployment dummy: 1 is unemployed	-0.003	-	-0.026	-	0.060	0.061	-

Note: all path coefficients significant at ≤ 5% level

Table 7.8 Total (indirect) effects of determinants of correct and acceptable policy

Psychological Determinants		Jakarta	Nagoya
ACE	Awareness of city's environment	0.40 (0.40)	1.06(1.06)
APC	Awareness of the problem of cars in society	1.11 (1.11)	0.97(0.97)
REC	Recognition of scheme's effects	0.59 (0.00)	-0.54(0.00)
CDC	Car dependency	-0.20 (0.00)	-0.31(0.00)
IFM	Inhibition of freedom of movement	-1.61 (-1.61)	-0.68(0.68)
TGP	Trust in government policy	0.27 (0.00)	-0.33(0.00)

Looking at the variable of annual income, it is revealed that it has a positive correlation with ACE and REC for not only Jakarta but also Nagoya. This means that respondents with higher income are more concerned with the problems manifested by vehicle traffic and recognition of scheme's effects while, on the contrary they are car dependent and worry about their freedom of movement being inhibited in both data sets. Moreover, they show positive

correlation with CDC and IFM in both locations. It means that worker respondents are likely more car dependence and inhibition of freedom of movement in both cities. This may be partially because they need to enter the city center more frequently as compared to student (in the Jakarta sample) and self-employed (in the Nagoya sample) trip makers.

Table 7.9 t-Test results for differences in estimated coefficients of path determinants

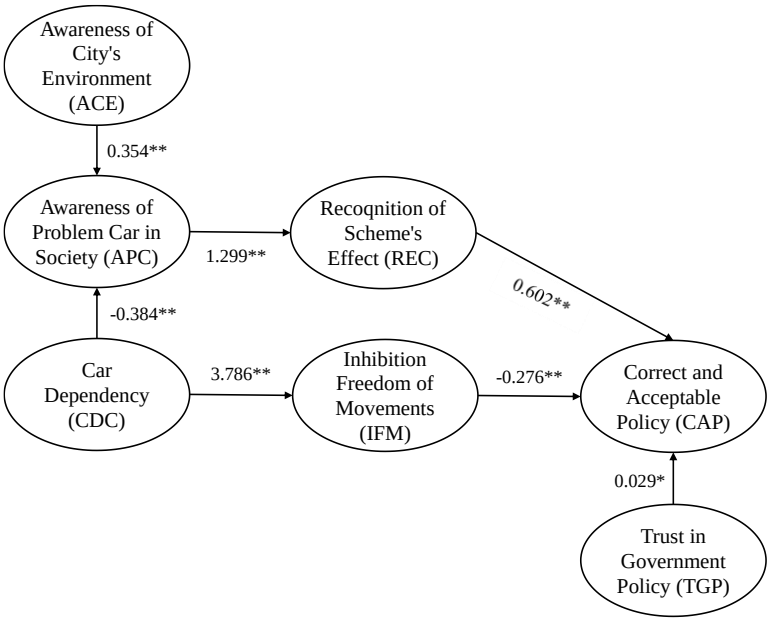
Causal Path			t-Test
Awareness of city's environment (ACE)	→	Awareness of the problem of cars in society (APC)	-27.37**
Car dependency (CDC)	→	Awareness of the problem of cars in society (APC)	-12.30**
Awareness of the problem of cars in society(APC)	→	Recognition of scheme's effects (REC)	5.71**
Car dependency (CDC)	→	Inhibition freedom of movements (IFM)	12.03**
Recognition of scheme's effects (REC)	→	Correct and acceptable policy (CAP)	46.41**
Inhibition of freedom of movement (IFM)	→	Correct and acceptable policy (CAP)	-2.76**
Trust in government policy (TGP)	→	Correct and acceptable policy (CAP)	-1.88*

&significant at 5% and 1% level*

Figure 7.6 and Figure 7.7 depict the causal relationships and their strengths amongst the psychological determinant scenarios that hypothesized in section 1 (see Figure 7.1 and Figure 7.5). To uncover more implications of these results and illuminate the differences between Jakarta and Nagoya, along with these path parameter estimations, the overall effect and indirect effect of each psychological determinants are calculated in relating to viewing the CC scheme as a correct and acceptable policy (see Table 7.8). Additionally, to understand whether there are significant differences in the causal path determinants based on the parameters estimated by the MS-MIMIC model, the t-Test results are reported in Table 7.9. These t-Test results disclose that the differences in path coefficients for each determinant pair are statistically significant between the Jakarta and Nagoya samples. Therefore, a comparative analysis of causal paths among psychological determinants and acceptability based on the hypotheses made in this study uncovers significant implications for policy implementation.

Based on the hypotheses given in Figure 7.1, we discuss the MS-MIMIC results in this section. In line with our hypothesis, perception of the effectiveness of CC policy is significantly influenced by problem awareness in both samples. Figure 7.6 and Figure 7.7 show that path coefficients for ACE and APC indicate a positive contribution in both cities. Interestingly, the variable of APC has the strongest direct and indirect effects on perception of CC as a correct and acceptable policy in the Jakarta sample, while in Nagoya sample is dominated by ACE. This means that the car-dependent society is seen as part of the problem in Jakarta, and people are more likely to understand that an effective policy is needed to address this problem. On the other hand, the city's environment is recognized as a problem in the Japan sample.

The factor loading of CDC into APC has a negative correlation for not only Jakarta but also Nagoya. Moreover, direct and indirect effects are fairly similar. This presumably means that people who are dependent on automobiles are less likely to be concerned about the problem of cars in society. Surprisingly, in the case of Jakarta, CDC has a positive coefficient with IFM. The likelihood is that Jakarta respondents are felt more Inhibition of freedom of movements if CC policy will be implemented. It may partially because of significantly higher auto dependence as it approved by higher direct effects in Jakarta (see Table 7.8). Furthermore, a negative correlation between CDC and IFM arises in the Nagoya sample. This may partially be explained by people in Nagoya being less constrained in their movements if the proposed scheme were to be implemented. Without doubt, the empirical evidence in previous section advises that people in Nagoya are more auto dependent than those in Jakarta. However, public transit services in Nagoya are fairly good compared to those in Jakarta.

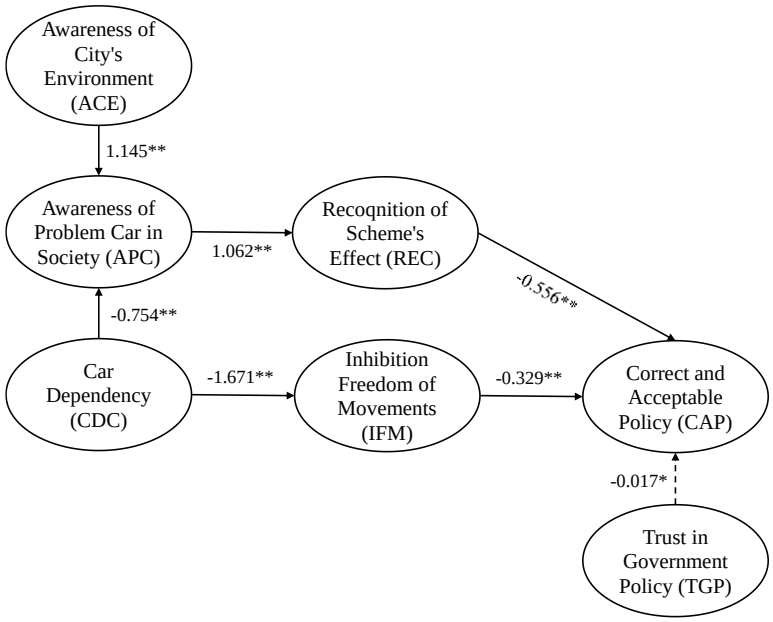


(dotted lines: psychological constructs; thick arrows: significant paths; *&**significant at 5% and 1% level)

Figure 7.6. Result of MS-MIMIC analysis for Jakarta sample

Table 7.9 reports the overall effects of these determinants on acceptance, showing the important role of trust in government in both countries, and particularly in Japan. These overall effects are fairly moderate coefficients as compared with the other determinants. A higher trust in government is positively associated with other determinants such as awareness and recognition of the proposed scheme's effects. In this context, we find that REC in Jakarta makes a positive contribution to people's acceptance that CC is a correct and acceptable policy, while the contribution is negative in Nagoya. Part of the reason for this may be that the CC scheme has long been proposed by the government of Jakarta. Campaigning for the CC scheme

has been gradual since 2004 (SITRAM, 2004) and has continued to the present (JUTPI, 2012). For this reason, Jakarta respondents may see greater cognitive validity in the scheme. It seems that people in Jakarta are more likely to believe that government policy is fair. Furthermore, a surprising negative path coefficient from TGP to CAP is found in Japan, possibly indicating that the latent constructs for Nagoya as illustrated in Figure 7.7 may have different meaning with the latent constructs for Jakarta. Further comprehensive investigation on this this effect is suggested for future study.



(dotted lines: psychological constructs; thick arrows: significant paths;
*&***significant at 5% and 1% level)

Figure 7.7 Result of MS-MIMIC analysis for Nagoya sample

7.3.4 Binary Response Model Analysis

In this chapter we use the same framework of HDC model which it used in **Chapter 6**. Given latent variables that estimated using the MS-MIMIC analysis described in section 7.3.3. Then, the estimation parameters obtained from the MS-MIMIC model are included directly into the discrete choice analysis. In this study the HDC model is drawn from binary response model. Noted that since the HDC model in this study is drawn from binary choice. It is possible to estimate such binary setting of HDC model using simultaneous (full information) approach in structural equation model (SEM) particularly with widely available commercial SEM packages such as Lisrel or Mplus (see for example Temme *et al.*, 2008). However, in this chapter, we keep using sequential method as earlier proposed in **Chapter 6.**

The binary response model offers convenient framework to analyze the situation of choice between two alternatives-whether the individual takes an action or does not, or chooses between one of two elemental choices (Greene & Hensher, 2010). Suppose that an observed outcomes, is determined by a latent regression which represent the propensities of a respondent to vote the CC proposals in each countries by voting accept or reject. Formally, the structural model consists of a latent equation:

$$y_i^* = \gamma' \eta_i + \beta' x_i + \varepsilon_i \, , \, y_i = 1(y_i^* > 0) \tag{7.3}$$

where η_i and x_i are vectors of the intangible and tangible exogenous variables, respectively. Moreover, γ' and β' are vectors of the unknown parameters, and i represents an individual observation across samples. The model is simply completed by assuming that the latent errors ε_i has a univariate standard normal distribution (IID) and estimation of structural equation using a simple probit link identifies the structural treatment effect γ' and β'. Then, the individual contribution to the likelihood function can be drawn as:

$$P_r(y_i = y_i|\eta_i, x_i) = \prod_{y_i=0} \left[1 - \Phi\left(\gamma' \eta_i + \beta' x_i\right)\right] \text{ x } \prod_{y_i=1} \Phi\left(\gamma' \eta_i + \beta' x_i\right) \tag{7.4}$$

Then, the likelihood function for the parameters may be written:

$$L\left(\gamma', \beta' | \eta_i, x_i, y_i\right) = \prod_{i=1}^{I} \left[1 - \Phi\left(\gamma' \eta_i + \beta' x_i\right)\right]^{1-y_i} \text{ x } \left[\Phi\left(\gamma' \eta_i + \beta' x_i\right)\right]^{y_i} \tag{7.5}$$

Transforming Eq. 7.5 into the log-likelihood function:

$$LL\left(\gamma', \beta' | \eta_i, x_i, y_i\right) \tag{7.6}$$
$$= \sum_{i=1}^{I} (1 - y_i) \ln\left[1 - \Phi\left(\gamma' \eta_i + \beta' x_i\right)\right] + y_i \ln\left[\Phi\left(\gamma' \eta_i + \beta' x_i\right)\right]$$

where $(1 - y_i)$ is the indicator function for a respondent, with $(1 - y_i)$ if a respondents i chooses outcome 0, Otherwise 1. In this study, samples from Jakarta and Nagoya were estimated separately using log-likelihood estimation which is written and implemented in GAUSS econometric programming version 3.2.32.

For further analysis, we incorporate three latent variables that we obtained from the MS-MIMIC model (i.e. REC; TGP; IFM). Along with latent variables we examine tangible attributes (i.e. charge scenarios, socio-demographics, mobility attributes). In addition to tangible attributes, we introduce social interaction measures of "virtual public approval". Basically, the social interactions refer to the idea that the utility an individual receives from a given action may influence on the choices of other individuals or reference group. Formerly, Brock & Durlauf (2001) has developed a framework for characterizing discrete decisions when individuals experience private as well as social utility from their choices. They studied

an individual choice which incorporate terms reflecting the desire of individuals to conform to the behavior of others in an environment of non-cooperative decision making. They concluded that the model is shown to produce a number of interesting features. In this chapter, the intention to accommodate specific measures of "virtual public approval" is to investigate social interactions among citizens in both cities. To capture a social interactions on the discrete decision process, the variable of "virtual public approval" is incorporated in HDC model. Moreover, the observed individual responses to vote the CC proposals (i.e. accepted or rejected) are treated as an apparent endogenous variable. Descriptions of endogenous and exogenous attributes and their empirical settings are summarized in Table 7.10. As for our data set, among 1,998 samples in Jakarta, a total of 1,528 valid samples are used after cleaning missing data. Similar treatment for Nagoya sample, a total of 1,015 final valid samples are utilized across 1,248 samples.

Table 7.11 exhibits the results of parameters estimation of binary response model for both Jakarta and Nagoya samples. Several indicates of model performance are calculated include log-likelihood at convergence ($LL(\beta)$) and adjusted rho-squared ($\bar{\rho}^2$) as shown in the bottom of Table 7.11. However, adjusted rho-squared ($\bar{\rho}^2$) has shown fairly low in fitting Nagoya data. It may be partially because of data noisy, or this less perfect dataset.

Table 7.10 Empirical setting and description of endogenous and explanatory variables

Description of variables	Jakarta		Nagoya	
	Mean	Std.	Mean	Std.
Endogenous Variable				
Voting to the CC proposal				
(5) Jakarta Accepted (N=1,067; 69.83%) and Rejected (N=461; 30.17%)	0.698	0.459	-	-
(6) Nagoya Accepted (N=422; 41.58%) and Rejected (N=593; 58.42%)	-	-	0.416	0.493
Exogenous Variables				
A specific choice's attributes				
Charges, IDR (Jakarta) and YEN (Nagoya)	24,057	10,515	898	489
Virtual public approval scenarios; 10%, 50% and 90%	51.126	32.624	45.113	33.444
Psychological determinant scenarios				
Recognition of scheme's effects (REC)	0.0	0.941	0.0	0.141
Trust in government policy (TGP)	0.0	0.156	0.0	0.143
Inhibition freedom of movements (IFM)	0.0	0.601	0.0	0.139
Socio-demographic and mobility characteristics				
Male dummy: 1 is male	0.529	0.499	0.6112	0.487
Age: 1 is teenager, 2 is 20-29,....,8 is ≥ 80	2.460	0.925	3.973	1.376
Monthly income (million IDR)	4.200	2.111	-	-
Annual income (million YEN)	-	-	4.935	2.611
Dummy, 1 trip purpose for working	0.552	0.497	0.478	0.500
Frequency of visiting CBD (days/week)	3.075	1.681	2.762	1.482
Frequency of using car (days/week)	3.891	1.417	2.457	1.769
Frequency of using transit (days/week)	3.398	1.611	3.237	1.481

Returning into estimated parameters, the variable of charge has a significantly negative impact

on the acceptance of the scheme's proposal for both Jakarta and Nagoya. This indicates that the level of charge plays an important role in gaining public acceptability; that is, the higher the levy, the fewer people will agree with the adoption of the scheme and the more likely they are to reject the proposal in both cities. Concerning to the variable of "virtual public approval", it is disclosed that the variable has a positive sign for both samples, but it has an insignificant contribution for Jakarta samples. It is a hint that the people in Nagoya exhibits social interactions; that is, they tend to be influenced by another individual's behavior, but it presumably does not in Jakarta.

Table 7.11 Results of the discrete choice model.

Variables	Jakarta		Nagoya	
	Coefficient	t-value	Coefficient	t-value
Constant	2.280	8.00	19.946	5.05
Specific choice's attributes				
Charges, IDR (Jakarta) and YEN (Nagoya)	-0.076	-2.25	-0.260	-3.13
Virtual public approval (%)	0.081	0.74	0.326	2.69
Psychological determinants attributes				
Recognition of scheme's effects (REC)	3.252	2.04	0.988	0.93
Trust in government policy (TGP)	6.217	1.81	-2.783	-1.37
Inhibition freedom of movements (IFM)	-5.041	-2.03	-1.985	-1.91
Socio-demographic and mobility characteristics				
Male dummy: 1 is male	-0.232	-1.11	-0.466	-1.00
Age: 1 is teenager, 2 is 20-29,....,8 is ≥ 80	-0.265	-5.83	0.064	1.56
Monthly/Annual income (million IDR/JPY)	0.072	3.25	0.026	1.41
Dummy, 1 trip purpose for working	-0.245	-2.33	-0.143	-1.31
Frequency of visiting CBD (days/week)	-0.139	-5.39	-3.396	-5.11
Frequency of using transit (days/week)	-0.067	-2.17	0.113	3.72
Frequency of using car (days/week)	-0.101	-3.66	-3.348	-5.09
Statistics Summary				
Sample size (N)		1,528		1,015
LL(initial)		-1059.13		-703.54
LL(β)		-840.00		-658.67
$\bar{\rho}^2$		0.195		0.045

Concerning to latent variables, the variable of "recognition of scheme's effects" (REC) has a significantly positive effect on Jakarta samples while it has shown insignificant in Nagoya samples. There is a clue that Jakarta respondents who understand the scheme will approve of it. That is, respondents who recognize what effects the scheme may have are more likely to understand its advantages; there is expectation that they believe the congestion-related problems experienced by motorists can be mitigated through implementation of the schemes. Next, the variable of "trust in government policy" (TGP) is showing a negative sign in Nagoya but it is exhibited a positive relationship in Jakarta; even though both parameters have shown a statistically significant only at the 10 % level. A possible reason is that people in Jakarta are more likely to belief that government policy is fair in terms of policy itself, or part of the reason may because of the CC scheme has been long time introduced by the government of

Jakarta (for more than 10 years, see section 7.3.3). It could rise more cognitively validity of the scheme's proposal in Jakarta. But rather hard to explain for Nagoya sample, possibly indicating unlikely to belief to government policy. Lastly, the variable of "inhibition freedom of movements" (IFM) has a statistically significant negative sign for both countries. These perceived obstacles to mobility may contribute considerably to reasons for rejecting the scheme. It is likely that respondents tend to reject policies in both cities because that they are essentially auto-dependent, consequently they do not want to limit their daily mobility routines.

In respect of socio-demographic characteristics, the gender variable "Male" has a negative coefficient in both countries but it exhibited a statistically insignificant in both samples. It presumably that male respondents are more car-dependent and consequently they could have a negative contribution for the scheme acceptance in both cities. Looking at the variable of age, it has been estimated to have a significantly negative in Jakarta but it has insignificant in Nagoya. In case of Jakarta, there is a tendency to oppose proposed scheme as age increases. It is likely because of respondents in Jakarta are skewed to young people. That is, young respondents (see Table 7.10 mean ages=2.460) dominate Jakarta's samples, accounting for more than 86.6% of samples belongs to ≤ 40 years respondents (see section 7.2.2). In common sense, the older people are, the more they will approve of the policy. However, for income, it has the same positive alert for both of cities. The more incomes there are, the more likely people in both of cities tend to vote the scheme.

In regards to individual's mobility attributes, both of the cities have depicted similar tendency in terms of sign exception for the variable of frequency in using transit to enter city center, while it tends to be different in variable significance for both samples. For instance, let's consider the variable of dummy of trip purpose for working. This variable has a significant negative contribution to the scheme acceptability both Jakarta and Nagoya. This finding reveals that the variables of dummy of trip purpose for commuting act as a barrier to the acceptance of scheme's proposal for both cities. Shifting to the variable of frequency of visiting CBD and frequency of using car to enter CBD, these variables have a statistically significant negative contribution to the policy acceptance not only in Jakarta but also in Nagoya. This findings further conclude that the variables of frequency of visiting CBD and frequency of using car to enter the CBD serve as a constraint to the policy acceptance in both countries. However, the variables of frequency in using transit to enter city center tends to elevate scheme acceptance in Nagoya while it may form a considerable barrier in Jakarta even though the parameter has shown insignificance. In the case Nagoya, public transport services are fairly excellent in current operations while it is fairly poor situations in Jakarta. It is presumable that these conditions would act as barriers to acceptance of the proposed scheme in Jakarta and

vice versa in Nagoya. Without doubt, public transit is absolutely necessary for citizens in both cities.

7.4 Conclusions

The present study focuses on the cross-country comparisons, therefore, our research primary aims to investigate determinant factors on the acceptability of CC proposal in Jakarta, and compare this to the acceptance in Nagoya with focal point mainly on psychological determinant aspects. With specific aims to explore the influences of psychological indicators on psychological motivations, we incorporate the influence of a set of psychological constructs into seven categories: "awareness of city's environment" (ACE), "awareness of problem car in society" (APC), "recognition of scheme's effects" (REC), "car dependency" (CDC), "inhibition freedom of movements" (IFM), "trust in government policy" (TGP) and "correct and acceptable policy" (CAP).

The findings from the MS-MIMIC analysis show that a number of psychological determinants provide an explanation for acceptability of proposed scheme for both cities. Psychological motivations including "awareness of city's environment" and "awareness of problem car in society" appear to be the most important direct determinant of recognition scheme's effects and indirect determinant of acceptability policies for both cities while proposed scheme is thought to be more "correct and acceptable" in Jakarta. Moreover, empirical evidences disclose that Nagoya is more "car dependency" than Jakarta even if a congestion is recognized more grievous in Jakarta. We further verify the effect of specific measure "trust in government policy" on the correct and acceptable policy, result is revealed a negative determinant for Nagoya and vice versa for Jakarta. These indicates the important role of current government performance for achieving acceptability for these proposals.

The findings from the binary response analysis further suggest that observable determinants, such as proposed charges and personal mobility attributes, can lead to the barrier of these proposed policies for both cities as well as intangible determinant of "inhibition freedom of movements" (IFM). Yet, key of psychological determinants of "recognition of scheme's effects" (REC) and "trust in government policy" (TGP) could enhance to scheme's acceptance in Jakarta but may considerably contribute to rejection in Nagoya.

Empirical findings of this work should provide general assistance in the context of Asian countries. It also may provide an insight for the government as it works to design a more acceptable policy in enhancing public acceptance particularly for Jakarta's government particularly help in the design of a more effective policy for the promotion of a congestion charging scheme in Jakarta.

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Chapter 8

CONCLUSIONS AND FUTURE WORKS

8.1 Conclusions

Since rapid growth in car ownership and sustained car usage have been a continuous phenomenon in the last period in Jakarta. Traffic congestion becomes emerging as a serious hindrance to economic development in capital of Indonesia. In spite of integrated TDM projects such as the Jakarta outer ring road (JORR), bus rapid transit (BRT) and the 3-in-1 HOV system implemented by Jakarta's government, congestion has increased and affected Jakarta particularly badly in recent decades, as extraordinary growth in motorization has taken place. To counter negative effects of personal mobility in traffic, the Government of Jakarta has been introducing congestion charging (CC) scheme (SITRAMP, 2004; JUTPI, 2012) and CC still remains an effective a way to mitigate the acute dependence of private vehicle use. Several efforts have been made by the government in terms of institutional and legal issues. For instance, the application of the CC proposal has been stated in the Act No. 22 of 2009 on road traffic and transport and the government regulation No. 32 year 2011 on traffic management, impact analysis and TDM. However, to date, this potential powerful policy has not been implemented due to government regulation in terms of operational standards and regulatory mechanisms have not been defined. Furthermore, the major challenge of the implementation of CC policy is to design a CC scheme that is both acceptable to the public and effective in achieving the objective of more sustainable mobility.

The CC policy occasionally has been implemented since the institutional barriers and public acceptability are considered to be crucial matters. It is the most important to understand what might improve the public's acceptance for such a scheme. It is necessary to know how citizens or users will evaluate a CC policy and then respond to it by investigating their preferences. Substantially, this is affected by whether they will receive benefits from the scheme or, rather, find their private mobility affected. Therefore, understanding this is a crucial to any investigations of what might improve social acceptance for CC strategy, as it aims to design a

scheme that is not only effective in achieving the objective but also acceptable to the public. Therefore, this dissertation focuses on public acceptance and explores the influences of its determinants to the acceptability of CC proposal in Jakarta by developing an econometric methodology to model public acceptance. The outcomes of the developed models could provide insights for the Government to implement and provide a more acceptable policy thereby enhancing public support. More specifically, the conclusions of this dissertation are listed as follows.

Chapter 4 explores the share of transportation expenditures of households taking into account life stage classifications and household characteristics. The reason for doing so is that the CC policy will impose additional monetary expenditures, in particular for commuters who commute to the proposed charging area. It is presumably that certain income groups are saving the transportation expenditure attributable to their income constraints. Understanding commuter's transportation expenditure and its related factors and components could provide valuable insights into traveler's behavior under the range of CC proposal. The analysis was performed using Stochastic Frontier (SF) model and the concept of production frontier is adopted. TEFs are treated as unobserved production frontier that influences the actual transportation expenditures observed in transportation survey. Utilizing PT data, households which include person commuting to the target area were extracted. TEFs were estimated for each household life stage category. Empirical results revealed that considerable differences in average TEFs among household life stages. The variation of frontier values as well as the trends in the ratio of expenditure to frontier values considerably differ across life stage groups. The ratio values across life stage groups are substantially shown larger values range from 0.528 to 0.969 except for single–person household. These values suggest that the actual transport expenditure are closer to the frontier values for across life stage groups. The findings reveal that people in Jakarta are consequently facing higher expenditure pressure. Meaning that people are largely using their frontier (transport expenditure capacity) due to their limitations, the limitations may include their income limitation. People may tend to be constrained by more spending money for commuting, and must allocate a higher portion of their income for their transportation but they have income limitation.

Chapter 5 proposes a parking deposit system (PDS) as an alternative of ordinary road pricing (ORP). The PDS is proposed as an alternative of ORP to overcome the shortcomings of CC that lead to poor public acceptability. This PDS is based on partial or full refunds to automobile users when they enter the charging zone. Refunds are provided only on parking fees or as discounts on purchases within the charging zone; no cash refund is given. The purpose of the PDS scheme was to reduce the number of automobiles entering the city center, but increasing the turnover rate, avoiding a decline in visitors to the city center and eventually increasing social acceptability while raising revenue. Using SP questionnaire data, a bivariate binary

response (BBR) model is formulated to model and investigate public response to ORP and PDS bundles. The developed model is used to investigate and to search explanatory variables that influence public perceptions considering Jakarta's citizen's consciousness. Empirical results underscore the importance of accommodating structural relationship of an endogenous ORP on the PDS acceptance. It suggest that there is a complementary relationship between approval and consciousness, with PDS offering better improvement for the scheme's acceptance accounts for 77% compared of ORP with 69% of public acceptance. Moreover, findings further reveal that respondents seemingly believe that PDS more attractive compare to ORP while PDS has less impact in reducing CBDs visitors compared to ORP. It should be noted that maintain people enter to the city, leading to only a minimal reduction in traffic. Therefore, charges rate and refund patterns must be carefully analyzed to verify that the original goals of the PDS are met.

Extensive psychological studies have been considered to identify individual factors that affect public support, indicating that the acceptability of transport pricing appears to be explained by a wide range of psychological motivations. Therefore, **Chapter 6** utilizes the framework of hybrid discrete choice (HDC) model to formulate generalized ordered (GOR) model and uses proposed model to assess the effects of various factors on respondents' choice behavior with respect to a proposed CC policy. Aiming to capture observable preference heterogeneity across ordinal choices and also capture latent segmentation of decision making protocol, an innovative latent class generalized ordered (LCGOR) model is further formulated, allowing the thresholds vary across observations. The thresholds are parameterized as a linear function of the exogenous variables for each class (i.e. selfish and altruistic classes). Using SP questionnaire data, a comprehensive set of explanatory variables into four categories: charges, latent variables related to respondent's psychological motivations formulated using multiple-indicators multiple-causes (MIMIC) model, mobility attributes and socio-demographic characteristics. The key factors influencing public acceptability include the charge level and respondent's variables such as car dependency, awareness of the problem of cars in society, frequency of visits to the city center and frequency of private mode usage. Furthermore, LCGOR model results obviously verify the existence of preference heterogeneity across outcomes. The findings from sensitivity analysis confirm that the altruistic class is more sensitive compared to selfish class. Furthermore, the average probability of acceptance at a given charge level of 21,000 IDR (the initial government proposal) is in excess of 51%. This is a substantially high level of acceptance at such a charge level. This presumably means that such a charge would not meet the objective of cutting car dependence.

In **Chapter 7**, causal paths among psychological determinants and their strength are measured and analyzed along with acceptability of the scheme's proposal from a cross-country perspective. Using similar context of the SP questionnaire data in Jakarta and Nagoya, a

framework of hybrid discrete choice (HDC) is used. A multiple-samples multiple-indicators multiple-causes (MS-MIMIC) and binary response model are performed. The findings from analysis with MS-MIMIC analysis show that a number of psychological determinants provide an explanation for the acceptability of the proposed scheme in both cities. Psychological motivations including "awareness of the city's environment" and "awareness of the problem of cars in society" appear to be the most important direct determinants leading to recognition of the effects of a congestion charging scheme and they are indirect determinants of policy acceptance in both cities. However, the proposed scheme is found to be more "correct and acceptable" in Jakarta. Empirical evidence discloses that Nagoya is more "car dependent" than Jakarta even though congestion is recognized as worse in Jakarta. The effect of the specific measure indicator "trust in government policy" on perception of correct and acceptable policies is investigated, revealing a negative determinant for Nagoya and opposite for Jakarta. This indicates the important role of current government performance for achieving acceptability for these proposals. Moreover, findings from discrete choice analysis further suggest that tangible determinants, such as charge scenarios and individual mobility attributes can be a barrier to acceptance in both cities, along with the intangible determinant of "inhibition of freedom of movement" (IFM). On the other hand, the key intangible determinants "recognition of the scheme's effects" (REC) and "trust in government policy" (TGP) might enhance acceptability of the scheme in Jakarta, while TGP may form a considerable barrier in the case of Nagoya.

Finally, empirical findings of this work should provide insight for the government as it works to design a more acceptable policy by enhancing public acceptance of the CC proposal. This work might be a particular help in the design of a more effective policy for the promotion of a CC scheme in Jakarta. It also may provide general assistance for other big cities in Indonesia in which they are suffering from dependence on private motorized mobility. Furthermore, the econometric models proposed in this work could be used not only in Indonesia, but also other Asian developing countries in order to analyze public acceptance behavior considering local individual consumer information that can be obtained from opinion survey such as SP questionnaire surveys.

8.2 Policy Recommendations

One of the main contributions of this study is to derive policy recommendations in order to help the government of Jakarta in design of more effective and acceptable policy to the public. Aggregating findings from our empirical studies, we formulate the following policy recommendations that could help to policy makers related to preparation of adoption CC scheme in Jakarta.

Firstly, the findings from frontier analysis reveal that people in Jakarta are consequently facing higher expenditure pressure. Earliest households are largely using their frontier. Therefore, CC is expected would be imposed monetary expenditure for earliest households. Recycling revenues could be addressed particularly for policy related to earliest households such as improvement public transport or providing certain incentives for earliest households. Noted that 90% of earliest household has low income level.

Secondly, empirical evidences obtained from artificial vote in Jakarta with respect to ORP and PDS proposals disclose that PDS improves acceptability amounting close to 8%. Meaning that PDS offers considerable promise as an alternative particularly to deal with mitigating through traffic issue. However, increasing of public acceptance only slightly. Possibly, this may partially due to people in Jakarta have insufficient knowledge related PDS strategy because this policy quite new for them. Therefore, a comprehensive introduction to the PDS outlines is necessary to enhance validity and acceptability this measures. As we find that trade-off PDS is revealed due to refund option. Thus, charges rate and refund patterns must be carefully analyzed to verify that the original goals of the PDS are met. Noted that the merit of PDS strategy maintains CBD visitors while more focuses on reducing through traffic. In this case, PDS strategy is essentially suitable with traffic condition in Jakarta, with substantially larger share of through traffic from South Jakarta to North Jakarta (i.e. Soekarno Hatta International Airport, Tanjung Priok seaport).

Further, sensitivity result from public acceptance analysis further confirms that charge at 21,000 IDR reaches more than 50% of public acceptance. An important issue for policy makers is the trade-off between effectiveness and acceptance. More acceptable to the public are likely less effective mitigate congestion. This presumably means that such a charge would not meet the objective of cutting car dependence. On the other hand, scheme acceptability falls from approximately 51% to 47% when the charges are increased to 30,000 IDR. Charges of between 30,000 IDR and 40,000 IDR appear to be a possible option for initial setting of charge, offering the possibility of solving the problem of car dependency while maintaining sufficient acceptability.

Finally, with Government currently under active of campaigning CC proposal in order to gain validity and acceptability of this proposal by public. It is important for policy makers to know that acceptance can be influenced and explained by personal factors such as perceived effectiveness and awareness (less congestion & better environment). It is also potentially correlated to the opinion on trust in government policy. This emphasizes the relevance of an intelligent communication strategy that explains aims and intended effects of proposed policy in order to design scheme to be more effective and acceptable.

8.3 Future Works

This dissertation has shown comprehensive contributions in providing insights for the government as it works to design a more acceptable policy by enhancing public acceptance of the CC proposal in Jakarta. However, there are several issues which could not be covered within this dissertation and remains as a future direction of the development of this research. The future direction of this research are summarized as follows.

Firstly, in **Chapter 4,** implementing Stochastic Frontier (SF) model was able to investigate upper bound of monthly transport expenditures across household life stages. However, in this case does not consider an individual level of attributes but rather consider household point of view. Therefore, it is contingent that transport expenditures likely to be potentially influenced by individual's attributes and subjective judgment of their frontier, so the explorations on individual level remains a topic for future development of this research. Additionally, analysis in this research used PT data which is collected in year of 2002. Renewing data set could provide more accurate behavior explanations related to travel cost budget in Jakarta.

Secondly, empirical results in **Chapter 5** underscore the importance of accommodating structural relationship of an endogenous ORP on the PDS acceptance. It suggest that there is a complementary relationship between approval and consciousness, with PDS offering better improvement for the scheme's acceptance. Moreover, findings further reveal that respondents seemingly believe that PDS is more attractive compare to ORP while PDS has less impact in reducing CBDs visitors compared to ORP. It is found that to maintain people enter to the city by offering commuter refund and discount is leading to only a minimal reduction in traffic. Therefore, charges rate and refund patterns must be carefully analyzed to verify that the original goals of the PDS are met. In this dissertation, the design of the charge and refund scheme is adopted from prior studies (Miwa *et al*., 2009; Ando *et al*., 2010). A comprehensive experiment for designing pricing charge and refund scheme must be re-experimented based on real situation in Jakarta. Furthermore, acceptance related to PDS is not comprehensively analyzed in this dissertation. Further investigation by inclusion of latent variables and decision protocols into discrete analysis could provide more rich behavior explanation to the acceptance toward PDS strategy.

Thirdly, in **Chapter 6**, inclusion of latent psychological perception and decision protocols into discrete choice analysis enables to capture more comprehensive behavioral representations of public acceptance behaviors. However, sensitivity result of the proposed model reveals that acceptability for a given charge of 21,000 IDR (the government's proposed charging level) reaches 51% (considerably high level of public acceptance). This presumably means that such a charge would not meet the objective of cutting car dependence. On the other hand,

acceptability of scheme falls from approximately 51% to 42% when the charges are increased to 40,000 IDR. This charges appear to be a higher acceptance even though charges are approaching 40,000 IDR. A potential question is that, are people in Jakarta willing to pay such a charge? Further analysis on willingness to pay measure (see for example Grisolia *et al*., 2015) is needed to disclose willingness to pay people in Jakarta considering proposed charge proposals.

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Curriculum Vitae

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2/2008 - 9/2009	Reconstruction and Rehabilitation Body (BRR NAD-NIAS) Supervision Body. Banda Aceh, Indonesia
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1/2006 - 1/2008	Bumi Aceh Lestari Group Banda Aceh, Indonesia

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6. Sugiarto, Miwa, T., Sato, H., Morikawa, T., (2015). Explaining differences in acceptance determinants towards congestion charging policies in Indonesia and Japan. *Journal of Urban Planning and Development*. (*Under Review*).

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Distribution of SP Questionnaire Patterns

No	Pattern	Approval Rate	No. of Sample	CAR				Motorcyce (MC)			
				ORP	PDS			ORP	PDS		
				Amount of Charge (IDR)	Amount of Charge (IDR)	Refund (IDR)	Real Amount of Charge (IDR)	Amount of Charge (IDR)	Amount of Charge (IDR)	Refund (IDR)	Real Amount of Charge (IDR)
1	1-1	10	100	10,000	10,000	7,000	3,000	3,000	3,000	2,000	1,000
2	1-2	50	100	10,000	10,000	7,000	3,000	3,000	3,000	2,000	1,000
3	1-3	90	100	10,000	10,000	7,000	3,000	3,000	3,000	2,000	1,000
4	2-1	10	100	10,000	10,000	10,000	0	3,000	3,000	3,000	0
5	2-2	50	100	10,000	10,000	10,000	0	3,000	3,000	3,000	0
6	2-3	90	100	10,000	10,000	10,000	0	3,000	3,000	3,000	0
7	3-1	10	100	21,000	21,000	11,000	10,000	6,000	6,000	2,000	4,000
8	3-2	50	100	21,000	21,000	11,000	10,000	6,000	6,000	2,000	4,000
9	3-3	90	100	21,000	21,000	11,000	10,000	6,000	6,000	2,000	4,000
10	4-1	10	100	21,000	21,000	16,000	5,000	6,000	6,000	4,000	2,000
11	4-2	50	100	21,000	21,000	16,000	5,000	6,000	6,000	4,000	2,000
12	4-3	90	100	21,000	21,000	16,000	5,000	6,000	6,000	4,000	2,000
13	5-1	10	100	35,000	35,000	15,000	20,000	10,000	10,000	4,000	6,000
14	5-2	50	100	35,000	35,000	15,000	20,000	10,000	10,000	4,000	6,000
15	5-3	90	100	35,000	35,000	15,000	20,000	10,000	10,000	4,000	6,000
16	6-1	10	100	35,000	35,000	25,000	10,000	10,000	10,000	6,000	4,000
17	6-2	50	100	35,000	35,000	25,000	10,000	10,000	10,000	6,000	4,000
18	6-3	90	100	35,000	35,000	25,000	10,000	10,000	10,000	6,000	4,000
19	7-1	10	100	35,000	35,000	35,000	0	10,000	10,000	10,000	0
20	7-2	50	100	35,000	35,000	35,000	0	10,000	10,000	10,000	0
21	7-3	90	100	35,000	35,000	35,000	0	10,000	10,000	10,000	0
Total Sample			2,100								

Form of SP Questionnaire

An Example Form: Pattern 1-1

A Survey Concerning Traffic and Environment in Downtown Jakarta

(Request for Cooperation)

- **This research survey concerning "traffic and environment" in the city center is being conducted by Nagoya University.**
- **Any numbers or factual conditions in the questions are hypothetical. They are not meant to be part of an actual plan of action.**
- **All data collected from your answers will be processed numerically. Please be assured that any personal information in your responses will not be disclosed.**
- **Please provide your most frank opinions in your answers.**
- **After providing your answers, please submit your survey form to a survey attendant.**

Thank you for your cooperation with this Nagoya University research activity!

Deadline : 2nd December 2013

For questions, please contact:

UNIVERSITAS NAGOYA, JEPANG

TELP : +81-52-789-3565

FAX : +81-52-789-5728

E-mail : sugiarto@d.mbox.nagoya-u.ac.jp

Question１. Please tell us about the purpose for the trip to City Center at the day you received this questionnaire. (Multiple answers allowed)

１. Work	２. Meetings and sales
３. Delivery	４. Trader
５. Shopping	６. Entertainment and eating
７. Studying and lessons	８. School

Question２. How many people including you came to the district at that day?

１. Only you	２. ２People
３. ３People	４. ４People
５. ５People	６. ６People or over

Question３.

(A) What means of transportation did you use when you came to the district.

１. Car（Drive by yourself）	
２. Car（Drive by your friend or family）	
３. Rail and subway	４. Regular bus/mini bus
５. Busway (Jakarta BRT)	６. Motorcycle
７. Taxi	８. Pedicab
９. Bajaj/local transport	10. Motorcycle taxi
11. Bicycle	12. Walking
13. Other (……..)	

(B) Answer the questions if you have chosen car or motorcycle as your chosen transport mode. Please tell me about where you parked your car.

1. Parking lot with temporary parking lot 2. Parking lot with monthly parking lot 3. On-street parking with charge 4. On-street parking without charge	
Entry time : h min Exit time : h min	**Ex:** If parking fee is 2,000 IDR for 60 min., write: 2000 IDR for 60 min
Parking fee (unit price)	IDR for min
Actual parking fee paid	Car Rp/hour MC Rp/hour
Person paying parking fee	1. Self 2. Passenger(s) 3. Other（……）

Question 4.

Please tell us about "where did you go" and "how long stayed there.（Up to 5 places）

	Name of the building	Stay time
First		min
Second		min
Third		min
Fourth		min
Fifth		min

Please read the following explanation carefully, and answer the questions.

In order to **solve traffic and environmental problems**, one plan involves levying a fee on drivers of cars entering the center of town, referred to as **Road Pricing**.

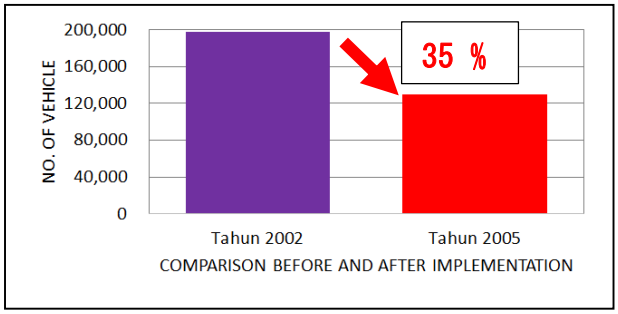
Road pricing plans have already been introduced in London and Singapore.

- In London, due to road pricing, the number of vehicles entering downtown areas has **decreased by 35%**.
- Due to this, in addition to **reducing CO_2 emissions** which are a factor contributing to global warming, cities have been able to facilitate **a safe environment for pedestrians**.
- **CO_2 emissions have been increasing annually in Jakarta.** One cause of this is the **impact of cars**.
- The issue of reducing automotive traffic must be considered seriously in Jakarta as well.

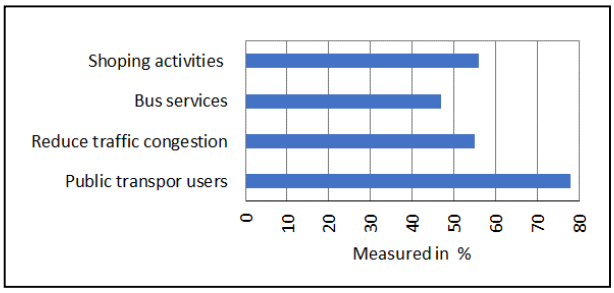
Road Pricing in Singapore

Similar to electronic road pricing (ERP), toll gates are set up through which drivers can pay fees using a card affixed to their vehicle.

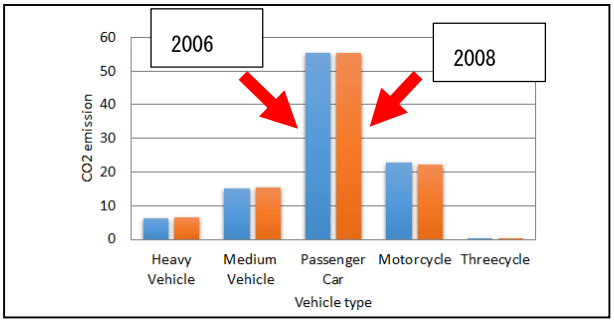
Reduced Traffic in London as a Result of Road Pricing



Londoners' Opinions on Road Pricing (based



Current CO_2 Emissions in Jakarta



Question５. Did you know the **"Road Pricing"**?

１. I know it very well
２. I have some image about it
３. I know just the words
４. I do not know it at all

Question６. Please tell us about your opinions of the following questions.
Please choose one close to your opinion from ①～④, and write a "○".
（Please answer them intuitively）

☆Please tell your opinion about the Road Pricing.

(1)Do you think that the Road Pricing is the **correct policy** to improve the environment and congestion?

Quite right	Right	Wrong	Totally wrong
①	②	③	④

(2)Do you think that the Road Pricing can be **accepted policy** in the public?

Well accepted	Accepted	Not accepted	Not accepted at all
①	②	③	④

(3)Please read the two opinions below.
Do you think that the Road Pricing is a **fair policy**?

Opinion１ Cars cause environmental problems and congestion, so the car users should pay some money.

Opinion２ It is unfair to pay fee for road usage.

Quite fair	fair	Unfair	Quite unfair
①	②	③	④

(4)Do you think that the Road Pricing policy should be implemented **to improve the congestion** in the city center?

Quite agree	Agree	Disagree	Totally disagree
①	②	③	④

(5)Do you think that the Road Pricing policy should be implemented **to improve the global warming**?

Quite agree	Agree	Disagree	Totally disagree
①	②	③	④

(6)Do you think that the Road Pricing policy can impede the **freedom of your driving**?

No impediment at all	No impediment	Impediment	Much impediment
①	②	③	④

(7)Do you think that the Road Pricing policy can impede the **freedom of your moving**?

No impediment at all	No impediment	Impediment	Much impediment
①	②	③	④

☆Please tell your opinion on the effect of the Road Pricing.

(8)Do you think **it can reduce the congestion**?

Much result	Some result	No result	No result at all
①	②	③	④

(9)Do you think **it can improve the environmental problems**?

Much result	Some result	No result	No result at all
①	②	③	④

(10)Do you think that **the environment for bicycle and pedestrians in the city center will be better**?

Quite better	Better	Worse	Quite worse
①	②	③	④

(11)Do you think that **the number of people who come to play and shopping in the city center will change**?

Much more	More	Less	Much less
①	②	③	④

☆Please tell your thoughts about daily movement.

(12)Do you think the **car** is **absolutely necessary** in daily life?

Quite necessary	Necessary	Unnecessary	Quite unnecessary
①	②	③	④

(13)Do you think the **public transport** such as bus or train is **absolutely necessary** in daily life.

Quite necessary	Necessary	Unnecessary	Quite unnecessary
①	②	③	④

☆Please tell your opinion about the traffic situation of Jakarta

(14)Do you think **the traffic is congested**?

Quite congested	Congested	No congested	No congested at all
①	②	③	④

(15)Do you think that it is **dangerous and hard to walk** because there are too many cars?

Quite hard and dangerous	Hard and dangerous	Easy and safe	Quite easy and safe
①	②	③	④

(16)Do you think that it is **easy to use rail and bus in daily life**?

Quite easy	Easy	Hard	Quite hard
①	②	③	④

☆Please tell your opinion about the effects of car to the whole society.

(17)Do you think that **the car is the major cause of global warming**?

Quite agree	Agree	Disagree	Quite disagree
①	②	③	④

(18)Do you think that **public transportation become a loss-making operation and bus routes be obsolete** because most people travel by cars?

Quite agree	Agree	Disagree	Quite disagree
①	②	③	④

☆Please tell your opinion about the local government.

(19)Do you think the current transport policy is correct?

Quite agree	Agree	Disagree	Quite disagree
①	②	③	④

(20)Do you think that the interaction between residents and government is enough?

Quite agree	Agree	Disagree	Quite disagree
①	②	③	④

☆Please tell us something about yourself.

(21)Do you always take some environmentally friendly actions?

Always take	Take	Not take	Not take at all
①	②	③	④

(22)Do you like driving?

Very like	Like	Unlike	Very unlike
①	②	③	④

☆ How do you think the "fees (income)" gathered through Road Pricing should be used? Using the **Example Answer** as reference, please indicate as a percentage what portion of these fees should go to which purpose. (Please make sure your choices add up to 100% in total)

Use of Fee Income	% Allocated
Use for making **public transportation such as trains or buses more convenient**	%
Use for making street traffic safer, by measures such as improving inner city intersections and furnishing sidewalks	%
Use for **stimulating local businesses** through regional funding grants and remodeling shopping streets	%
Other purposes (If you have an idea for fund use not mentioned above, please write it here.) (Please write specifically:)	%
Total	**100%**

Example

※Ex1：

「All Fee Income」 should be used for public transportation.

Use of Fee Income	% Allocated
Use for making public transportation such as trains or buses more convenient	100%
Use for making street traffic safer, by measures such as improving inner city intersections and furnishing sidewalks	0%
Use for stimulating local businesses through regional funding grants and remodeling shopping streets	0%
Other purposes (If you have an idea for fund use not mentioned above, please write it here.) (Please write specifically:)	0%
Total	**100%**

※Ex2：

Your opinion is that 60% of 「All Fee Income」 should be used for public transportation, 20% for traffic safety and 20% for welfare.

Use of Fee Income	% Allocated
Use for making public transportation such as trains or buses more convenient	60%
Use for making street traffic safer, by measures such as improving inner city intersections and furnishing sidewalks	20%
Use for stimulating local businesses through regional funding grants and remodeling shopping streets	0%
Other purposes (If you have an idea for fund use not mentioned above, please write it here.) (Please write specifically: for welfare)	20%
Total	**100%**

Question 7. The following is for **hypothetical discussion**. Please read the following carefully, and answer the questions.

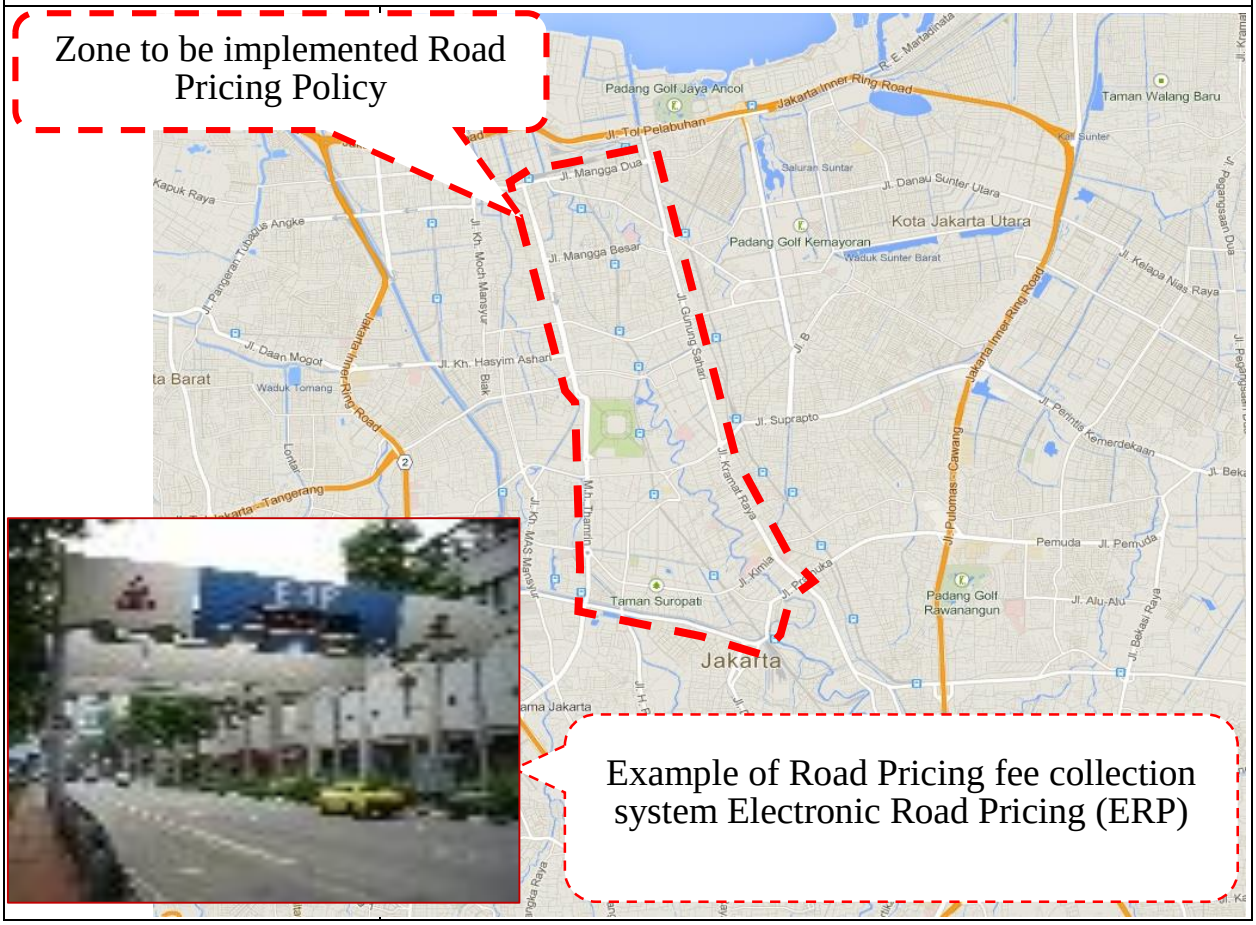
★While plans for implementing Road Pricing are under discussion in Jakarta, such discussions are not related to this survey.

Scheme of Road Pricing Implementation	
Operation time	7:00-10:00 am & 16:30-19:30 pm.
Fee to be charged	**IDR 10,000 (car)** or **3,000 (motorcycle)**
Payment system	Electronic pricing method
Zone to be implemented (first priority)	Blok M-Stasiun Kota, Jl Gatot Subroto (Kuningan-Senayan), Jl Rasuna Said-Tendean, Tendean-Blok M serta Jl Asia Afrika-Pejompongan.

The proportion of **Jakarta** citizens' **"Approval"** or **"Opposition"** to this plan are shown in the table to the right.

Proportion of Jakarta citizen Approval and Opposition

Approve	10%
Oppose	90%



☆Do you want to participate in the vote to decide the introduction of the Road Pricing.

(1)Do you want to vote for either agree or disagree?

１． Agree
２． Disagree

☆Please answer the questions about your today's activity.

(2)If the Road Pricing were implemented, do you think that **you would decrease the frequency of coming to this area by car or motorcycle**

Not decrease at all	Not decrease	Decrease	Much decrease
①	②	③	④

(3) If the Road Pricing were implemented, do you think that **you would increase the frequency of coming to this area by bus or train**?

Not increase at all	Not increase	increase	Much increase
①	②	③	④

(4) If the Road Pricing were implemented, do you think that **you would decrease the frequency of coming to this area**?

Much increase	Increase	Decrease	Much decrease
①	②	③	④

Question 8. **We introduce new term of Road Pricing so-called New Road Pricing which is resembling the current system is being evaluated for implementation. First, please carefully read the explanation below.**

There is currently no plan to implement road pricing in Jakarta.

《Overview of the "New Road Pricing system"》

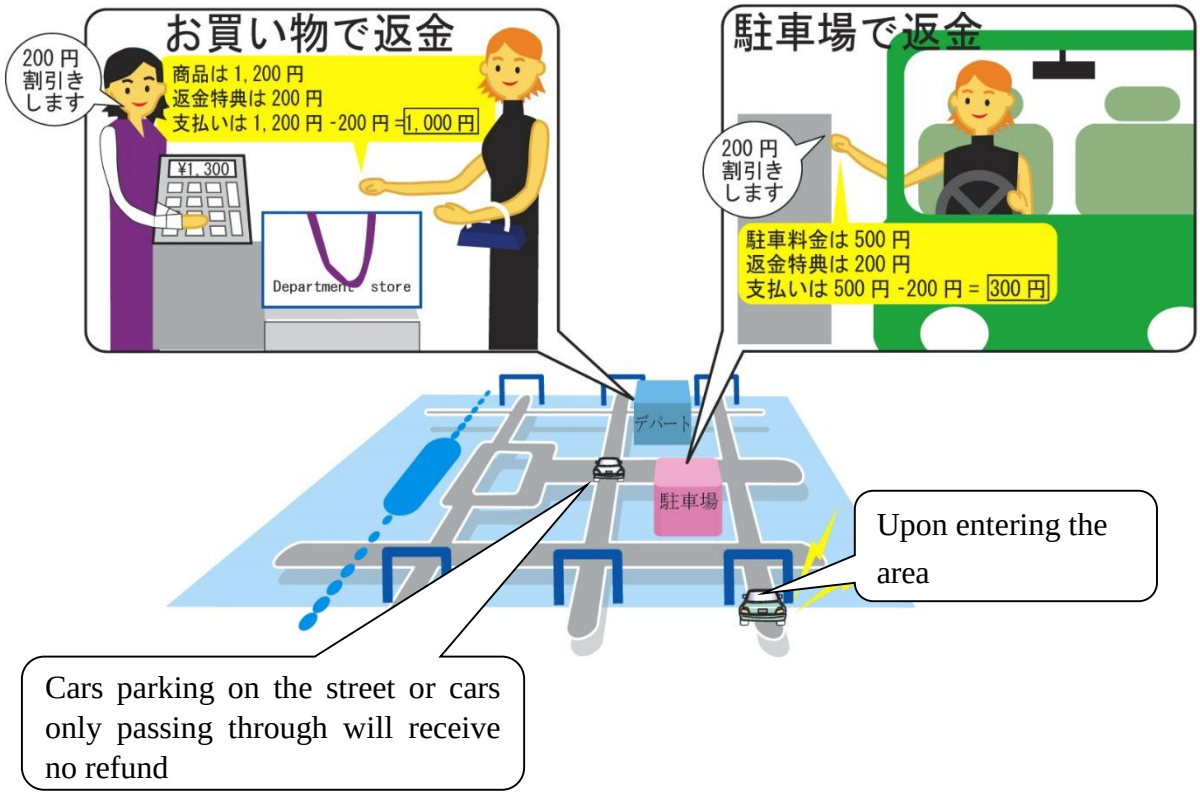
- Vehicles will need to pay **IDR 10,000 (car)** or **3,000 (motorcycle)** upon entering the Road Pricing area.
- However, under New Road Pricing, drivers will benefit from refunds.
- Drivers will get **IDR 7,000 (car)** or **2,000 (motorcycle)**back when they park their cars in parking lots
- Refunds only can be used **for the discount shopping within the area and paying parking fees**.
- However, for people who do not use parking lots in designated areas, or for cars that only pass through the area, the refund will be zero

The proportion of **Jakarta citizens' "Approval"** or **"Opposition"** to this plan Are shown in the table to the right.

Proportion of Jakarta Citizen

Approval and Opposition

Approve	**10%**
Oppose	**90%**



☆Do you want to participate in the vote to decide the introduction of the New Road Pricing.

(１)Do you want to vote for either agree or disagree?

１．	Agree
２．	Disagree

☆Please tell me your opinion about the “New Road Pricing”.

(2)Do you think that the new type “New Road Pricing” is the **correct policy** to improve the environment and congestion?

Quite right	Right	Wrong	Totally wrong
①	②	③	④

(3)Do you think that the new type “New Road Pricing” can be accepted **policy** in the public?

Well accepted	Accepted	Not accepted	Not accepted at all
①	②	③	④

(4)When compared to the “Road Pricing” on page 11, do you think that the **new type road pricing will be more easily accepted by public**?

Much easily accepted	Easily accepted	No change	No change at all
①	②	③	④

☆The New Road Pricing will give what kind of effect on yourself and your town, please tell us.

(5)Do you think that it can impede the freedom of your driving?

No impediment at all	No impediment	Impediment	Much impediment
①	②	③	④

(6)Do you think that it can impede the freedom of your moving?

No impediment at all	No impediment	Impediment	Much impediment
①	②	③	④

(7)If the **New Road Pricing** was implemented, do you think that **you would decrease the frequency of coming to this area by car**?

Not decrease at all	Not decrease	Decrease	Much decrease
①	②	③	④

(8) If the **New Road Pricing** was implemented, do you think that **you would increase the times of coming to this area by bus or train**?

Not increase at all	Not increase	increase	Much increase
①	②	③	④

(9) If the **New Road Pricing** was implemented, do you think that **you would decrease the times of coming to this area**?

Much increase	Increase	Decrease	Much decrease
①	②	③	④

(10) If the **New Road Pricing** was implemented, do you think that **more people would come to this area for shopping and playing**?

Much increase	Increase	Decrease	Much decrease
①	②	③	④

☆If the “New Road Pricing” was introduced, do you think “which action instead of today’s one would be taken” ?

1. Parking **in the parking lot** “in the Road Pricing area”
2. Parking **on the road** “in the Road Pricing area”
3. Parking **“outside** the Road Pricing area**”** and come here **by walking or public transportation**
4. Come here **by public transportation**
5. **Not come here**

(11) **How would you react** if any of the following **6 fee patterns** were to be implemented**?**

Pattern	**Fee in IDR**	**Refund** at time of parking or shopping	**Please describe your actions today.** (Select any of 1-5)
1	**10,000 (car)** **3,000 (MC)**	**10,000 (car)** **3,000 (MC)**	1. I would stop at a **parking lot within** the designated area 2. I would **park on the street within** the designated area 3. I would **park** **outside** the designated area, and then use **public transit** or **walk** 4. I would **use public transit from the start** 5. I would **not go to this location**
2	**21,000 (car)** **6,000 (MC)**	**11,000 (car)** **2,000 (MC)**	1. I would stop at a **parking lot within** the designated area 2. I would **park on the street within** the designated area 3. I would **park** **outside** the designated area, and then use **public transit** or **walk** 4. I would **use public transit from the start** 5. I would **not go to this location**
3	**21,000 (car)** **6,000 (MC)**	**16,000 (car)** **4,000 (MC)**	1. I would stop at a **parking lot within** the designated area 2. I would **park on the street within** the designated area 3. I would **park** **outside** the designated area,

			and then use **public transit** or **walk** 4. I would **use public transit from the start** 5. I would **not go to this location**
4	**35,000 (car)** **10,000 (MC)**	**15,000 (car)** **4,000 (MC)**	1. I would stop at a **parking lot within** the designated area 2. I would **park on the street within** the designated area 3. I would **park** **outside** the designated area, and then use **public transit** or **walk** 4. I would **use public transit from the start** 5. I would **not go to this location**
5	**35,000 (car)** **10,000 (MC)**	**25,000 (car)** **6,000 (MC)**	1. I would stop at a **parking lot within** the designated area 2. I would **park on the street within** the designated area 3. I would **park** **outside** the designated area, and then use **public transit** or **walk** 4. I would **use public transit from the start** 5. I would **not go to this location**
VII	**35,000 (car)** **10,000 (MC)**	**35,000 (car)** **10,000** **(MC)**	1. I would stop at a **parking lot within** the designated area 2. I would **park on the street within** the designated area 3. I would **park** **outside** the designated area, and then use **public transit** or **walk** 4. I would **use public transit from the start** 5. I would **not go to this location**

Please tell us about you

Q1 : Gender

1. Male 2. Female

Q2 : Age

1. 10-19 2. 20-29 3. 30-39 4. 40-49

5. 50-59 6. 60-69 7. 70-79 8. 80 or over

Q4：Final educational background

1.	Elementary School	2.	Junior High School
3.	Senior High School	4.	Diploma
5.	Bachelor	6.	Master

Q4：Your monthly income

（If you are the part-time job or you are the housewife, please answer the annual income of the person who is the head of your household）

1.	Below 0.6 million IDR	2.	0.6-1million IDR
3.	1-1.5 million IDR	4.	1.5-2 million IDR
5.	2-3 million IDR	6.	3-4 million IDR
7.	4-5 million IDR	8.	5-7.5 million IDR

Q5：Your monthly transportation expenditure.

（for all household members including you）

1.	Below 0.3 million IDR	2.	0.3-0.5 million IDR
3.	0.5-0.75 million IDR	4.	0.75-1million IDR
5.	1-1.5 million IDR	6.	1.5-2 million IDR
7.	2-2.5 million IDR	8.	2.5-3 million IDR

Q6：Occupation

1.	Govern. employees	5.	Unemployed
2.	Army/police	6.	Student
3.	Non. Govn. employees	7.	Housewife

Please answer which field are you engaged

1. Financial & insurance	2. Sales & restaurant
3. Transportation	4. Real estate
5. Service	6. Industry

Q7：Do you have a driver license

1. Yes	2. No

Q8：See question7 in page11. Please tell the frequency and main purpose to come in the **Road Pricing**

1. Work	2. Meetings and sales
3. Delivery	4. Trader
5. Shopping	6. Entertainment and eating
7. Studying and lessons	8. School

The frequency of coming

1. More than 5 days a week	2. 3 - 4 days a week
3. 2-3 days a week	4. 1-2 days a month

Which transportation mode are used

1. Car（Drive by yourself）		
2. Car（Drive by your friend or family）		
3. Rail and subway	4. Regular bus/mini bus	
5. Busway (Jakarta BRT)	6. Motorcycle	
7. Taxi	8. Pedicab	9. Bajaj/local transport
10. Motorcycle taxi	11. Bicycle	12. Walking
13. Other (……)		

Q9：The frequency of car use in daily life

1. More than 5 days a week	2. 3 - 4 days a week
3. 2-3 days a week	4. 1-2 days a month

Q10：The frequency of public transportation usage in daily life

1. 5 days a week or more	2. 3 - 4 days a week
3. 2-3 days a week	4. 1-2 days a month

Q11：Your information

Address/village :

Sub district :

District/City :

Postal Code :

This concludes the survey.

Thank you very much for your cooperation!