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RESEARCH REPORT

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Designing a Choice Modelling Survey to Value the Health and Environmental Impacts of Air Pollution from the Transport Sector in the Jakarta Metropolitan Area

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Poor air quality in Indonesia’s capital city is having a significant impact on residents’ health and there is an urgent need to introduce new initiatives to deal with the problem. To help justify investment in such new strategies, a recent EEPSEA study has looked at the value that citizens in the Jakarta Metropolitan Area (JMA) place on pollution reduction policies for the transportation sector. The study is the work of Mia Amalia from the Environmental Management and Development Program at the Australian National University. It shows that, although many residents are mistrustful of the government’s ability to clean up the city’s air, they do place a significant value on clean air.

Households in the JMA are willing to pay up to USD 66.51 per annum over a three-year period. Nonetheless, on average, respondents in the JMA were willing to pay Rp 584,333 (USD 66.51), Rp 558,000 (USD 63.51) and Rp 579,333 (USD 65.94) per household per annum over a three-year period for the implementation of the improved public transport policy (TS), the vehicle restriction policy (RD), and the old-vehicle reduction strategy (RO), respectively. These policies would make a significant positive improvement to both Jakarta’s air quality and to the health of its citizens.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
1.0 INTRODUCTION 1
1.1 Description of the Problem 1
1.2 Existing and Proposed Policies 3
1.3 Earlier Phases of the Research 5
1.4 Phase 3 – Valuation 6

2.0 VALUING THE HEALTH AND ENVIRONMENTAL IMPACTS OF PM10 POLLUTION: REVIEW OF LITERATURE 7
2.1 Introduction 7
2.2 Impact of PM10 Pollution 7
2.3 Cost Benefit Analysis to Assess Policy Alternatives 8
2.4 Stated Preference Method to Value Changes in Health and Environmental Conditions 9
2.5 Test for an Incentive Compatible Provision Rule 16

3.0 METHODOLOGY: SURVEY DESIGN AND IMPLEMENTATION ………..... 18
3.1 Introduction 18
3.2 Questionnaire Design 18
3.3 Discussion with Experts 21
3.4 Focus Group Discussions 22
3.5 Surveys 22
3.6 Questionnaire Refinement 25
3.7 Survey Implementation 35
3.8 Data Processing and Analysis 38

4.0 ANALYSES OF SURVEY DATA 40
4.1 Socio-demographic of Respondents 40
4.2 Analyses of Respondents' Responses to General Questions 41
4.3 Modelling Utility Functions using Conditional Logit Models ……….......... 44
4.4 Modelling Utility Function using Random Parameter Logit Models 48
4.5 Comparing Model Fit 49

5.0 CONCLUSIONS 51

REFERENCES 53
APPENDICES

Appendix A. Model Results
Appendix B. Questionnaire
Appendix C. Final Show Cards for Survey
Appendix D. Cards for Focus Group Discussion

LIST OF TABLES

Table 1. Attributes and levels........20
Table 2. Orthogonal design for nine attributes with three levels........21
Table 3. Subdistrict classification according to PM10 concentration........24
Table 4. Group composition of two focus group discussions in the JMA........26
Table 5. Respondents' income group for the first pre-test........33
Table 6. Estimation results for the first pre-test........33
Table 7. Respondents' income group for the second pre-test........33
Table 8. Estimation results for the second pre-test........34
Table 9. Respondents' income group for the orthogonal design survey........35
Table 10. Estimation results for the orthogonal design survey........35
Table 11. Efficient design choice sets for block 1........36
Table 12. Decision maker for household spending........37
Table 13. Summary of number of respondents for each group and block........37
Table 14. Number of districts for every group........38
Table 15. Respondents' socio-economic background for the efficient design survey........41
Table 16. Comparison between survey results and existing socio-economic level........42
Table 17. Comparison between survey results and 2008 population projection data........42
Table 18. Decision maker for household spending........43
Table 19. Awareness of the effects of air pollution........44
Table 20. Verification of the effects of air pollution........44
Table 21. Attribute rankings........44
Table 22. Alternative payment vehicles........45
Table 23. Protest respondents........45
Table 24. Effect coding for odour attribute........46
Table 25. Estimation results of CL model for group 1 and group 2........46
Table 26. Implicit prices in thousand Rupiahs and Poe et al. test results........48
Table 27. Hausman test results for model 1 and model 3........50
Table 28. Comparison of implicit prices (in thousand Rupiahs)........51
Table 29. Comparison of compensating surplus for each new transport policy (in thousand Rupiahs per household per annum over a three-year period)........52
Table 30. Present value of total benefit for three new transport policies for a three-year period........52

LIST OF FIGURES

Figure 1. Illustration of the cluster sampling method........25
Figure 2. Sample of show cards presenting a choice set........34
Figure 3. Sampling areas........38

Designing a Choice Modelling Survey to Value the Health and Environmental Impacts of Air Pollution from the Transport Sector in the Jakarta Metropolitan Area

Mia Amalia

EXECUTIVE SUMMARY

Jakarta Metropolitan Area's (JMA) air is heavily polluted, leading to very poor ambient air quality. Air pollution is generated by every sector that uses energy, including the transport sector. This sector emits a number of primary pollutants and some of them form secondary pollutants. Air pollution and its negative impacts have been recognised and addressed by the development of air pollution control policies for every sector in Indonesia. Three policies were introduced in the transport sector: a) improvement in public transport facilities; b) improvement in traffic management; and c) reduction in number of old vehicles. The primary objective of this research is to estimate the benefits of having cleaner ambient air for JMA citizens as a result of these three policies. Fieldwork conducted in 2008 involved a choice modelling survey to estimate how JMA citizens value lowering the health risks associated with poor air quality. The choice modelling method separated the property of air pollution impacts into the following attributes: number of sick leave days, visibility and odour. The paper documents in greater detail the processes involved in the design and implementation of this method to serve as reference material for researchers who intend to use this tool. The survey results were analysed using Conditional Logit and Random Parameter Logit Models. The results showed that, on average, respondents were willing to pay from USD 63.51 to USD 66.51 per household per annum over a three-year period for the implementation of the three new transportation policies.

1.0 INTRODUCTION

1.1 Description of the Problem

Jakarta Metropolitan Area's ambient air is highly polluted (Suhadi et al., 2005; Resosudarmo and Napitupulu, 2004; Napitupulu et al., 2002; Syahril et al., 2002; Tomo and Syahril, 2002; Resosudarmo and Thorbecke, 1996; Soedomo et al., 1991; Achmadi, 1989; Tri-Tugaswati et al., 1987; Bappenas, 2006). These researchers' conclusions are based on data from a continuous monitoring system established by the Bureau of Meteorology and Geophysics in the 1970s, and was developed into the current system by the Ministry of Environment in 1999 using 28 air quality monitoring stations (KLH[1], 2006; IMAP[2], 2002). These stations produce data of the average concentrations of pollutants nitrogen oxide (NOx), sulphur oxides (SOx) and dioxide (SO_2), carbon monoxide (CO), and total suspended particles (TSP) (IMAP, 2002).

[1] KLH stands for *Kementerian Lingkungan Hidup* (Ministry of Environment).
[2] IMAP stands for the Indonesian Multi Sectoral Action Plan Group on Vehicle Emission Reduction.

Compared with big cities in other developing and developed countries, total suspended particle (TSP) concentration in the JMA is amongst the highest, second only to New Delhi. Using World Health Organization (WHO) air pollutant concentration standards, TSP concentration in the JMA is 2.7 ($250\mu g/m^3$) higher than the standard ($90\mu g/m^3$), while NO_2 concentration is approximately $10\mu g/m^3$ higher than the standard (Health Effect Institute, 2004). Using the World Development Index's data, Jakarta Province's PM10 concentration was in 11^{th} position among other countries in the world in 2002, while for SO_2 and NOx, it was ranked 97^{th} and 67^{th}respectively in 2001 (The World Bank, 2006).

The main sources of air pollutants in the JMA are domestic activity, industry, municipal solid waste burning and the transport sector (Bappenas[3], 2006). The transport sector is the main source of CO, NOx, THC, and TSP[4] (Bappenas, 2006). NOx, PM10 and CO hourly variations have sharp concentration peaks in the morning and afternoon. These concentrations correlate with traffic congestion and show that emissions from the transport sector have an effect on these parameters' concentration (Supalal, 2001 cited in IMAP, 2002).

Since mobile source air pollution is one of the most important sources of urban air pollution, specific studies have been conducted in this area (Ostro, 1994; Syahril et al., 2002; IMAP, 2002; Tomo and Syahril, 2002). All these studies have concluded that each parameter has a different vehicular emission load[5]. In 1992, the vehicular emission loads for Jakarta were 35% for NOx and 73% for TSP (Ostro, 1994). In 1995, the emission load from vehicles to the ambient air quality of Jakarta and its surrounding area was 69% for NOx, 15% for SO_2, and 40% for TSP (JICA[6] and Bapedal[7], 1997). Syahril et al. (2002) predict that the emission load from vehicles in 2015 will be between 2.73 and 3.68 times higher than emission loads in 1998.

Air pollution damages human health and the environment. For instance, it increases mortality and morbidity (Bappenas, 2006, p.64). Respiratory diseases are among the highest ranked diseases suffered by Indonesian citizens. In Jakarta Province, approximately 46% of diseases are air-pollution-related, such as respiratory disease (43%), eye irritations (1.7%) and allergic reactions, such as asthma (1.4%) (Dinkes DKI Jakarta[8], 2005, p.201-202). All of these diseases are mostly suffered by children.

In 2004 there were about 6,400 premature deaths related to air pollution in JMA (KLH, 2005). On average, the estimated loss of productive days was around 24 days per productive-aged person per annum in 2004 (Mitra Emisi Bersih[9], 2004, cited in KLH, 2005). In 2005 a study that used equipment to measure individual exposure was attached to survey respondents and indicated that the PM2.5 and CO concentration inhaled by JMA residents was higher when the subjects were on the street, driving or working, than when they were indoors (Haryanto, 2005, cited in Bappenas, 2006, p.67). Haryanto (2005)

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[3] Bappenas stands for Badan Perencanaan Pembangunan Nasional (National Development Planning Agency).
[4] In California the PM10 levels are 55% of the TSP mass (Lurman, 1989 cited in Hall et al., 1992).
[5] Vehicular emission load: share of emissions from vehicle to ambient air.
[6] JICA stands for Japan International Cooperation Agency.
[7] Bapedal stands for Badan Pengendalian Dampak Lingkungan (National Pollution Control Agency).
[8] Dinkes DKI Jakarta is Dinas Kesehatan DKI Jakarta (the Jakarta Province Health Agency).
[9] Mitra Emisi Bersih (Clean Emission Partner, a non-governmental organisation in Indonesia that concentrates on urban air pollution issues).

concluded that the risk of inhaling PM2.5 and CO is higher when people are on the way to and from work and both private and public transport users have approximately the same exposure level.

1.2 Existing and Proposed Policies

1.2.1 Existing policies

Existing policies to address air pollution problems from the transport sector are mainly command and control policies (Sadat et al., 2005). The main regulation is the Indonesian National Air Pollution Control Policy (NAPC)[10]. The NAPC sets standards for ambient air quality, emissions, noise and the air pollution index. To meet all these standards, this regulation assigns local governments a central role in keeping the air quality below the identified thresholds (*Pemerintah Republik Indonesia*[11], 1999, Article 18). The NAPC deals with the large variations in local environmental conditions by addressing the need for local governments to set their own standards which cannot exceed the NAPC standards (*Pemerintah Republik Indonesia*, 1999, Article 5). The Ministry of Environment Decree (MED No. 141/2003) regarding New Type and Current Production Motor Vehicle Exhaust Emission Standards (CPMV Standard) has tried to address the discrepancy between indirect ambient air pollution control and direct pollution control by controlling the source – vehicles. The CPMV standard also considers available air pollution control technology to reduce vehicular emission (*KLH*, 2003b[12]).

Local governments too have responsibilities for meeting all environmental standards set by the Central Government (*Pemerintah Republik Indonesia*, 2000, Article[13]). Even though this policy relieves the Central Government of some of its responsibilities in managing the environment, it still relies on government, in this case local government, to lead the way to cleaner air quality and the responsible monitoring and control of emissions and ambient air quality. Jakarta Province (JP) has taken a further step by setting its own Jakarta Air Pollution Control Regulation (Jakarta APC, Jakarta's Provincial Regulation No. 2/2005). In regard to air pollution caused by mobile sources, this policy makes periodic vehicular emission assessment compulsory for all types of vehicles. It also specifies that all public transport and local government fleets should use liquefied petroleum gas (LPG) as an energy source instead of oil: the LPG emission load is lower than that of oil and LPG stations are available in the JP area (*Bappenas*, 2006).

1.2.2 Proposed policies

Improvement of public transport facilities

The first proposed policy used in this research is the *improvement of public transport facilities* (TS). This first policy takes into account the current development of public transport facilities in Jakarta Province. In this first improvement scenario, the policy is implemented by building bus rapid transport (BRT) facilities, including special bus corridors and bus stops, building monorail facilities, improving light rail facilities,

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[10] Government Regulation No. 41/1999
[11] Government of Republic Indonesia
[12] In Annex I Section 2 of MED No. 141/2003
[13] Government Regulation regarding Provincial and Local Governments' Responsibility (PLGR, PP No. 25/2000).

providing walking paths and bike lanes to reduce the number of private vehicles operating in the JMA, and shifting the use of fuel from gasoline to compressed natural gas for buses, electric power for light trains and monorails and non-motorised transport. Current developments include the operation of high-capacity buses in eight bus corridors, light rail for commuters, and walking paths to and from bus corridors. Light rail for commuting between Jakarta Province and its sub-urban areas is in very poor condition and is usually overloaded. Walking paths in other areas are still very poor and no bicycle lanes are available. Bicycle riders use the same lanes as motorised vehicles.

Future development will include seven new bus corridors to accommodate transportation within Jakarta Province as well as moving commuters from sub-urban areas to Jakarta Province and back. Commuters from Kota and Kabupaten Bekasi, Kota Depok as well as Kota and Kabupaten Tangerangare planned to be served by BRT. It is planned that all 15 bus corridors will be fully operational by the end of 2010 (*Suara Transjakarta*, 2009). For the monorail, current plans include two lines: one 14.3 km-long loop line serving business districts in Jakarta Province and another line 13.5 km in length connecting the north-western sub-districts of Jakarta Province with the south eastern sub-districts. There would be two interchange stations for the passengers to switch between lines and from monorail to bus corridors and to the light train network (The Monorail Society, 2009). For non-motorised transport such as bike riding, the number of bicycle users in Jakarta Province was approximately 5,000 in 2009 (Kompas, 2009). The number of bicycle users in Jakarta Province began to rise in 2002 as the ‘bike to work’ community began a campaign to popularise this way of travel. Bicycle users have been pressing the government to construct special bike lanes for use in Jakarta Province, especially in the business district areas (Antara, 2009).

The scenario for the first policy was that if the above plan and campaign were successful then JMA citizens would reduce private vehicle usage, especially in Jakarta Province. The critical stage in scenario development for this policy was determining changes in vehicle composition resulting from the implementation of the new policy. According to a survey conducted by the Institute for Transportation and Development Policy (ITDP, 2005), the current BRT system has slightly changed the choices made by people in JMA about vehicle usage. From a total of 65,000 trips per day, about 14% and 6% of BRT passengers were private car and motorcycle users respectively. A more recent (2007) ITDP study provided figures for the demand on eight BRT corridors. High demand for the new BRT system was attributed to the new shaded walkways along bus stops and to and from commuter light train lines (ITDP, 2005, p.31). For the monorail system, ITDP (2003, p.17) conducted a demand estimation study, using an origin-destination matrix provided by JICA and Bapedal (1997). The study estimated that passengers using the Blue and Green lines in peak hours would reach 20,000 and 4,000 passengers per peak hour respectively.

Restriction of vehicle numbers in busy areas

The second proposed policy was the *restriction of vehicle numbers in busy areas* (RD). This policy was designed to reduce the number of private vehicles on the streets and would be implemented by raising parking fees in public areas such as shopping centres, applying fees in public areas such as offices, and collecting entry fees to busy areas. Under this policy, the busy areas were defined as five cities within Jakarta Province. Each of these cities has the highest PM10 concentration compared to other cities in the JMA.

Scenarios developed for the second policy were purely hypothetical since there were no previous studies available to aid the analysis. The scenarios assumed that the numbers of private vehicles, private cars and motorcycles operating in the five cities were reduced to 50%, 30%, and 10% of 2004 figures, respectively.

Reduction in number of old vehicles

The third proposed policy is the *reduction in number of old vehicles* (RO). It is planned that this policy will be implemented by raising registration fees for old cars and motorcycles. Old vehicles were defined as vehicles that do not comply with the new standard stated in the Ministry of Environment Decree No.141/2003 (MED No. 141/2003). Nugroho et al. (2005, p.26-27) made an estimation of the ratio of new to old vehicles operating in the JMA between 2003 and 2015. They used current 2002 vehicle numbers and available vehicle growth data from National Police Department. For instance, according to their model, in 2015 about 57% of operating passenger cars will be cars that comply with new emission standards as stated in MED No. 141/2003. Conditions for each year were used to estimate the impact of the third policy on the reduction of PM10 concentration in JMA. PM10 concentrations from vehicles were estimated using emission factors.

1.3 Earlier Phases of the Research

1.3.1 Phase 1 – urban air pollution dispersion model

This phase was designed to answer the first research question: What is the contribution of on-road mobile sources to air pollution, represented by a concentration of PM in JMA? An urban air pollution dispersion model was developed to explain the main sources of PM in the JMA. It combined a meteorological model and an emissions model. The impacts of transport policies designed to reduce PM10 concentration were modelled using this dispersion model. The same policies were used as choice alternatives in the non-market valuation part of this research. The annual average PM10 in subdistricts was used as one of the conditions for sample region selection.

1.3.2 Phase 2 – dose response model

This phase was designed to answer the second research question: What impacts does PM have on human health? To answer this question, a risk assessment procedure (Kessel, 2006) was adopted to guide the development of dose-response models for PM and respiratory sicknesses and deaths. Dose-response modelling is one of the techniques used to estimate the relationship between pollutant dose and the number of sicknesses or deaths. The outputs from the urban air pollution model were used as an input to construct the dose response models. PM10 concentrations, in every *kecamatan*[14], were used as the 'dose' and the number of sick leave days[15] was treated as the 'response'. Steps to establish the dose response model were:

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[14] A *kecamatan* is a sub-district within a city.

[15] This study focuses on the number of sick leave days due to data constraint. Development to include the value of mortality caused by PM10 pollution in the JMA needs comprehensive data on daily mortality data and PM10 or PM2.5 data in every sub-district in the JMA.

1. Codifying sub-district to relate output from the urban air pollution dispersion model with *Susenas* 2004 data.

2. Defining and collecting data input on PM10 level in every *kecamatan* as 'dose'.

3. Using variables in the data set as independent variables to explain the relationship between fever, coughing, colds and asthma with PM10. Explanatory variables include the number of cigarettes taken per day by the respondent, the level of indoor pollution, type of work undertaken, the respondents' perception of the presence of pollution in their neighbourhood, socio-economic characteristics such as their houses' physical condition, *B*, neighbourhood condition, *N*, and household expenditure, *E*.

4. Regression analysis. In this step simple regression analysis was used to observe the relationship between one independent and one dependent variable. Since the type of dependent variable is a count variable, the models that best match the structure of the data are the Poisson and negative binomial models. The final model used was the negative binomial model. The average number of sick leave days caused by all four illnesses in 2004 was four days per month for respondents who reported that they were ill in the previous month.

1.4 Phase 3 – Valuation

Using the output from the steps outlined in sections 1.3.1 and 1.3.2, this research constituted the third phase of the overall study. This final part was funded by EEPSEA and is designed to investigate how much people value improved air quality. Hence, the research question is: *What values do JMA citizens have for lowering the number of sick leave days, achieving better visibility and reducing odours resulting from a decrease in air pollution concentration?* The values under examination in this research are not bought and sold in markets. They are 'non-market' values that could not be estimated, at least directly, with reference to data collected from market transactions. Specific non-market valuation techniques were employed to allow their estimation. This type of method, choice modelling and its application to the context of health improvements in the JMA are detailed in the next section. This method was employed because it can isolate people's values for specific air quality attributes such as number of sick leave days, visibility range and odour.

The primary objective of this research is to estimate the benefit of having cleaner ambient air for the citizens of JMA. The second objective is related to the methodology used in this research: to test the differences in implicit prices between two groups: one group with an explicitly stated provision rule and another without a provision rule. The research also assessed how citizens' value varies with socio-economic variables such as average income, education, age and respiratory illnesses; air pollution attributes such as the number of sick leave days, visibility and odour.

2.0 VALUING THE HEALTH AND ENVIRONMENTAL IMPACTS OF PM10 POLLUTION: REVIEW OF LITERATURE

2.1 Introduction

Studies have been conducted to reveal the possible link between air quality and human health (Hubbell, 2006; Dzwegielewska and Mendelsohn, 2004; Pearce and Seccombe-Hett, 2000; Shechter and Kim, 1991). The objective is to estimate how air pollution may be related to increased incidence of mortality and morbidity from various diseases and to calculate the economic benefits from reducing the number of incidences. The steps are: establishing the link between ambient conditions and their effect on humans; determining the population at risk, and, finally, valuing the economic benefits from the improvement of air quality (Kneese, 1984, p.41; BTRE, 2005, p.83).

This research deals with the valuation of health and environment. The valuation[16] process encompasses the assignment of money values to changes in environmental services, including non-marketed goods (Pearce and Seccombe-Hett, 2000, p.1419) such as clean ambient air. A valuation study on how air pollutants affect people's health needs to include an analysis of where and when people become exposed to those pollutants (Small and Kazimi, 1995, p.15) and which policy causes the change (Small, 1977, p.112). Previous studies offer methods to value the reduction of health incidence. The following sections will discuss the impact of PM10 on health and the environment (section 2.2); cost benefit analysis to assess policy alternatives' available methods to value changes in health conditions (section 2.3); and details of choice modelling as the selected valuation method (section 2.4 and section 2.5).

2.2 Impact of PM10 Pollution

PM10 is a particle with an aerodynamic diameter less than 10 micrometres (Gamble and Lewis, 1996, p.838). Sources of PM10 are: exhaust fumes from the transport sector, power plants, incinerators, farming, construction sites and the combustion of fossil fuels (Gamble and Lewis, 1996, p.838). PM10 consists of primary and secondary PM10. Secondary PM10 forms as the reaction results of VOC, NO_x and SO_x. The health damage caused by the combination of primary and secondary PM10 is higher than that caused by primary PM10 alone, making health costs higher (Small and Kazimi, 1995, p.21). Studies in this field have mostly focused on the relationship between health conditions and PM10 concentration in ambient air (Vinzents et al., 2005, p.148). This approach is different from most epidemiological studies focusing on pollutant concentration deposited in lungs, blood or tissues.

Previous studies conclude that exposure to PM10 causes death due to respiratory illnesses (Hong et al., 1999, p.875), cardiovascular diseases (Gamble and Lewis, 1996, p.838), lower respiratory tract symptoms, chronic cough, bronchitis, chest and lung illnesses (Bernard et al., 2001, p.205; Pope III et al., 1995, p.475), and asthma (Koren and Utell, 1997, p.534). In this research, the indicator of illnesses caused by PM10 was the number of sick leave days caused by fever, colds, coughs and asthma, following previous

[16] Valuation is a means of measuring public preferences for environmental resources, not a valuation of those resources themselves (Pearce and Seccombe-Hett, 2000, 1423).

studies conducted by Ostro (1994) and Hall et al. (1992). Studies on PM dose-response function in South East Asia mostly focus on the effects of forest fires on respiratory illnesses in Indonesia (Kunii et al., 2002), Malaysia (Mott et al., 2005; Sastry, 2002) and Singapore (Emmanuel, 2000; Tan et al., 2000; Chew et al., 1995). David Glover et al. in Glover and Jessup (1999) focuses on the short-term haze impact, caused by forest fires, on health. They use air pollution index (API) readings in the state of Sarawak and the Pollutant Standard Index (PSI) for Singapore as dose instead of a specific pollutant such as PM.

Studies on the effect of PM10 on mortality (Ostro et al., 1999; Vajanapoom et al., 2002) and respiratory symptoms (Preutthipan et al., 2004; Wongsurakiat et al., 2001) are useful reference for this research. The four studies listed use data from Thailand. Indonesian studies on PM effect are very rare. Most of them focus on the impact of lead on children's IQ (Kusnoputranto, 2002; Browne and Husni, 1999). One study focuses on the effect of PM10 on health in Indonesian rural areas (Hong et al, 2004) and a fairly new one investigates the effects of PM2.5 on human health (Haryanto, 2005). Individual dosage meters attached to all respondents were the source of the PM2.5 data (Haryanto, 2005).

Besides its effect on health, air pollution also affects visibility as 'particles and gasses scatter and absorb light', reducing contrast and visibility, especially for distant objects (Utah Department of Environmental Quality, 2009, p.1). Meteorological conditions can also affect visibility since they can disperse pollutants from the source to other areas (Idso and Cooley, 1981, p.229). The main types of pollutant reducing visibility are aerosol particles such as dust, smoke and haze, as well as droplets of water (Wang et al., 2009a, p.2). Given this close relationship between visibility and particulate concentration in ambient air, visibility data can be used to estimate total suspended particle (TSP) or particulate matter (PM) in urban centres and vice versa (Idso and Cooley, 1981, p.236). The main sources of aerosol that reduce visibility come from the increased use of fossil fuels (Wang et al., 2009b, p.1470).

2.3 Cost Benefit Analysis to Assess Policy Alternatives

In developing air pollution control policies, Cost Benefit Analysis (CBA)[17] can relate the costs of pollution control with the benefits of having better ambient air quality (Hammitt and Zhou, 2006, p.399). To make those two elements comparable, both need to be monetised. However since costs are usually incurred before the benefits and costs are easier to calculate than benefits, they tend to be overestimated while the benefits are underestimated (Lipfert et al., 1991). The concept of willingness to pay (WTP) in CBA was developed in the decision making process to address externalities (Kenkel, 2006, p.422). Another concept used in CBA in the field of health economics is the Value of Statistical Life (VSL). The VSL is individual tradeoffs between those two goods (Hammitt, 2000, p.1396). VSL is WTP divided by risk reduction (Itaoka et al., 2005, p.372). This concept can be explained by the indifference curve between two goods: wealth and risk. Since VSL is not constant, this value only applies to small changes in risk (Itaoka et al., 2005, p.372). Hammitt (2000) made a clear statement to illustrate VSL: 'If an individual's

[17] CBA is a method with welfare economics as a theoretical foundation (Gafni, 2006, p.415).

VSL is M, it means that similar groups of people will pay M to eliminate a risk that would expect to randomly kill one among them this year.'

Value of Statistical Life has been used to estimate the benefit from environmental policies by estimating the reduction in premature mortality (Harrison and Rutstrom, 2006, p.325), such as for the Clean Air Act in the USA (USEPA, 1997), as well as for ozone and particulate reduction, such as in Mexico City (World Bank, 2002). Since VSL has been applied uniformly to any change in mortality risk, several researchers suggest that VSL should be different according to risk characteristics such as 'voluntariness' of the risk, the fear of the risk, age, and health status (Itaoka et al, 2005, p.372). Dissimilarity between VSL and WTP is in defining mortality as an income neutral good or a normal good, depending on income. A meta-valuation review from 10 countries suggested that the income elasticity range of VSL is from 0.5 to 0.6, which tells us that human life has the same value no matter how much income an individual has (Viscusi and Aldy, 2003, p.40). A study that analysed VSL in 13 countries estimated 'an income elasticity of VSL' of 0.96 so this study also came to the conclusion that VSL is an income neutral good (Brajer et al., 2006, p.95). Conversely, Bowland and Beghin (2001, p.387) suggested that 'WTP for life is elastic with respect to income' which implies that life is a 'luxury' good. Consequently, people with a higher income will spend a higher share of their income to avoid premature death (Bowland and Beghin, 2001, p.387). This study suggested that WTP treats life as a normal good.

There are at least three techniques available to estimate WTP for health improvement: direct estimation of damages (Small, 1977; Krupnick and Portney, 1991; Hall et al., 1992; Small and Kazimi, 1995; Maddison et al., 1996), revealed preference using the hedonic price method, and stated preference using the contingent valuation method (Stevens, 2004; McCubbin and Delucci, 1996). VSL can be estimated using stated and revealed preference (Hammitt, 2000). As stated in section 2.2, air pollution can also affect visibility. Available valuation techniques to estimate WTP or WTA for changes in visibility are the revealed preference method using hedonic price (Delucchi et al., 2002) and the stated preference method using contingent valuation (Loehman et al., 1994; Delucchi et al., 2002; Stevens, 2004). An application of a stated preference method is preferable since the good, in this case visibility, can explicitly be 'identified, described and marketed' (Delucchi et al., 2002, p.147). Delucchi et al. (2002, p.144) summarised from earlier studies that the total WTP for improved air quality are mainly for health improvement (49% to 91%) and for aesthetics and visibility (9 to 40%). In the above studies, the measurement used to estimate visibility perceptions was the 'estimated number of days per year that air quality was closest to clear' (Loehman et al., 1994, p.480) and visibility range in miles (Stevens, 2004, p.4; Delluchi et al., 2002, p.148). This study intends to assess the impact of air pollution on health and the environment, including visibility and odour using a stated preference method to estimate WTP.

2.4 Stated Preference Method to Value Changes in Health and Environmental Conditions

2.4.1 Stated preference methods

A stated preference method is a direct approach. It can ask individuals about how they would value changes in quantity or quality of a public good in hypothetical situations (Shechter and Kim, 1991, p.133; McCubbin and Delucci, 1996, p.265). As a consequence of those changes, individuals might change their behaviour. The changes can be measured by asking whether or not they are willing to pay or to accept such changes and by how much (Mansfield et al., 2006, p.215). Or in a case where unhealthy conditions might occur, individuals might be asked about their WTP to reduce the occurrence of that condition (Small and Kazimi, 1995, p.14). Since the situation is hypothetical, individuals might be unfamiliar with the choices and they do not have any incentive to answer the question thoughtfully and truthfully. Providing thorough and perfect information is one of the keys to obtaining reliable answers (Halvorsen, 1996, 497). In addition, individuals' valuation of risk changes is relevant because an individual can calculate their own expenditure, for example for medical costs and forgone earnings caused by restricted days of activities and premature death (Small, 1977, p.113). To increase the reliance of this method, a rough estimation of individual earnings needs to be traced and one of the techniques used is through gross consumption (Small, 1977, p.113).

The stated preference method has been used to value risks in heart attacks (Acton, 1973 cited in Hammitt, 2000), transport risks, ozone exposure among children (Mansfield et al., 2006; Hall et al., 2003), as well as mortality and morbidity caused by air pollution (Shechter and Kim, 1991; Dziegielewska and Mendelsohn, 2004; Hammitt and Zhou, 2006; Itaoka et al., 2005). Stated preference technique includes the contingent valuation method (CVM) and choice experiment or choice modelling (CM). In the CVM for changes in ambient air quality, individuals can be asked to value changes in mortality, bronchitis, asthma, minor health effects, visibility and material damages (Dziegielewska and Mendelsohn, 2004, p.132; Hammitt and Zhou, 2006, p.399). Studies to estimate people's WTP to avoid air-pollution-related illnesses use various stated preference methods. They vary from contingent valuation (CV) in China (Hammitt and Zhou, 2006), graded pair and discrete choice in Canada (Johnson et al., 2000) and Bayes meta-analysis (Johnson et al., 1997; Levy et al., 2000), to conjoint survey (Mansfield, 2006) and stated choice approach in Vietnam (Cook et al., 2007, p.100). Itaoka et al. (2005) use choice experiment to estimate WTP for power generation.

Choice modelling is a stated preference method that will be used to estimate JMA citizens' values for lower health risks due to less pollutant concentration in the JMA's ambient air. This technique has been selected because it can estimate all values of clean air including use, passive and non-use value, whereas other methods, for instance revealed preference, can only be used to estimate the use and passive use value but not non-use value. There are critics of the stated preference method, such as CV and choice modelling, however, the stated preference method is based on a firm 'theoretical concept' and will produce reliable results with proper application (Johnson et al., 1997, p.645).

2.4.2 Definition, strengths and weaknesses of choice modelling approach

Choice modelling is a survey-based approach used to estimate changes in welfare conditions (Hanley et al., 2001, p.435). This approach has been used in various countries for different sectors such as in the water resource sector in the ACT (Blamey et al., 1999), in mangrove management in Malaysia (Othman et al., 2004) and cropland conversion in North West China (Wang et al., 2006). CM can measure use, passive and non-use values (Wang et al., 2006, p.2; Hanley et al., 2001, p.436; Blamey et al., 1999, p.340). It relies on respondents' preference statements toward several environmental management schemes (Boxall et al., 1996, p.245). This approach can compare more than two different management strategies (Hanley et al., 2001, p.450-1; Blamey et al., 1999, p.337). CM has weaknesses such as scoping problems and hypothetical bias (Hanley et al., 2001, p.450-1). Complex questionnaires can also lead to irrational choices, especially in the latter pages where respondents begin to feel weary (Hanley et al., 2001, p.450-1). Also, as with CV, discrepancies between the 'whole' value of good and the sum of 'part' values of the same good still occur in CM estimations (Mogas et al., 2006, p.24).

The steps in the CM are: (1) identifying policy options; (2) describing each option in terms of: major community concerns, ecological impact, financial cost, supply capacity and environmental quality; and (3) focus group meetings to discuss options and their implications. People and organisations involved in the focus group meetings can be environmental groups, local government and the users of the goods in question (Blamey et al., 1999, p.343).

2.4.3 Questionnaire as a primary tool in choice modelling approach

A CM questionnaire has the following components: problem definition, payment vehicle, choice sets as well as socio-economic and attitudinal questions (Morrison and Bennett, 2004, p.594-7; Blamey et al., 1999, p.347). All these components need to be defined clearly to suit respondents' understanding to assure reliable replies (Blamey et al., 1999, p.347). Focus group discussions can assist in the problem statement refinement, attributes and payment vehicle selection and also in questionnaire improvement (Blamey et al., 2000, p.277).

Boundaries of the problem

To define the boundaries of the problem, the questionnaire needs to be equipped with an environmental-issued description, specific problem definition and possible solutions to the problem (Morrison and Bennett, 2004, p.594-7). The form can vary from a framing exercise in the form of 'rating scale questions' (Krupnick and Adamowicz, 2006, p.47) to a causal effect description of the problem followed by scenario construction. All the information in this section needs to be kept narrow and sensitive information must be excluded to help the respondents focus on the problem addressed (Whittington, 1996, p.5).

Attribute selection

Alternative attributes can be generated through expert survey, scientific research (Wang et al., 2006, p.3; Bennett and Adamowicz, 2001, p.48) and focus group discussions (Morrison and Bennett, 2004, p.598). In an expert survey and a focus group discussion, experts and focus group participants are asked to list indicators to define the good (Morrison and Bennett, 2004, p.598).

The good's attributes need to be 'demand relevant, policy relevant and measurable' (Blamey et al., 2002, p.168; Bennett and Adamowicz, 2001, p.48). A combination of different levels of attributes will then be used in the choice sets. Different levels of attributes also work as a useful tool to minimise interviewer bias since respondents will concentrate on those differences to make the right choice (Bennett et al., 2004, p.339). The choice sets will include non-environmental characteristics and monetary costs (Bennett et al., 2004, p.492) so that the tradeoffs between attributes can be used to estimate WTP and attributes' economic value (Boxall et al., 1996, p.244).

Attributes' individual effect on respondents' preferences needs to be 'isolated', thus they need to vary 'independently' (Bennett et al., 2004, p.492). For the same reason, ‘causally-related attributes’ need special attention since respondents might try to define the relationship and come up with wrong conclusions (Blamey et al., 2002, p.183). If, at the end, the use of these kinds of attributes at the same time are unavoidable, an explanation that there is no correlation between those attributes is needed (Blamey et al., 2002, p.183).

Payment vehicle and amount of payment

A payment vehicle needs to be defined carefully so that the respondents can act as they make the real choices so that hypothetical bias can be reduced (Hanley and Spash, 1993, p.62; Whittington, 2002, p.329). Potential payment vehicles should be common (Hanley and Spash, 1993, p.62) and accepted among respondents. Consequently, respondents might feel that the payment vehicle is secure and reliable, reassuring them that their contribution will be used for the correct purpose (Bennett and Adamowicz, 2001, p.53). The amount of payment in the CM approach becomes one of the attributes. There are two types of payment vehicle available: voluntary payments such as donations, gifts and payment for a private good, and also coercive payments such as taxes, rates, fees, charges or price (Bateman et al., 2002, p.131). The coercive payment vehicle is usually used to elicit a public good value (Takeshita and Hidano, 2006, p.6)

Experimental design

A choice set in a CM application consists of alternatives, attributes and levels of attributes. To estimate the relationships between a choice set’s components ideally all possible combinations of alternatives, attributes and levels should be included in the questionnaire. However, the inclusion of all possible combinations, ‘full factorial’, into the experimental design cannot be done if the number of combinations is too large for the respondent to handle (Bennett and Adamowicz, 2001, p.57). This problem can be tackled by using some of the combinations, ‘fractional factorial’, and by dividing the design into blocks (Bennett and Adamowicz, 2001, p.57). Selected fractional factorial design used in CM studies has to maintain the property of orthogonality (Bennett and Adamowicz, 2001, p.57). Orthogonal designs can be constructed using statistical software such as SPSS (Street et al., 2005, p.461) and SAS (Johnson et al., 2006, p.178) and also can be obtained from tables of orthogonal arrays (Sloane, 2008). A choice set can be built from one fractional factorial design, called L^{MA}[18] design (Johnson et al., 2006, p.172; Street et al., 2005, p.461; Bennett and Adamowicz, 2001, p.58) or from a combination of several fractional designs. Street et al. (2005, p.461) and Johnson et al. (2006, p.164-172) describe how to combine fractional designs to form choice sets. The decided choice sets should be checked for dominant alternatives (Bennett and Adamowicz, 2001, p.59). Dominant alternatives are usually excluded from the design (Bennett and Adamowicz, 2001, p.59).

The latest development of CM experimental design tends to shift from an orthogonal design to an efficient design. The efficiency of an experimental design is determined by comparing ‘the generalised variance of the parameter estimates’ (Street et al., 2005, p.462). A statistically efficient design will have small elements of the variance-covariance matrix (Rose et al., 2008, p.395). The measurement used for comparing statistically efficient designs is D-error, the determinant of the inverse of the variance-covariance matrix (Hensher et al., 2005, p.153). D-optimal design, experimental design with the lowest D-error, can estimate the same attribute coefficient with fewer samples (Rose and Bliemer,

[18] L is the number of levels, M is the number of alternatives and A is the number of attributes.

2008, p.17). To obtain D-optimal design, knowledge of coefficient priors is needed (Rose and Bliemer, 2008, p.17). Where priors for the attribute coefficients are not available, this design can be obtained via the following steps: (1) create an orthogonal design; (2) conduct pilot survey with an orthogonal design; (3) estimate parameters/priors; (4) create an efficient and (5) conduct survey with an efficient design (Rose and Bliemer, 2008, p.25).

2.4.4 Model specification

Conditional Logit Model

A CM application is based on the behavioural assumption modelled by the Random Utility Model (RUM). This model (Equation 1) consists of two parts: observable (V_{ij}) and unobservable (ε_{ij}) components (Verbeek, 2004, p.192). In a Conditional Logit Model, 'the utility functions are conditioned on observed individual, choice invariant characteristics, z_i, and attribute of the choices, x_{ij}' (Green, 2007, p.N3-11), then V_{ij} can be written as Equation 2. The ε_{ij} are 'assumed to be independently distributed across utilities' making the probability of individual t choosing alternative j as depicted in Equation 3, and the probability is presented in Equation 4 where y_i is the index of the choice made. This model has a weakness relating to the assumption that all ε_{ij} are independent. This property is called Independence of Irrelevant Alternatives (IIA) (Verbeek, 2004, p.209). The test, to analyse whether or not the IIA is violated, is a Hausman and McFadden test which compares two models with all variables to a model using a subset of variables (Verbeek, 2004, p.210). If the property of IIA is violated, other models which relax the IIA property are available. These models are the Multinomial Probit Model, the Nested Logit Model (Verbeek, 2004, p.210) and Random Parameter Logit (Wang et al., 2006, p.3).

The indirect utility function, V_{ij} can take different models, the simplest one is a linear model (Equation 5) where *ASC* is an alternative specific constant, 'β is a parameter vector and X is a vector of k attributes from a choice set' (Wang et al., 2006. p.3). *ASCs* may or may not be included in the model. *ASCs* relate to 'the influence on choice of freestanding emotions and presentation effects' by capturing the mean level of utility independent of the attributes (Blamey et al., 2000, p.272; Morrison et al., 2002, p.162), however, their inclusion in the model can 'improve the model fit' (Adamowicz et al., 1997 cited in Mogas et al., 2006, p.24).

$$U_{ij} = V_{ij} + \varepsilon_{ij} \qquad 1$$

$$\text{2.4.4.1.1.1 } V_{ij} = \beta' x_{ij} + \gamma_j' z_i \qquad 2$$

$$\text{Prob}(U_{ij} > U_{iq}) \text{ for all } q \neq j \qquad 3$$

$$P(y_i = j) = \frac{exp V_{ij}}{\sum_{q=1}^{J_i} exp V_{iq}} \qquad 4$$

$$V_{ij} = ASC + \sum \beta_k X_k \text{ , where i=1,…,k} \qquad 5$$

$$IP = -\frac{\beta_k}{\beta_c} \quad 6$$

$$CS = -\frac{1}{\beta_c}\left(V_0 - V_1\right) \quad 7$$

Commonly two models are built, one which includes only attributes and the other which includes all attributes and socio-economic attributes. Since the variables used are different, each model's *ASC* will vary. Both models are compared using a 'parameter fit indicator' such as log likelihood values, rho-squared (ρ^2) statistics and the chi-squared (x^2) (Rolfe et al., 2000, p.300). Models with better statistical indicators will further be used to estimate welfare change.

The best model estimators are used to calculate implicit price (Equation 6) – trade off between attributes (Bennett and Adamowicz, 2001, p.63; Hanley and Spash, 1993, p.76), where β_k is the coefficient of the attribute in question and β_x is the coefficient of the cost attribute (Rolfe et al., 2000, p.295). Compensating surplus can also be estimated using Equation 7 where β_c is the coefficient of the cost attribute, V_o is the utility of the current condition and V_1 is the utility of the new proposed condition (Wang et al., 2006, p.5).

Random Parameter Logit Model

The Random Parameter Logit (RPL) Model assumes and captures unobserved 'heterogeneity' among respondents (Liljenstolpe, 2008, p.70; Lusk et al., 2007, p.510), 'disentangles IIA from IID' (Hensher and Reyes, 2000, p.352), and relaxes the IIA assumption used in the Conditional Logit Model. Dispersion around the coefficients' mean is an indicator that heterogeneity exists within the model, the Conditional Logit Model cannot capture the dispersion leading to the 'imprecise estimation of population preference' (Hynes et al., 2008, p.1012; Wang et al., 2006, p.22; Lusk et al., 2007, p.510). Recognition of taste heterogeneity is important 'to avoid bias in attribute coefficient estimates leading to poor policy selection in public good management' (Hynes et al., 2008, p.1011; Biro et al., 2006, p.150). To explain the sources of observable heterogeneity, interactions between socio-demographic variables with *ASCs* need to be included in the model (Birol et al., 2006, p.151). Some studies conclude that there are no improvements of model fit by implementing RPL to the data set (Provencher and Moore, 2006, p.122) but some find that significant improvements in the model fit are achieved using the model (Birol et al., 2006, p.151).

Following Greene (2007, p.N17-2-3; 2007, N3-18-19), RPL is defined as 'a one level multinomial logit model for individuals i=1, …, N with alternative j=1,…, J_i in individual i's choice set (Equation 8), where α_{ji} as an alternative specific constant which may be fixed or random, θ_j as a vector of non-random coefficient, ϕ_j as a vector of non-random coefficients, β_{ji} as a coefficient vector that is randomly distributed across individuals, z_i as a set of choice invariant individual characteristics, f_{ji} as a vector of M individual and choice varying attributes of choice, and x_{ji} as a vector of L individual and choice varying attributes of choices.

The alternative specific constant and the coefficient vector are randomly distributed across individuals with fixed means. This model allows the means of the parameter to be heterogeneous with observed data w_i, then the individual heterogeneity is presented by Equation 9 for a normal distributed and by Equation 10 for a lognormal distribution, where w_i is a set of choice invariant characteristics producing individual heterogeneity, ρ_{jk} is the constant term and δ_{jk} is a vector of coefficients with an individual specific mean. The random term, v_{jki} is distributed according to the assumed distribution; σ_{jk} is the standard deviation of the marginal distribution of ρ_{jki}. The v_{jki} is individual choice specific and the source of the heterogeneity.

Taking into account correlated and uncorrelated σ_k the full random parameter logit model is presented in Equation 11 where Δ and Γ are the full vectors of K random coefficient of δ and θ respectively and Ω is the diagonal matrix of σ_{ijk}.

$$P(j|v_i) = \frac{exp(\alpha_{ji} + \theta'_j z_i + \phi'_j f_{ji} + \beta'_{ji} x_{ji})}{\sum_{q=1}^{J} exp(\alpha_{ji} + \theta'_j z_i + \phi'_j f_{ji} + \beta'_{ji} x_{ji})} \qquad 8$$

$$\rho_{jki} = \alpha_{ji} \text{ or } \beta_{jki} = \rho_{jk} + \delta_k' w_i + \sigma_k v_{ki} \qquad 9$$

$$\rho_{jki} = \alpha_{ji} \text{ or } \beta_{jki} = exp(\rho_{jk} + \delta_k' w_i + \sigma_k v_{ki}) \qquad 10$$

$$P(j|v_i) = \frac{exp(\alpha_{ji} + \beta_i' x_{ji})}{\sum_{m=1}^{J} exp(\alpha_{mi} + \beta_i' x_{mi})} \qquad 11$$

where,

$$\beta_i = \beta + \Delta w_i + \Gamma \Omega_i v_i$$

In the RPL model, the price or cost parameter is usually kept fixed (Ruud, 1996 in Lilhenstolpe, 2008, p.74; Lusk et al., 2007, p.511; Birol et al., 2006, p.151). Another approach is by making the cost or price coefficient as random parameter and using lognormal distribution for this coefficient (Hynes et al., 2008, p.1020; Browstone and Train, 1999; Train, 1998). This distribution is used to make sure that the cost coefficient is negative.

Other attributes including *ASCs* can be treated as being a random parameter (Hensher, 2001, p.104) or a fixed parameter (Wang et al., 2006, p.21). The common types of distribution used are normal (Hynes et al., 2008, p.1020) and triangular (Hensher, 2001, p.104). Both types of distribution allow negative and positive values to be generated (Wang et al., 2006, p.20; Hensher, 2001, p.104).

The number of replications of simulated draws, to derive the random parameters, varies among different researchers. One researcher used 100 replications using Halton draws (Liljenstolpe, 2008, p.74), 500 (Wang et al., 2006, p.106), 1,000 (Birol et al., 2006, p.151; Carlsson and Martinsson, 2008, p.1238) and 5,000 quasi-random draws (Hess, Train and Polack, 2006 cited in Hynes et al., 2008, p.1012). Selection of random parameter depends on parameters' standard deviations. For developing the model, 10 to 20 iterations can be used to select the most appropriate random parameter (Hensher et al., 2007). These random draws are used to approximate integral used in the RPL equation (Hynes et al., 2008, p.1012).

2.5 Test for an Incentive Compatible Provision Rule

2.5.1 Biases

Incentive compatibility concept occurs from group behaviour theory where free riding is the optimal strategy (Samuelson's theory cited in Mitchell and Carson, 1989, p.129). When the 'number of consumers increase' the problem will be higher since they understand that their contribution will be very low compared to the total contribution (Mitchell and Carson, 1989, p.131). This is true in a public good context.

In a stated preference context, if the method is not incentive compatible, it will lead to strategic behaviour (Mitchell and Carson, 1989, p.135) and hypothetical bias (Harrison, 2006, p.70). If the respondent thinks that his response will affect the final decision and he believes that he will have to pay the amount he has agreed to pay, then he has 'a positive incentive' to reveal his true preference and the method becomes incentive compatible (Harrison, 2006, p.68).

According to Hoehn and Randal (1983 cited in Mitchell and Carson, 1989, p.149), in dichotomous choices, where there are only two options with a fixed level of public good and its cost since 'a person could do no better than vote yes if their WTP was at least as large as the price and vote no if not' (Mitchell and Carson, 1989, p.151). However Harrison (2006, p.72) argues that the condition will only be incentive compatible if the respondent makes the 'real' choice by actually paying his offer.

Choice experiments applied for 'new quasi-public goods may be close to incentive compatible' (Carson and Groves, 2007, p.205). This is true especially to estimate 'marginal tradeoffs between attributes' when only one good will be consumed (Carson and Groves, 2007, p.205). If an incentive-compatible method is restricted to the method that can reduce strategic bias, then choice experiment is incentive compatible (Hanley et al., 2001, p.447-8; Rolfe et al., 2000, p.289). This is because the respondent usually focuses on certain attributes so that it is possible to estimate 'marginal tradeoffs between attributes' (Carson and Groves, 2007, p.199). List et al. (2006, p.25) also have evidence from their research that choice experiment performs well for both private and public goods since in both studies hypothetical and real values are similar. Contingent ranking is also incentive compatible (List et al., 2006, p.25; Harrison, 2006, p.68) and can provide more information. However, all alternatives require no violation in the IIA assumption (Carson and Grove, 2007, p.199).

Biases can occur in an application of the stated preference method. Hypothetical bias occurs when there is a difference between the choice made when the respondent faces real consequences compared to the choices made when they face no real consequences from their actions (Harrison, 2006, p.71). This is the main test for incentive compatibility (Harrison, 2006, p.68). Harrison (2006, p.72) further explores the hypothetical bias. This bias exists in contingent valuation making the method not incentive compatible. His conclusion is based on two studies: Cummings et al. (1995) and Cummings et al. (1997).

Both studies conclude that respondents with a hypothetical questionnaire have higher responses than the ones facing real conditions. In choice experiments, the hypothetical bias is evident in the stage where a respondent makes a choice between change and the status quo, not when he makes choices between 'which type of change' (Harrison, 2006, p.78).

Strategic bias can happen in a situation when the respondents believe that the bid will be collected and they might understate their WTP and state more if they think that the good will be provided by the government (Mitchell and Carson, 1989, p.128; Hanley and Spash, 1993, p.58). In CV, strategic behaviour is a function of how the respondent sees the payment obligation and whether or not they have to pay the actual amount, an uncertain amount or a fixed amount (Mitchell and Carson, 1989, p.143). That is why a fixed amount of payment for public goods can reduce strategic bias (Riera, 2001, p.29; Garrod and Willis, 1999, p.138). Most attempts to estimate strategic bias have been highly structured experiments in which one group of respondents is told one set of factors about the situation that minimises their incentive for strategic behaviour, and another group receives a different set that maximises their incentive for strategic behaviour (Bohm, 1972 in Whittington et al., 1990, p.298).

2.5.2 Improving the questionnaire

According to Harrison (2006, p.80-97), there are two ways to make a stated preference study less biased: instrument calibration and statistical calibration. Instrument calibration is done by improving the wording in the questionnaire used in the survey and by using more explicit language in stating provision rules (Kristrom, 1999, p.784). The wording should make the survey question more 'consequential' so that the respondent cares about the outcome and feels that their response will actually influence the future outcome (Carson and Groves, 2007, p.183).

Making variations in the questionnaire design is one of the tests proposed (Harrison, 2006, p.80; Whittington et al., 1990, p.298; Cronin, 1982 cited in Mitchell and Carson, 1989, p.155). Another way is to include a statement or a provision rule to make sure that there is a probability that their response will have an actual impact (Harrison, 2006, p.87) so that the respondent will answer to maximise their expected welfare (Carson and Groves, 2007, p.183). The following statement is one example: 'local households will have to pay the cost of pollution control and your response will influence the level of your local taxes' (Cronin, 1982 cited in Mitchell and Carson, 1989, p155). To test whether or not the respondent believes that their response will influence the decision-making process, one question that asks 'whether they believe that the government will use the output of the survey to plan the program' should also be included in the questionnaire. In the data analysis stage their response would then be related to the amount of payment they proposed (Mitchell and Carson, 1989, p.152).

Harrison (2006, p.82-85) proposes another method – statistical calibration – which can be done by: comparing 'original responses to the hypothetical responses'; combining data from different sources to see differences between hypothetical and real responses; and pilot implementation of policy to see how people will react to real conditions.

Another way is by restricting the sequence of the questionnaire. This is why different survey delivery techniques have different outcomes. In a mail survey, the respondents have time to formulate a strategic response given all the information they have received (Mitchell and Carson, 1989, p.164). This is because strategising needs considerable time and thought (Mitchell and Carson, 1989, p.135). Interviews and telephone surveys are better because they are short, reduce the amount of thinking time and the information flow can be controlled (Mitchell and Carson, 1989, p.164), however they restrict the amount of time respondents have to carefully consider their preferences.

Incentive compatible provision rules were used in the questionnaire to test methodological issues in CM. The test conducted was designed to understand whether or not different frames involving provision rules would result in different responses. The provision rules are a key element of incentive compatibility as they tell respondents about the probability of their responses having an actual impact on policy implementation. In this research, respondents were divided into two groups. One group was given a provision rule and the other group was not given a provision rule or statement. The rule specified that a policy would be implemented if the number of responses satisfied a requirement given in the questionnaire.

3.0 METHODOLOGY: SURVEY DESIGN AND IMPLEMENTATION

3.1 Introduction

This research is concerned with relative values caused by changes in the JMA's ambient air quality as the result of the implementation of different transport sector policies. It links policy scenarios with changes in the number of sick leave days caused by respiratory illnesses and environmental conditions. The status quo alternative was the current condition without any change in transport sector policy to improve the JMA's air quality. This research treats clean air as a public good, therefore the approach was a public valuation approach.

3.2 Questionnaire Design

3.2.1 Question development

The choice modelling questionnaire used in this study consists of eight sections, detailed below. The first questionnaire draft was developed using output from sections 1.3.1 and 1.3.2 and from two focus group discussions conducted in July and August 2007. Explanations about the selection of respondents, the confidentiality of the responses and the time commitment needed to finalise the questionnaire were recorded on a separate information sheet. The respondents' consent was sought by asking them to sign the consent form.

The first draft of the questionnaire has the following parts:

1. Introduction. In this section, the respondents were informed about the purpose of the research and the importance of the information.

2 Framing. In this section, the respondents were asked about their experiences of air pollution in the JMA and were asked to rank attributes from the most to the least dangerous.

3 Problem description. The problems were divided according to the attributes used in the choice sets: average number of sick leave days per person per month, visibility range, and the number of days with an undesirable odour.

4 Possible solutions to the problem. Possible solutions to the problem in the form of new transport policies were also presented in this section. Alternative transport policies used in this research were: (1) improvement of public transport facilities; (2) improvement of traffic management; and (3) reduction in number of old vehicle. The cost of policy implementation was represented by: an additional land and property tax, a vehicle tax, especially for old vehicles, as well as an entry fee and higher parking fees in central activity areas. These policies were presented in the choice sets so that respondents' preferences towards them could be understood. Therefore, not only the outcomes but also the vehicles of those outcomes were investigated.

5 Statement to test different frames involving a provision rule. As stated in section 2.5.2, the sample was divided into two groups. One group of respondents were given a provision rule that stated the condition in which the policy would be implemented. The other group was not given any statement before the choice sets were presented.

6 Choice sets. Choice sets consisted of three new policy alternatives and one status quo condition. Three attributes were identified. They were: citizens' health conditions represented by the average number of sick leave days per person per month caused by fever, cold, coughs and asthma; increase in visibility; and reduction in the number of undesirable odour days caused by pollution from the transport sector. The first two attributes resulted from previous steps and from literature studies while the last attribute was formed from input from 2007 focus group participants. All attributes' levels were determined through literature studies and previous research steps. The cost attribute level was decided after focus group discussions and field tests in 2008.

7 Health condition. In this section the respondents were asked whether or not they had experienced illnesses related to air pollution and the daily length of time spent outdoors.

8 Socio-economic condition. In this section, respondents were asked to state their occupation, level of education, monthly household consumption, postcode or subdistricts and number of children.

During the fieldwork, the questionnaire was further refined (as discussed later) using input from:

1 Experts on surveys and air pollution control policy. All survey experts contacted during the fieldwork have experience of doing surveys in the JMA. The air pollution expert is known for her expertise in air pollution policy analysis for the JMA.

2 Participants of focus group discussions. All participants were JMA citizens, coming from the 12 cities within the JMA.

3 Surveyors and respondents in the field tests.

3.2.2 Experimental design

Two experimental designs were used in this study to develop the combination of attribute level for the choice sets. The first was a choice set with an orthogonal design and the second was an efficient design. Attribute definitions and levels are presented in Table 1. The orthogonal design choice sets used in this study were constructed using the L^{MA} approach (Louviere et al., 2000 cited in Street et al., 2005, p.461) and based on the orthogonal design developed by Dr John Rose using NGene software. The design has 13 attributes (four for each policy option and one for the block) and three levels (0, 1, 2) (Table 2) where I stands for *Illness*, V for *Visibility*, O for *Odour* and C for *Cost*.

Choice sets with dominant alternatives (outlined in Table 2) were deleted to form 24 final choice sets. The 24 choice sets were distributed into six blocks. Therefore, each respondent was given four choice sets. These choice sets were used in the field test and in the main survey with orthogonal design.

Table 1. Attributes and levels

Attributes	Unit	Status quo levels	Experimental design levels
Illness	Days	4	3, 2, 1
Visibility	Metres	10	30, 50, 70
Odour	-	Very disturbing	Disturbing, slightly disturbing, not disturbing
Cost	Rupiah	0	100,000; 500,000; 900,000

The efficient design choice sets were developed using an available template developed by Dr Rose. The template was in the form of a Microsoft Excel file. The original design was developed for eight attributes with three levels. The template was modified so that it could generate an efficient design with the lowest D-error for 12 attributes (four for each policy) with three levels. Data gathered from the orthogonal design survey were used to create the efficient experimental design. Priors for all attributes (*Illness, Visibility, Odour* and *Cost*) were used to determine an experimental design with the lowest D-error (Rose et al., 2008, p.400). The final 24 choice sets distributed into six blocks.

Table 2. Orthogonal design for nine attributes with three levels

Choice sets	I1	V1	O1	C1	I2	V2	O2	C2	I3	V3	O3	C3	Block
Attribute number	1	2	3	4	5	6	7	8	9	10	11	12	13
1	2	0	2	1	0	0	2	0	2	1	0	2	1
2	1	2	1	0	2	2	0	2	1	1	0	2	1
3	0	1	0	2	1	1	1	1	0	1	0	2	1
4	0	1	0	0	2	2	2	0	2	2	2	1	1
5	2	0	2	2	1	1	0	2	1	2	2	1	1
6	1	2	1	1	0	0	1	1	0	2	2	1	1
7	1	2	1	2	1	1	2	0	2	0	1	0	1
8	0	1	0	1	0	0	0	2	1	0	1	0	1
9	2	0	2	0	2	2	1	1	0	0	1	0	1
10	1	1	2	0	1	0	0	1	2	2	1	2	2
11	0	0	1	2	0	2	1	0	1	2	1	2	2
12	2	2	0	1	2	1	2	2	0	2	1	2	2
13	2	2	0	2	0	2	0	1	2	0	0	1	2
14	1	1	2	1	2	1	1	0	1	0	0	1	2
15	0	0	1	0	1	0	2	2	0	0	0	1	2
16	0	0	1	1	2	1	0	1	2	1	2	0	2
17	2	2	0	0	1	0	1	0	1	1	2	0	2
18	1	1	2	2	0	2	2	2	0	1	2	0	2
19	0	2	2	2	2	0	1	2	2	0	2	2	0
20	2	1	1	1	1	2	2	1	1	0	2	2	0
21	1	0	0	0	0	1	0	0	0	0	2	2	0
22	1	0	0	1	1	2	1	2	2	1	1	1	0
23	0	2	2	0	0	1	2	1	1	1	1	1	0
24	2	1	1	2	2	0	0	0	0	1	1	1	0
25	2	1	1	0	0	1	1	2	2	2	0	0	0
26	1	0	0	2	2	0	2	1	1	2	0	0	0
27	0	2	2	1	1	2	0	0	0	2	0	0	0

Notes:

I is for *Illness*, V for *Visiblity*, O for *Odour* and C for *Cost*.

Each number (1, 2, 3) represents three different policies.

Block shows how the choice sets can be divided into three, six or even 12 blocks. Each respondent is given one block of choice sets.

3.3 Discussion with Experts

Five discussions were held in Jakarta with two survey institutions: (1) Department of Sociology, University of Indonesia and (2) PT Intan Media Insan Cendekia (PT IMIC); two individual survey experts: Indri Seskayuni and Safril Faried Tjandraatmadja, and one air pollution expert, Shanty Syahril. The above survey institutions and survey experts gave inputs for surveyor recruitment and questionnaire content, including the language used. The air pollution expert provided input on the description of air pollution policies and the attributes used in the questionnaire and show cards.

3.4 Focus Group Discussions

Two focus group discussions were conducted in Jakarta. The first took place on 29 July 2007, for the middle income group, and the second discussion was on 1 August 2007, for the low income group. This classification was aimed to describe the uniformity of participants' socio-demographic background within a group. The discussions were held in one of the National Development Planning Agency's meeting rooms in Central Jakarta (*Jakarta Pusat*). This venue was chosen because it is located in the centre of the JMA.

Since the venue was a government office, the invitation was issued by the Director of Spatial Planning and Land Management. The invitation explained that the discussion was for one of the staff's research studies not for one of the government's programs. The participants were also informed that local transport would be provided. They were not given any written information regarding the amount of payment[19].

3.5 Surveys

3.5.1 Interviewers' training

The survey was carried out by staff recruited by PT Intan Media Insan Cendekia (PT IMIC). For the field test, four interviewers were recruited and 20 were taken on for the main survey. Two field supervisors were appointed to supervise the interviewers. Both took turns to accompany and witness interviewers during interviews. Field supervisors were also in charge of checking the interview results before submission to the researcher for a final check and data input.

Two interviewer training sessions were conducted. Both training sessions were conducted in three parts:

1. The first part was conducted to explain the survey's objective and the questionnaire's content. The researcher explained the objective of every question and discussed appropriate probes for every question.
2. The second part was designed for the interviewers to practice. First they practiced reading and pointing the assigned show card. Then a discussion session was held to understand possible difficulties.
3. The third part was all about role play. First interviewers, then the researcher and field supervisors, acted as respondents for the surveyors.

All possible responses and difficulties were noted and discussed in the first training session. In the second training session, the interviewers who went into the field for tests were given the opportunity to share their experiences with the new interviewers.

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[19] Amount of payment given, after the discussion was concluded, was Rp200,000 per person. This figure is slightly higher than the standard used by both the Indonesian government (Rp.75,000 per hour) and private survey companies (Tjandraatmadja, 2008).

3.5.2 Sampling method

After earlier discussions with the supervisors and later with the appointed survey company, the following approach was used [20]. This approach has been successfully implemented in Indonesia and tackled local problems such as the unstructured and mixed use of land parcels in the types of neighbourhoods that are commonly found in Indonesia's cities. The sampling method was basically a cluster sampling method. A summary of the sampling method is presented in Figure 1 and sampling areas in Figure 2. The steps were as follows:

1. Thirteen subdistricts were selected from 166 subdistricts in the JMA. The subdistricts were proportionally selected according to PM10 levels. All subdistricts were grouped according to the classification made by the Indonesian Ministry of Environment (No. Kep Ka Bapedal 107/1997). The classification was simplified into four categories as presented in Table 3. For PM10 concentration in category four, the proportional sampling method came up with one subdistrict. Adjustment was made so that this category was represented with one average low income and one high-income subdistrict. Therefore, the total subdistricts surveyed were 13 instead of 12.

2. Five villages were selected within every subdistrict and two sub-villages from every village. Sub villages were used to create primary sampling units (PSU). With this approach there were 10 PSU for every subdistrict.

3. PSU was the smallest sampling unit consisting of 50 households within one sub-village. PSUs were selected randomly from the sub-village lists. Five households per PSU were interviewed.

4. In Indonesia, there are no uniform uses of land parcels. There is a high possibility that public facilities such as schools, mosques and informal shops are present among houses. A common percentage for public facilities as well as unoccupied houses and vacant parcels is approximately 40%. The common percentage for non response caused by illiteracy or refusal to be interviewed was 33.3%. Therefore the calculations were as follows:

$$\textit{Number of houses to be contacted} = 5 \times 1.4 \times 1.33 = 9.31 \qquad (12)$$

$$\textit{Interval between houses} = \frac{50}{9.31} = 5.37 \ \textit{rounded to 6} \qquad (13)$$

5. The interviewers listed all households within the PSU. The first house was selected by the field supervisors and from that first house the surveyors walked straight or

[20] The initial sampling plan was a multistage random sampling method using household lists provided by the local governments' statistical agency. However, this approach was viewed as unacceptable by the University Ethics Committee. According to the University's ethical regulation, local governments do not have consent from their citizens to release any listing containing citizens' identity, even if the list only contains addresses without names and phone numbers.

turned left until they reached the 50th land parcel. Using results from the above calculation, the interviewers approached nine households within one PSU, the houses were in land parcels 1, 7, 13, 19, 25, 31, 37, 43 and 49. The population characteristics such as monthly expenditure and the social-economic status in every district were known, so it was possible to re-weight the sample to obtain population characteristics.

Table 3. Subdistrict classification according to PM10 concentration

MoE classification		Research classification		No. of subdistricts	No. of Sample
PM10 (µg/m3)	Classification	PM10 ($\mu g/m^3$)	Classification		
Below 50	Good	Below 50	Good	119	7
51-150	Moderate	51-150	Moderate	19	2
151-350	Unhealthy	151-420	Unhealthy	20	2
351-420	Very unhealthy				
421-500	Dangerous	Above 421	Dangerous	8	2
Above 501	Very dangerous				
Total				166	13

Source: Adopted from Head of Bapedal Decree No. 107/1997

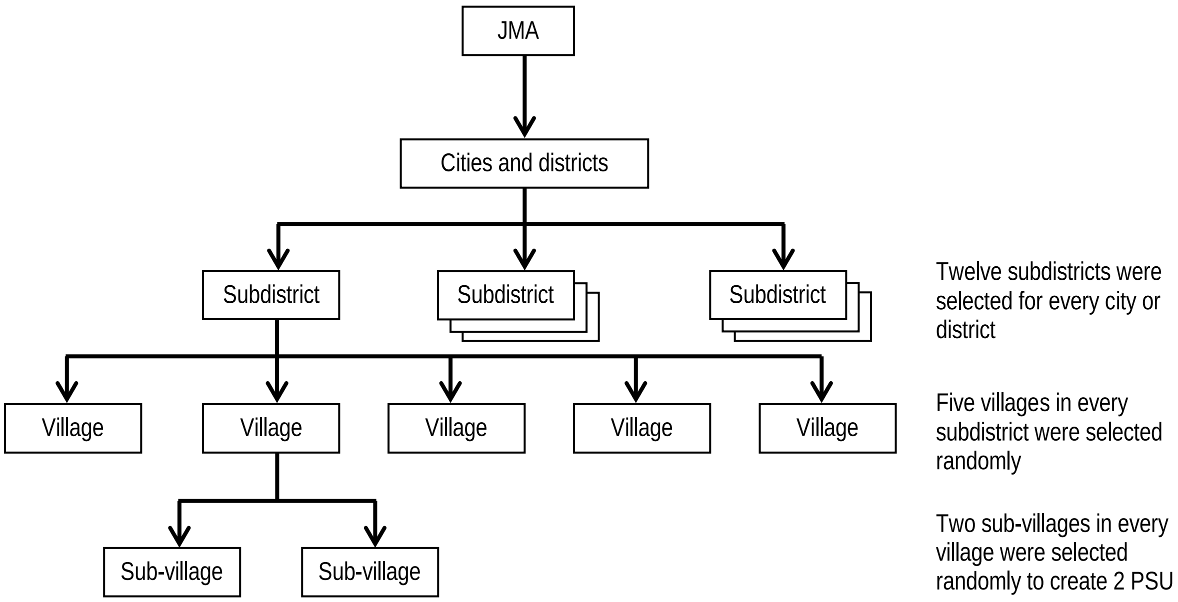

Figure 1. Illustration of the cluster sampling method

3.6 Questionnaire Refinement

3.6.1 First questionnaire refinement – input from experts

A second draft was a refined version of the first draft as suggested by survey experts and air pollution experts in Jakarta. It was made to suit the characteristics of the target respondents. The experts' recommendations were as follows.

1. Simplify the language, especially for policies and choice sets description.
2. Use pictures to describe the policies and conditions in the choice sets. Pictures should be communicative and provide illustrations of causal effects between air pollution with the attributes used. One picture should only represent one condition, for example: a picture for four sick leave days should be different from two sick leave days.
3. Eliminate difficulties in the field by using only two documents: the questionnaire and show cards. A separate answer sheet made the survey more difficult for the surveyors.
4. Use qualitative measurement to describe 'smell' rather than used number of smelly days. Number of smelly days can be used in a waste and wastewater management context but not for air pollution from the transport sector.

This second draft was used as discussion material in both focus group sessions. Details of participants' input can be seen in section 4.1.2. All this input was used to refine the questionnaire. The refined version (third draft) was used in the field test (section 4.2.1).

3.6.2 Second refinement – input from focus group discussion participants

The objective of the focus group discussions was to gain feedback on the questionnaire draft from JMA citizens. All the information was used to revise the CM questionnaire. The focus groups began by answering the questionnaire, followed by discussion about the pictures on the show cards, questionnaire content and statements to test incentive compatibility. All questions and show cards were shown using a PowerPoint presentation through a projector and each participant was asked to answer the questions on an answer sheet. An adequate amount of time was allocated to explain the purpose and process of the discussion as well as to seek consent from the participants.

Selection of focus group participants

Participants were classified by their socio-economic groups: low income for participants with monthly earnings lower than Rp 1,500,000 and middle income for participants with monthly earnings higher than Rp 1,500,000. Nine participants were invited to each session and all nine of the low income group turned up but only six of the middle income group attended. The total number of participants was 14.

In each session, the origin of the participants was deliberately varied, each participant representing one district or municipality in the JMA. However, because three participants failed to attend, one district, Jakarta Selatan, had no representative (Table 4).

Table 4. Group composition of two focus group discussions in the JMA

Group composition		Low income group		Middle income group		Total
		No.	Percentage	No.	Percentage	
Gender						
	Female	4	44.4	3	50.0	7
	Male	5	55.6	3	50.0	8
Education level						
	Master	0	0.0	2	66.6	2
	Bachelor	0	25.0	4	33.3	4
	High school	7	77.8	0	0.0	7
	Primary school	2	22.2	0	0.0	2
Age groups						
	20-30	3	33.3	2	33.3	5
	31-40	5	55.6	3	50.0	8
	41-50	1	11.1	1	16.7	1
Origin						
3171	Jakarta Selatan (M)	0	0.0	0	0.0	0
3172	Jakarta Timur (M)	0	0.0	1	16.7	1
3173	Jakarta Pusat (M)	1	11.1	0	0.0	1
3174	Jakarta Barat (M)	1	11.1	1	16.7	2
3175	Jakarta Utara (M)	1	11.1	0	0.0	1
3201	Bogor (D)	1	11.1	0	0.0	1
3216	Bekasi (D)	0	0.0	1	16.7	1
3271	Bogor (M)	1	11.1	0	0.0	1
3275	Bekasi (M)	1	11.1	1	16.7	2
3276	Depok (M)	1	11.1	0	0.0	1
3603	Tangerang (D)	1	11.1	1	16.7	2
3671	Tangerang (M)	1	11.1	1	16.7	2

Topics covered during the FGDs

Discussions with focus group participants were grouped into six categories: (1) pictures in the show cards, (2) policies, (3) attributes, (4) payment vehicles and amount of payments, (5) sentences used and (6) statement to test incentive compatibility.

1 Pictures. Three pictures were presented in the discussion: (a) problem description (Appendix D, Figure D-1), consisting of illness, visibility and smell caused by vehicle smoke; (b) policy options, drawn as a sketch on a white board and (c) choice sets (Figure D-2).

In Figure D-1, the low income group said that they could understand the issues and they found that the pictures helped the problem description. The middle income group focused more on the sentences rather than the pictures presented. They said that Figure D-1 described the problem well while the sketch of policy options could not be understood easily. They found that Figure D-2 could not represent the problem of visibility and smell caused by air pollution. They suggested the use of photos to represent the reduction in visibility and the smell caused by vehicle smoke.

In the sentences below the pictures the middle income group suggested including the words ‘dust’ and ‘smoke’ to highlight the pollution produced by vehicles. They also suggested that the words ‘car’ and ‘motorbike’ be used instead of ‘vehicles’ in order to give respondents a clear understanding of what is meant by ‘vehicles’. They said that the word ‘vehicles’ seemed to them to represent only ‘cars’.

For the policy options (drawn on the white board), the low income group said that they needed the picture to help them to understand the policy options while the middle income group said that they could understand the policies from reading them. However, the middle income group suggested that pictures help people with a limited educational background. They also suggested some words to be used in the pictures such as ‘bike lane’, ‘bus lane’, ‘monorail’ and ‘high parking ticket area’.

For Figure D-2, the low income group preferred choice sets with pictures while most participants in the middle income group could make a choice without them. The low income group said the character’s expression helped them to compare the condition in the choice sets for visibility and smell attributes. The number of sick leave days, represented by red crosses in the calendar, did not help much and the low income group suggested that the red crosses be replaced by red blocks so that the pictures were clearer and easier to understand.

The middle income group said that the smoke in the ‘smell’ attribute was confusing. They suggested that the smoke should be more transparent so that the background can still be seen. They made the same comments as the lower income group about the red crosses in the calendar and asked to add the source of the information of the ‘average sick days’ used in the show cards. For the ‘visibility’ pictures they said that they were satisfied that they could be understood and felt that they represented the attribute well.

2 Policies. When the focus group participants were given time to comment on the policies, both groups came up with different opinions. The low income group saw the third policy, a reduction in the number of old vehicles, as an unacceptable policy. They believed that a higher registration fee for an old vehicle was not fair for low income groups because lower income groups cannot afford to buy new vehicles. They also felt that old vehicles do not pollute the air if the machine is checked regularly.

The middle income group preferred the first and third policies. They said that if the public transport system was better, citizens would opt to use it rather than to use private vehicles. They also suggested that the third policy was a good policy and could be integrated with the vehicle inspection and maintenance strategy implemented by the Jakarta Provincial Government to check private vehicle emissions. According to the participants, the inspection results could be used to determine the amount of additional tax for high pollution vehicles.

The middle income group seemed reluctant to accept the second policy: more expensive parking tickets and fees to enter high density areas. They said that this policy could be used if all local governments within the JMA made sure that there was an end to 'informal parking fees'. However, they agreed that the fee to enter the Central Business District (CBD) would help to reduce air pollution in certain areas and that the amount of private vehicles being used would reduce.

3 Attributes. Both lower income and middle income group participants agreed that illness, visibility and smell could represent the air pollution caused by vehicles. Middle income group participants suggested that the words 'smoke' and 'dust' should be used in the questionnaire as well as in the show cards, so that the respondents would understand the indicators used to describe air pollution.

4 Payment vehicles and amount of payment. Low income group participants asked for some clarification on the terms of payment. When it was explained that the term of payment was a yearly payment and that it would probably be included in the land and property tax payment, they were satisfied because they believed that this type of payment would go straight to the government. They are familiar with this type of tax and stated that most households they know were paying this type of tax every year. They did not seem too interested in more expensive parking tickets and higher vehicle taxes because most of them use public transport.

For the low income group, the amount of payments used were Rp 25,000, Rp 50,000 and Rp 75,000 per year. Most of the participants agreed that the amount of payment was too low and they agreed that they would pay up to Rp 75,000. They said that they would prefer to pay an additional Rp 75,000 in tax to experience fewer sick leave days. According to the participants, sick leave days meant that they would lose income and have to pay out extra money for doctors and medicine.

Reflecting from the first focus group, the amounts of payment for the middle income group were increased to Rp 100,000, Rp 200,000, and Rp 300,000. For them, an additional Rp 300,000 per year was 'acceptable' and they said they did not mind paying up to Rp 750,000 to increase their productivity in the future and to experience less illness and traffic jams during office hours[21]. Amount of payments used in the focus group discussion proved to be too low. Increased costs (Rp 100,000; Rp 500,000 and Rp 900,000) were further used in the field test.

One participant in the middle income group suggested that an icon be used to represent 'cost'. In the choice sets represented, cost was not represented by an icon

[21] Traffic jams were not one of the attributes. In data analyses, the condition will be captured by the ASC or the program label.

and the narrow column height gave the impression that 'cost' was not an important variable.

5 Process to select an option in a choice set. When the participants were asked how they choose an option in the choice sets, the low income group participants chose according to attribute level. Most of the middle income group chose according to the program. The most preferred program was improvement in public transport. In the interviewers' training, interviewers were told about this possible problem. Show card No. 3 (Appendix C) was developed so that interviewers could guide the respondents to understand the equal importance of attributes and policies.

6 Sentences used. Low income group participants preferred informal words and sentences while the middle income group preferred formal ones. Middle income group participants suggested some improvements to the sentences and words used. They said that formal language would create less bias and would ensure that the questionnaire was taken more seriously by respondents.

7 Statements to test difference between groups with and without a provision rule. In this session, the participants were asked to analyse the two statements and were asked to state the difference between the statements. The respondents were told that only one of the statements would be used in the final questionnaire. Two alternatives were presented to understand how the participants reacted to each of the statements. The two statements were:

Statement 1: The authority will decide which program is to be implemented and the amount of payment needed from households. We will need you to tell the truth so that the authority can design the best transportation program for the JMA.

Statement 2: The program to be implemented and the amount of payment needed from households will depend on your response.

The low income group seemed to agree that the first statement suggested that the local government would choose the program and the amount of additional tax while the second statement suggested that the respondents' choice of the most popular program would be implemented. They also said that they preferred the second statement and would take the survey seriously if they were given the second statement since their choice would count. According to them, the first statement discouraged them to choose the best option because in the end their choice would not be taken into consideration when the government designs the program.

The middle income group suggested some revision to the statements. Most of the participants agreed that the second statement meant that their opinion would be taken seriously in the program design when compared to the first statement. They suggested adding 'local government' to the second statement so that it would be clear that the local government would use the most popular option to design the program.

Refinements in questionnaires based on FGDs

The refinements were grouped into six categories: (1) pictures on the show cards, (2) policies, (3) attributes, (4) payment vehicles and amount of payments, (5) sentences used and (6) statement to test incentive compatibility.

1 Pictures

a. Problem description. In the first show card, the second problem (visibility) and the third problem (smell) were represented with photos showing low visibility and people disturbed by vehicle smoke and dust. A calendar was inserted in the first picture representing the first problem (the number of sick leave days) so that the respondent could relate exposure to air pollution with the number of sick leave days taken. Words such as ‘dust’ and ‘smoke’, representing air pollution, were used on the card. The word ‘vehicles’ was replaced by ‘cars’ and ‘motorbikes’. Card 1 in Appendix C is the final show card to describe problems caused by air pollution.

b. Policy options. Four pictures were used to describe the policy options. The first picture represented current conditions and the second, third and fourth pictures represented suggested policies: an improved transport system; a reduction in the number of vehicles in central activity areas via the application of entry fees and more expensive parking tickets in the CBD; and a reduction in the number of old vehicles. Words such as ‘bike lane’, ‘bus lane’, ‘monorail’ and ‘high cost parking ticket area’ were suggested by focus group discussion participants and were used in the pictures. Card 2 in Appendix C describes the ‘status quo conditions’ and ‘policy options’.

c. Choice sets. The choice sets were improved according to suggestions from the focus group participants:

i. Sick leave days. The red crosses were replaced with red blocks.

ii. Visibility. The character was placed in the same position so that the respondents could see differences in the visibility, not in the character’s position. The background pictures were more feasible than before.

iii. Smell. The smoke was made more transparent so that the background became clearer.

iv. Cost. An icon was introduced to represent the payment process and to make the column height bigger than before. With these design changes, cost was made as important as the other attributes. The range of payments were changed to Rp 100,000, Rp 500,000 and Rp 900,000.

2 Policies. Differences in the policy options selected were expected across groups. The lower income group cannot afford new vehicles, so would not opt for the third policy. The middle income group used private vehicles as their main form of

transport so would tend to refuse the second policy of higher cost parking tickets and fees to enter the central activity areas where they work. Sentences such as ‘old vehicles pollute more than new vehicles’ were used in the questionnaire to further explain the third policy.

3 Attributes, payment vehicles and amount of payment. Words suggested by the focus group participants such as ‘smoke’ and ‘dust’ were used in the questionnaire so that the respondents would understand the indicators used to describe air pollution. For cost attributes, the amounts tested in the field were Rp 100,000, Rp 500,000 and Rp 900,000. These amounts of payments were chosen because in the low income group participants seemed to accept Rp 75,000 and the middle income group participants were willing to pay Rp 300,000.

In the final questionnaire, combinations of four payment vehicles were used: higher land and property tax, higher vehicle tax, higher parking fees in JMA and payment to enter the JMA. These payment vehicles were used in the questionnaire to overcome many issues expected to occur such as high number of protests caused by specific payment vehicles. The use of four payment vehicles achieved the same result as a single payment vehicle where respondents needed to give up some of their disposable income to obtain an improvement. This trade-off between giving up some of their money to achieve an improvement was the monetised unit of respondent value needed in this research.

An assessment of the use of a single payment vehicle was made in the focus group discussions. A higher electric fee, clean water fee or solid waste retribution were proposed. Almost all households need to pay for these expenses, making them possible types of public payment vehicle for this research. However, the participants struggled to link the possible use of these additional funds to improvements in air quality. To them, these types of payments would not end up in local governments’ development funds but with the service providers. The use of a single payment vehicle, such as a land and property tax, would exclude renters, while a vehicle tax would exclude respondents who do not posses a vehicle. The final four payment vehicles were designed to link all the proposed policies and to make the respondents see the connection between their payment and local government funds.

4 Sentences used. Sentences used were informal and conversational. More details were added so that interviewer bias could be reduced. The interviewers were asked to use the exact words and sentences in the questionnaire rather than their own.

5 Statement to test the provision rule. The statement below was used to test differences between the two groups. It corresponded with theories discussed in section 2.5.

Group 1: Without statement.

Group 2: The program to be implemented by the local government and the amount of payment from your household will depend on the most popular program chosen by JMA citizens.

3.6.3 Refinements based on field tests and pilot survey results

Field tests were conducted in three villages in JMA: Tambun Utara (Bekasi City), Cilendek Timur (Bogor City) and Cilincing (Jakarta Utara) between 19 August 2008 and 22 August 2008. In each village two primary sampling units (PSU) were selected and nine households within one PSU were approached with the target of five respondents per PSU. Choice sets design used in the field test were based on the orthogonal design.

Thirty-eight respondents were interviewed by four surveyors in the first pre-test. The lowest and the highest income groups were not represented adequately in this survey (Table 5). Conditional Logit Models were developed using the first pre-test survey results. Four equations (section 3.8) were specified to estimate coefficients of attributes. The coefficient signs were correct for *Illness*, *Odour* and *Cost* while incorrect for *Visibility*. *Illness*, *Odour* and *Cost* were significant while *Visibility* was not significant (Table 6).

The second pre-test was run targeting high-income groups (Table 7). The same models were developed for this second pre-test. The results showed that all attribute parameter signs were correct but the visibility coefficient was not significant (Table 8).

Table 5. Respondents' income group for the first pre-test

Income level	Income range	No. of respondents
1	Below Rp 250,000	0
2	Rp 250,001-Rp 600,000	0
3	Rp 600,001-Rp 900,000	3
4	Rp 900,001-Rp 1,250,000	11
5	Rp 1,250,001-Rp 1,750,000	10
6	Rp 1,750,001-Rp 2,500,000	8
7	Rp 2,500,001-Rp 3,500,000	4
8	Rp 3,500,001-Rp 5,000,000	1
9	Rp 5,000,001-Rp 7,500,000	1
10	Above Rp 7,500,001	0
Total	4	38

Table 6. Estimation results for the first pre-test

Variables	Coefficient	p-value
I (*Illness*)	-0.26671	0.0863
V (*Visibility*)	-0.00070	0.9241
O (*Odour*)	-0.87948	0.0000
C (*Cost*)	-0.00001	0.0001
ASC_{PT}	0.06578	0.9270
ASC_{RV}	-0.21646	0.7583
ASC_{RO}	-0.04398	0.9498

Table 7. Respondents' Income group for the second pre-test

Income level	Income range	No. of respondents
1	Below Rp 250,000	0
2	Rp 250,001-Rp 600,000	0
3	Rp 600,001-Rp 900,000	0
4	Rp 900,001-Rp 1,250,000	3
5	Rp 1,250,001-Rp 1,750,000	9
6	Rp 1,750,001-Rp 2,500,000	2
7	Rp 2,500,001-Rp 3,500,000	9
8	Rp 3,500,001-Rp 5,000,000	6
9	Rp 5,000,001-Rp 7,500,000	0
10	Above Rp 7,500,001	1
Total		30

Table 8. Estimation results for the second pre-test

Variables	Coefficient	p-value
I (Illness)	-0.36277	0.0394
V (Visibility)	0.00134	0.8630
Odour (O)	-0.57223	0.0006
Cost (C)	-0.00002	0.0000
ASC_{PT}	0.81032	0.3167
ASC_{RV}	0.49971	0.5245
ASC_{RO}	0.34137	0.6675

Observations during the field tests gave some insight into how the respondents reacted to the questions asked, which questions needed to be clarified, as well as what kind of wording and sentences should be used. Using both results from pre-test observation as well as input from the surveyors, the questionnaire and show cards were further revised. The final version used more conversational language. Some sentences were not grammatically correct but were easier to understand. The presentation sequence of show cards was improved, so that it was easier for the surveyors to handle. The final questionnaire and show cards can be found in Appendix B and Appendix C respectively. A show card sample presenting one choice set is presented in Figure 2.

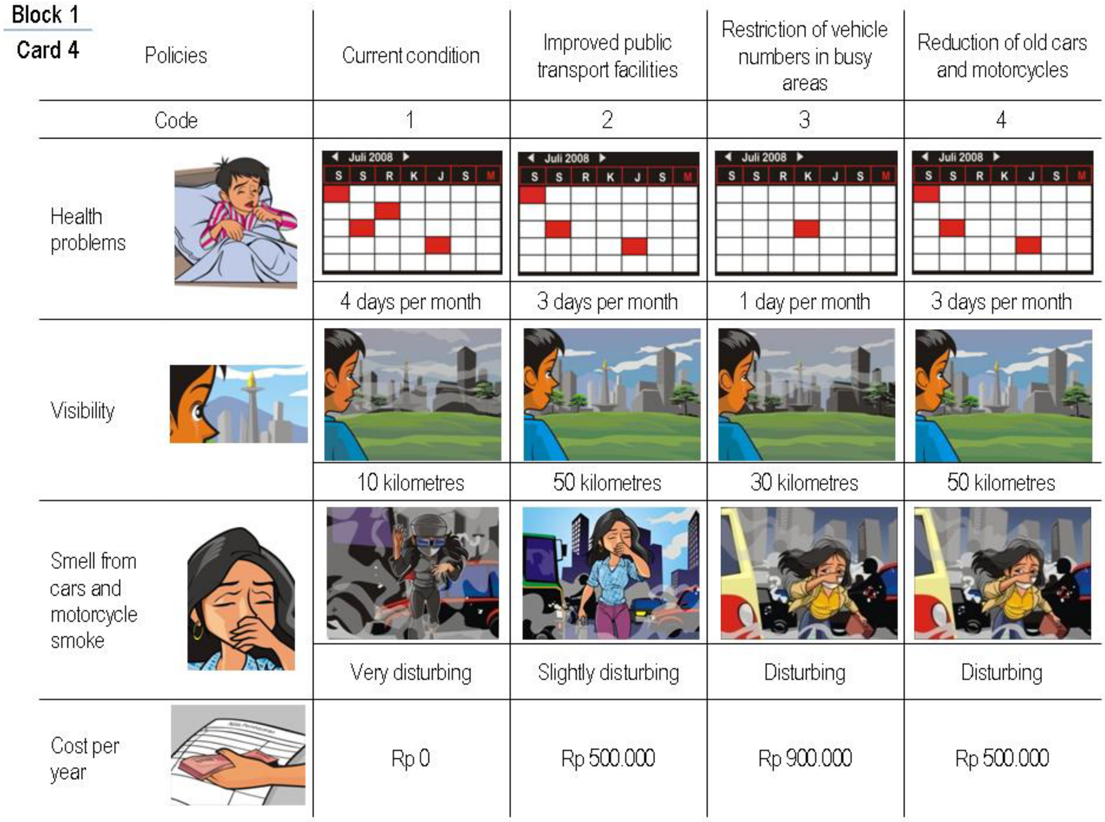

Figure 2. Sample of show cards presenting a choice set

3.6.4 Pilot survey using orthogonal design

In the pilot survey, 60 respondents were interviewed using the orthogonal design. The interviews were done in two stages: the first from 30 August 2008 to 31 August 2008 at Depok Jaya (Depok), Cengkareng Timur (Jakarta Utara) and Kayu Manis (Jakarta Timur) and the second from 3 September 2008 to 4 September 2008 at Larangan Selatan (Tangerang City), Sukabumi Utara (Jakarta Barat) and Harapan Mulya (Bekasi City). The results from both stages were used to estimate priors to create the efficient design. This second step, using the efficient design, was done in 13 subdistricts. The survey was conducted from 11 September 2008 to 26 September 2008. Survey results were presented in two sections: the orthogonal design survey and the efficient design survey.

Table 9. Respondents' income group for the orthogonal design survey

Income level	Income range	No. of respondents
1	Below Rp 250,000	0
2	Rp 250,001-Rp 600,000	0
3	Rp 600,001-Rp 900,000	3
4	Rp 900,001-Rp 1,250,000	20
5	Rp 1,250,001-Rp 1,750,000	15
6	Rp 1,750,001-Rp 2,500,000	11
7	Rp 2,500,001-Rp 3,500,000	11
8	Rp 3,500,001-Rp 5,000,000	6
9	Rp 5,000,001-Rp 7,500,000	1
10	Above Rp 7,500,001	1
Total	4	68

Table 10. Estimation results for the orthogonal design survey

Variables	Coefficient	p-value
Illness	-0.30773	0.0081
Visibility	0.00023	0.9656
Odour	-0.74319	0.0000
Cost	-0.00001	0.0000
ASC_{TS}	0.39327	0.4624
ASC_{RV}	0.09784	0.8513
ASC_{RO}	0.12966	0.8043

Sixty-eight respondents were interviewed using the orthogonal design. A summary of income level variations is presented in Table 9. Using the same models, all attribute coefficients had correct signs. However, the visibility variable was not significant (Table 10). Attribute coefficients from the orthogonal design surveys were used as priors to develop the efficient design choice sets.

3.7 Survey Implementation

3.7.1 Logistics

In this final stage of the survey, respondents were selected randomly using the systematic sampling design detailed in section 3.5.2. Before the interviews took place the respondents were screened. The first screening was for literacy. The interviewer asked the respondent to read the information sheet and sign the consent form. If the respondent seemed to have difficulty in conducting both tasks, the interview would be terminated. The second screening concerned the decision-making capacity in the household. Only respondents with a capacity to make decisions on household spending, with or without any help from other members of the family, were interviewed (Table 12). The third screening was regarding respondents' age. Respondents below 20 or above 66 were not interviewed. This decision was taken to reduce response errors. Commonly, people below 20 in JMA are either not married or married but still live with their parents. People above 66 years of age are usually retired and in the care of or supported financially by their children or other family members. Both groups were considered age groups that could not decide their spending on their own account. After the screening process, respondents were given a book containing show cards. Later, interviewers would guide respondents to see and observe the content of each page while they read the questionnaire.

Table 11. Efficient design choice sets for block 1

Choice sets	Options	Illness	Visibility	Odour	Cost	Block
1	0	4	70	Very disturbing	0	1
1	1	3	50	Slightly disturbing	500,000	1
1	2	1	30	Disturbing	900,000	1
1	3	3	50	Disturbing	500,000	1
2	0	4	70	Very disturbing	0	1
2	1	1	30	Slightly disturbing	500,000	1
2	2	2	50	Slightly disturbing	500,000	1
2	3	2	50	Disturbing	100,000	1
3	0	4	70	Very disturbing	0	1
3	1	3	30	Disturbing	500,000	1
3	2	3	70	Not disturbing	100,000	1
3	3	2	50	Slightly disturbing	500,000	1
4	0	4	70	Very disturbing	0	1
4	1	1	70	Slightly disturbing	900,000	1
4	2	2	70	Slightly disturbing	900,000	1
4	3	2	30	Disturbing	500,000	1

Table 12. Decision maker for household spending

Decision makers	No. observation	Percentage
Respondent only	135	20.87
Respondent and other family member	512	79.13
Total	647	100.00

3.7.2 Sampling

Surveys using efficient design choice sets were conducted in 13 subdistricts. These districts were selected according to average income and PM10 levels, as detailed in Table 1, and the sub-villages were selected as detailed in Figure 1. Sampling areas are presented in Figure 3: circles for the efficient design and triangles for the orthogonal design. These surveys targeted equal proportions of respondents for every group and block. However, the final results showed that respondents were not equally distributed to all groups and blocks. The total number of respondents interviewed was 647: 324 for Group 1 and 323 for Group 2. The 647 respondents were distributed into six blocks (Table 13).

Table 13. Summary of number of respondents for each group and block

Group 1		Group 2		Total
Block	No. of respondents	Block	No. of respondents	
1	55	1	54	109
2	49	2	55	104
3	59	3	52	111
4	54	4	56	110
5	53	5	51	104
6	54	6	55	109
Total	324	1.0	323	647

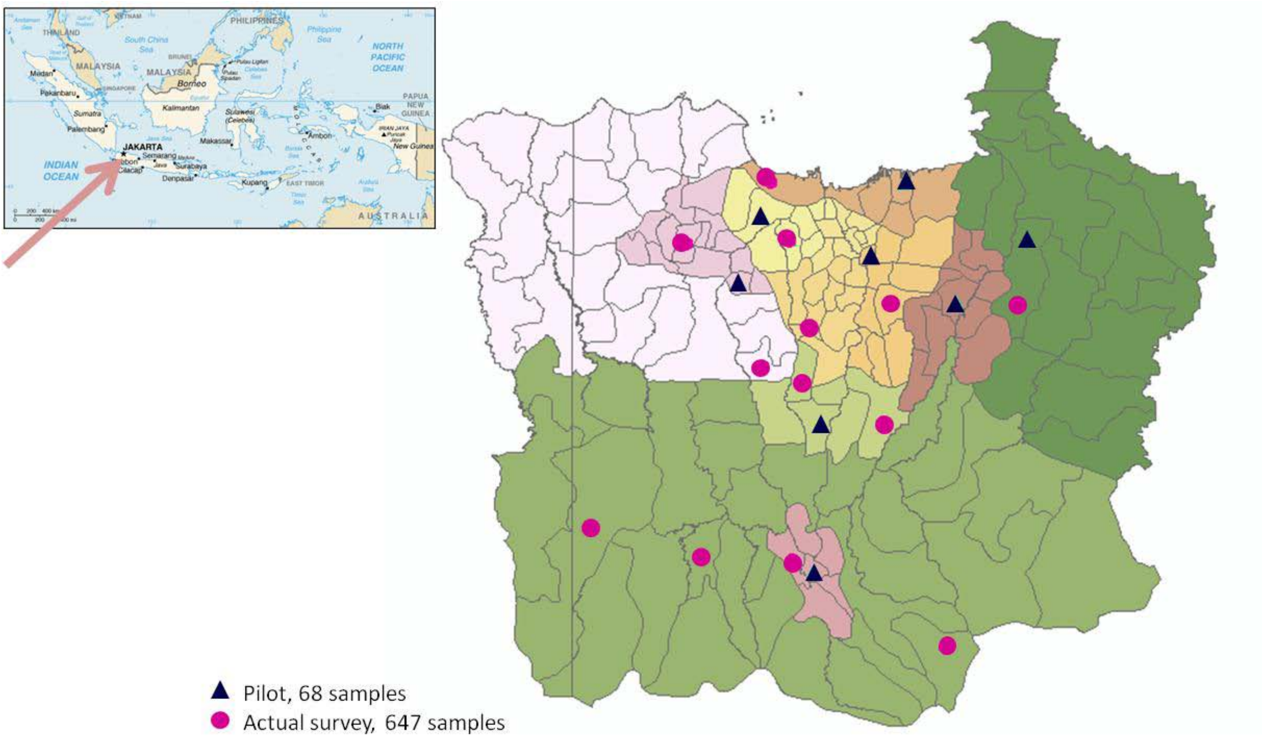

Figure 3. Sampling areas

Table 14. Number of districts for every group

PM10 classification		Number of districts	Number of districts in the sample	Number of samples per district (income level)		
MoE	Survey			High	Middle	Low
Good	Good	119	7	2	2	3
Moderate	Moderate	19	2	1	1	2
Unhealthy Very unhealthy	Unhealthy	20	2		1	1
Dangerous Very dangerous	Dangerous	8	2	1		1
Total	2.0.1	116	13	4	4	5

3.8 Data Processing and Analysis

The survey data were checked by the field supervisors and then by the researcher before being entered into the database. Data was input into a Microsoft Excel worksheet. Data were analysed using NLOGIT for estimating the utility functions, for descriptive statistics and for processing health data.

Data were analysed using two models: the Conditional Logit (CL) Model and the Random Parameter Logit (RPL) Model. The model with the best fit was used in further analysis. All these models needed to be tested since 'no model is found to be generally superior to the others' (Hynes et al., 2008, p.1014).

For CL, four models were estimated using NLOGIT: three specific models for each transport policy and one model for the status quo condition. The last three models have *ASCs*, the models are presented in Equations 14, 15, 16 and 17. In the equations: *TS* represents the first transport policy: *improvement of public transportation facilities*, *RV* for the second policy: *restriction of vehicle numbers in busy areas*, *RO* for the third policy: *reduction in number of old cars and motorcycles* and *SQ* represents the *status quo* condition. On the right-hand side: *I* represents *Illness*, *V* represents *Visibility*, *O* for *Odour* and *C* for *Cost*.

$$V_{SQ} = I\beta_I + V\beta_V + O\beta_O + C\beta_C \quad (14)$$

$$V_{TS} = A_{TS} + I\beta_I + V\beta_V + O\beta_O + C\beta_C \quad (15)$$

$$V_{RD} = A_{RD} + I\beta_I + V\beta_V + O\beta_O + C\beta_C \quad (16)$$

$$V_{RO} = A_{RO} + I\beta_I + V\beta_V + O\beta_O + C\beta_C \quad (17)$$

The socio-demographic characteristics were added as new variables. The socio-demographic variables used in this study were: *Age, Gender, Education, Income, Kids* and *Distance* representing age, gender, educational attainment, income, number of kids and average distance from respondents' home to the JMA centre. Other variables were also included in the equation, they were variables related to health conditions and respondents' daily habits. The variables were: *Fever*, *Cold*, *Cough*, and *Asthma*, representing the number of sick leave days in the last month caused by fever, cold, coughs and asthma respectively. Other variables were: *Outdoor*, the number of hours respondents spent outside, and *Smoke*, whether or not the respondents smoked. These variables were added to the equation by interacting them with *ASC* for each equation. For instance, for the first policy, *Age* was interacted with *ATS, ASC* for the first policy. All variables are described in Table B.1 in Appendix B.

The Conditional Logit Model assumes that the model meets the IIA assumption. This assumption states that 'the ratio of the probabilities of any two alternatives should be preserved despite the presence or absence of any other alternative within the set of alternatives included within the model' (Hensher et al., 2007, p.519). The specification test for IIA assumption is the Hausman and McFadden test. Following Hensher et al. (2007, p.519) the test was as follows: (1) estimating an unrestricted model; (2) estimating a restricted model by taking one of the alternatives; (3) calculate q in Equation 18 where b_u was a column vector of parameter estimates for the unrestricted model and b_r was a column vector of parameter estimates for the restricted model and V_r was the variance-covariance matrix for the restricted model and V_u was the variance-covariance matrix for the unrestricted model. In this test, q was a chi-square statistic where the degrees of freedom are equal to the number of parameters estimated in the model. If the p-value was lower than 0.05, then the IIA assumption for the model is rejected (Hensher et al. 2007, p.523).

$$q = [b_u - b_r]' [V_r - V_u]^{-1} [b_u - b_r] \tag{18}$$

To understand whether or not the IIA assumption was violated, the Hausman and McFadden tests were conducted. The common procedure is by using an **;ias** command provided by NLOGIT4.0. However, for models with more than one *ASC*, the following steps apply (Hensher et al., 2007, p.595-600).

1 Estimating of the unrestricted Conditional Logit model.
2 Creating permutation matrix, J1, to extract relevant elements from B and VARB matrices. B and VARB are automatically created by NLOGIT.
3 Creating Bu and Vu matrices using Equations 19 and 20.
4 Estimating the restricted model where one of the alternatives is rejected.

$$B_u = J1 \times B \tag{19}$$

$$V_u = J1 \times VARB \tag{20}$$

$$B_n = B_u - B_r \tag{21}$$

$$V_n = V_u - V_r \tag{22}$$

5 Creating new permutation matrix, *J2* then B_r and V_r using the same equation above.
6 Calculating Bn and Vn using Equations 21 and 22.
7 Calculating p-value using number of estimated parameter in the unrestricted model as the degree of freedom.

Analyses using an RPL model followed the same procedure as CL. For this model, all parameters except for *Cost* and *ASCs* were set as random parameters. The number of iterations using the Halton draw sequence was set to 500 and the parameters were correlated. The same procedures also applied for LC model analyses, however, some specific steps were added to accommodate the model's specification. Three models were estimated: two, three and four classes, then they were compared according to the indicators presented in section 2.4.4.

4.0 ANALYSES OF SURVEY DATA

4.1 Socio-demographic of Respondents

The socio-demographic backgrounds of the respondents are presented in Table 15. To create representativeness within the survey, aside of PM10 levels and subdistricts' average income, socio-economic status (SES) was used as the main indicator in selecting survey respondents. The SES level used in this survey was the one used by a survey company: PT ACNielsen Indonesia. Chi-squared tests were used to observe distribution differences between survey results and JMA citizens' socio-economic conditions.

Table 15. Respondents' socio-demographic background for the efficient design survey

Group composition		Group 1: without a provision rule		Group 2 with a provision rule		Total
		No.	Percentage	No.	Percentage	
Gender						
0	Female	154	47.5	160	49.5	314
1	Male	170	52.5	163	50.5	333
	Total	324		323		647
Education level						
1	Never attend school	1	0.3	4	1.2	5
2	Primary school (no certificate)	29	9.0	26	8.0	55
3	Primary school	85	26.2	86	26.6	171
4	Secondary school	69	21.3	78	24.1	147
5	High school	106	32.7	96	29.7	202
6	Diploma	13	4.0	19	5.9	32
7	Graduate and postgraduate	21	6.5	14	4.3	35
	Total					647
Age groups						
1	Below 20	0	0.0	0	0.0	0
2	20-25	30	9.3	39	12.1	69
3	26-30	56	17.3	50	15.5	106
4	31-35	55	17.0	60	18.6	115
5	36-40	62	19.1	52	16.1	114
6	41-45	40	12.3	30	9.3	70
7	46-55	57	17.6	59	18.3	116
8	56-65	24	7.4	33	10.2	57
9	Above 66	0	0.0	0	0.0	0
	Total					647
Income						
1	Below Rp250,000	2	0.6	0	0.0	2
2	Rp 250,001 – Rp 600,000	25	7.7	32	9.9	57
3	Rp 600,001 – Rp 900,000	63	19.4	51	15.8	114
4	Rp 900,001 – Rp 1,250,000	90	27.8	88	27.2	178
5	Rp 1,250,001 – Rp 1,750,000	72	22.2	71	22.0	143
6	Rp 1,750,001 – Rp 2,500,000	40	12.3	44	13.6	84
7	Rp 2,500,001 – Rp 3,500,000	23	7.1	26	8.0	49
8	Rp 3,500,001 – Rp 5,000,000	7	2.2	7	2.2	14
9	Rp 5,000,001 – Rp 7,500,000	2	0.6	1	0.3	3
10	Above Rp 7,500,001	0	0.0	3	0.9	3
	Total					647

The survey SES distribution was not significantly different from real conditions with the chi-squared result equal to 2.1033, which is lower than the critical value (12.5916 with six degrees of freedom at the 0.05 level) (Table 16). Across the samples, the gender structure was the same with the structure of the JMA residents, 51% were male and 49% were female. The age structure was not significantly different from the 2008 projection by the National Statistical Agency with the chi-squared result equal to 3.6414, which is lower than the critical value (12.5916 with six degrees of freedom at the 0.05 level) (Table 17).

Table 16. Comparison between survey results and existing socio-economic level

Expenditure	Social economic status (SES) level	Expected results (%)	Survey results (%)
Below 600000	E	11	9
600,000 - 900,000	D	18	18
900,000 - 1,250,000	C2	23	28
1,250,000 - 1,750,000	C1	22	22
1,750,000 - 2,500,000	B	15	13
2,500,000 - 3,500,000	A2	7	8
Over 3,500,000	A1	4	3
Chi-squared	2.1033		
Chi-squared critical (df = 6, α = 0.05)	12.5916		

Table 17. Comparison between survey results and 2008 population projection data

Age groups	Age group proportion 2008 (%)*	Survey results (%)
20 - 25	16	11
26 - 30	16	16
31 - 35	16	18
36 - 40	14	18
41 - 45	12	11
46 - 55	17	18
56 - 65	10	9
Chi-squared	3.6414	
Chi-squared critical (df = 6, α = 0.05)	12.5916	

Note: *BPS, 2009 Population projection data

4.2 Analyses of Respondents' Responses to General Questions

4.2.1 Screening the respondents

In the survey, respondents were screened according to their literacy and their capacity as a decision maker in their household. Only literate respondents and respondents who make decisions on their household spending were asked to complete the survey (Table 18). Results from the screening questions showed that from 647 literate respondents, only 135 respondents act as the sole decision maker for their family. The rest of the respondents decide household spending with the help of at least one family member. It showed that for most households in the JMA, the decision-making process involves discussion between the head of the household and family members.

The choice modelling exercises asked in the surveys required respondents to read and weight different options presented in illustrations and in writing. This was why only respondents who can read were selected in the survey. Otherwise, the survey results would be difficult to interpret since respondents' understanding of the issues and the questions would vary. Respondents' capacity to decide their household spending is important in stated preference studies. This is because their answers or choices are closely related to their spending and the funds that are available to spend on a new post of their expenditure such as a new tax. That is why only respondents who have authorisation to spend on behalf of the household were interviewed in the surveys.

Table 18. Decision maker for household spending

Decision makers	No. observation	Percentage
Respondent only	135	20.87
Respondent and other family member	512	79.13
Total	647	100.00

4.2.2 Framing the issue: respondents' awareness of air pollution in JMA

The first general question was designed to lead the respondent into the main issue covered by the questionnaire, which was whether or not the respondent was aware of or understood the effects of air pollution. Only 18.24% (Table 19) of respondents said that they were not aware of the effects of air pollution. Most of the respondents (81.76%) thought that they understood the effects of air pollution in general. When they were asked the second framing questions, most of them were aware of the impact of air pollution on disturbing odour, health and visibility range. The percentages of respondents who have a preliminary understanding of the impact of air pollution on odour, health and visibility range were 93.51%, 83.62% and 72.95%, respectively. According to the survey results, most of the respondents were aware that odour was one of the impacts of air pollution.

The second question was also intended to introduce the attributes used in the choice sets questions. In the interview, the interviewer read the information while the respondent was asked to observe Card 1 (Appendix C, Card 1). Card 1 was designed to give the respondent some idea of each of the attributes and their relationship with air pollution. After the respondent read and received all of the explanations about the effects of air pollution, the respondent was asked whether or not her or his opinion was the same as before being given the explanation or the same as when given the explanation. The highest 'yes' responses were for the odour attribute then illness. The lowest 'yes' response was for visibility. This is acceptable since disturbing odours from the transport sector can be easily experienced compared to illness and visibility (Table 20). Again, this question confirmed that respondents' understanding of odour was better than their understanding of the impact of air pollution on illness and visibility.

In the third question, the respondents were asked to rank the attributes from the most to the least important (Q3 in Appendix B). Most of the respondents chose odour (51.93%) as the most important attribute, first rank, while the least important, third rank, was visibility (61.67%) (Table 21). Respondents' responses to the third question further indicated that odour is the most important variable among the three attributes used. These findings would be verified by the modelling results in sections 4.3, 4.4 and 4.5.

Table 19. Awareness of the effects of air pollution

Respondents' answers	No. of responses	Percentage
Yes	529	81.76
No	118	18.24
Total	647	100.00

Table 20. Verification of the effects of air pollution

Response	Percentage of responses		
	Illness	Visibility	Odour
Yes	83.62	72.95	93.51
No	16.38	27.05	6.49
Total	100.00	100.00	100.00

Table 21. Attribute rankings

Ranks	Percentage of responses		
	Illness	Visibility	Odour
1	37.56	10.51	**51.93**
2	38.18	27.82	34.00
3	24.27	**61.67**	14.06
Total	100.00	100.00	100.00

4.2.3 Protest identification to choice modelling exercises

After the main questions with choice sets, respondents were asked to suggest alternative payment vehicles. Most of respondents seemed to agree with the offered payment vehicle (85.94%). The rest of the respondents chose other payment vehicles such as: value-added tax, which is mainly paid by the business sector and people with high purchasing power; progressive income tax, which is paid by people in formal employment; vehicle tax and luxury vehicle tax, which is paid by people who have motorised vehicles, especially luxury ones (Table 22). Respondents' answers tended to shift the tax burden from all households to high-income households which have greater purchasing power, larger incomes and households which have luxury vehicles.

The identification of a 'protest' to the choice set questions was directed at respondents who always chose the status quo. Out of 647 respondents, 173 (26.74%) always chose the status quo. Most of the respondents who chose the status quo favoured the second option: the amount of annual payment is too high (80.34%). They were categorised as non-protesters. Only 2.97% of respondents showed a tendency to question government reliability to implement the air quality improvement project using the three alternative policies (Table 23) and 2.32% said that they did not know which one was the best choice in each of the four choice sets presented in the show cards. Respondents who could not decide the best choice and who did not believe in the scenarios presented were excluded from the analysis.

Table 22. Alternative payment vehicles

Respondents' responses	No. of responses	Percentage
No alternative payment vehicle	556	85.94
Value-added tax	30	8.81
Progressive income tax	32	0.77
Vehicle tax and luxury vehicle tax	24	3.71
Others	5	0.77
Total	647	100.00

Table 23.Protest respondents

Statement choices for protest respondents	No. of responses	Percentage
I don't know which is the best choice	15	2.32
Amount of annual payment is too high	139	21.48
I don't believe that the government will use the funds to reduce air pollution in the JMA	19	2.94
Total	173	26.74

4.3 Modelling Utility Functions using Conditional Logit Models

4.3.1 Estimation results for the two groups

Three new policies and one status quo policy were used in the choice questions. Four utility functions were estimated for each sub-sample. Conditional Logit (CL) models were used to estimate attribute parameters for both Group 1, without a provision rule, and Group 2, with a provision rule. Three *ASCs* were applied for each policy: *ATS* for public transport improvement, *ARD* for reducing vehicle density in busy areas and *ARO* for reducing the number of old vehicles owned in the JMA. Respondents' preferences towards the three different policies were captured by these *ASCs*. *Illness*, *Visibility* and *Cost* are continuous variables while *Odour* is a categorical variable. In the choice modelling literature *Odour,* as a categorical variable, should be coded using a dummy (Bateman et al., 2002, p.282) or effects coding (Hensher et al., 2007, p.120). In this study, both the dummy and effects coding cannot be used since the attribute levels in the status quo were unique. The levels used by the status quo condition were not used by other alternatives. The weakness of this approach is that the addition of one unit of *Odour* cannot be interpreted as being twice as large when compared to the lower one. To resolve the problem, the number of levels were reduced from four to three by coding *very disturbing* and *disturbing* using the same effect coding as level one (Table 24) and *slightly disturbing* and *not disturbing* as levels two and three. The weakness of this approach was that there would be no difference in interpreting the very disturbing and disturbing conditions used in the show cards. This problem came up in this research because in the experimental design stage *Odour* had number of days as a unit instead of as a level of disturbance .

Table 24. Effect coding for odour attribute

Levels for *Odour*	*Odour 1*	*Odour 2*
Very disturbing and Disturbing coded as Disturbing	1	0
Slightly disturbing	0	1
Not disturbing	-1	-1

Therefore, the level used in the status quo was also used by other alternatives. This approach made the model estimation possible using effects coding. The equations used to estimate the model are Equations 23, 24, 25 and 26. The model estimated using this approach is presented in Table 25.

$$V_{SQ} = I\beta_I + V\beta_V + O1\beta_{O1} + O2\beta_{O2} + C\beta_C \qquad 23$$

$$V_{TS} = A_{TS} + I\beta_I + V\beta_V + O1\beta_{O1} + O2\beta_{O2} + C\beta_C \qquad 24$$

$$V_{RD} = A_{RD} + I\beta_I + V\beta_V + O1\beta_{O1} + O2\beta_{O2} + C\beta_C \qquad 25$$

$$V_{RO} = A_{RO} + I\beta_I + V\beta_V + O1\beta_{O1} + O1\beta_{O2} + C\beta_C \qquad 26$$

Table 25. Estimation results of CL model for group 1 and group 2

Variables	Group 1		Group 2	
Illness	-0.300	***	-0.184	***
Visibility	0.000		0.005	*
Odour 1	-0.369	***	-0.386	***
Odour 2	-0.114	*	-0.080	
Cost	-0.002	***	-0.002	***
ATS	-0.392	**	-0.047	
ARD	-0.489	**	-0.271	
ARO	-0.637	***	-0.255	
LL	-1,528.702		-1,554.219	
AIC	2.371		2.418	
BIC	2.403		2.450	
Chi-squared	421.890		423.560	
Probability chi-squared	0.000		0.000	
Rho-squared	0.121		0.120	

Note: significant at 10% (*), 5% (**) and 1% (***)

For both groups, the probability of a ‘change’ option being selected was increased according to: (1) the lower the number of sick leave days caused by respiratory-related illnesses; (2) the higher the visibility range; (3) the lower the degree of odour disturbance; and (4) the lower the cost respondents need to pay. All significant attributes have the a priori expected signs in both groups. Insignificant attributes were *Visibility* for Group 1 and *Odour 2* for Group 2. All *ASCs* were significant for Group 1 and all insignificant for Group 2. The results showed that *Visibility* was not an important feature of air pollution to Group

1, which was not given any provision rule before the choice sets, while *Odour* 2 was not important to Group 2. These differences between the two groups' results need to be tested to understand their significance.

4.3.2 Testing differences between the two groups

Differences between sub-samples were investigated using three tests: likelihood ratio tests, the Poe et al. test (1994) and testing the significance of the *Group* variable in a combined model. A likelihood ratio test was used to test for differences between the two CL models estimated for the two groups. The results suggested that there was no significant difference between the two models estimated for the two sub samples. The critical value for the chi-squared test with a 95% confidence level was higher (15.507) than the calculated chi-squared value (14.704).

The Poe et al. test (1994) was used to assess differences between implicit prices produced for the two different sub-samples. Confidence intervals for the implicit prices were obtained using the Krinsky and Robb (1986) procedure. This procedure involves drawing 1,000 sets of parameters and using them to calculate the mean and standard deviation of implicit prices for all attributes. If there is no significant difference between both estimation results, then the expected proportion of difference is between 0.025 and 0.975 (Poe et al., 1994). The tests showed that there were no significant differences between the implicit price for Group 1 and Group 2 since none of the proportions are above 0.975 or lower than 0.025 (Table 26, last column). The significance level of the *Group* variable in a model that combined both sub-samples was used to draw a stronger conclusion that the sub-samples were not significantly different. Using a CL model, the p-value for the *Group* variable was not significant (p-value = 0.119) indicating that there was no significant difference between the two sub samples. Since the two sub-samples are not significantly different, further analyses combined both sub samples into one dataset. Therefore, the provision rule given to the second Group did not provide different estimation results, suggesting that it did not have a significant impact on the true parameter estimate.

Table 26. Implicit prices in thousand Rupiahs and Poe et al. test results

Variables	Group 1		Group 2		Proportion of difference (Poe et al. test)
	IP	CI	IP	CI	
Illness	-129.20	± 0.75	-77.37	± 0.71	0.058
Visibility	--	--	1.87	± 0.03	0.051
D to ND	-365.79	± 3.10	--	--	0.576
SD to ND	-255.58	± 2.93	-225.77	± 2.69	0.677

Note: D = disturbing, SD = slightly disturbing, ND = not disturbing

4.3.3 Estimation results for all samples

Two CL models were estimated for the combined samples: Model 1 was an attributes-only model and Model 2 included other explanatory variables (Appendix A, Table A-1). Similar to the ‘separate-groups’ results, the probability of a ‘change’ option being chosen was increased according to: (1) the lower the number of sick leave days; (2) the higher the visibility; (3) the lower the degree of odour disturbance; and (4) the lower the cost. *Visibility* was insignificantly different from zero in both models. All *ASCs* were significant and negative. Observing the overall fit of the model, measured by McFadden’s rho-squared, Model 2 (rho-squared = 0.215) was better than Model 1 (rho-squared = 0.120).

The results demonstrate that the respondents support reductions in air pollution. However, all the *ASCs* were negative, suggesting that respondents oppose the implementation of new policies. Negative *ASCs* show a ‘status quo bias choice’ (Mazzanti, 2001, p.11) or a reluctance to move from current conditions (Kerr and Sharp, 2008, p.390; Concu, 2006, p.8; Brey et al., 2007, p.310). In the survey, 173 respondents consistently chose the status quo condition (Table 23). Another possible cause was that the lowest cost level, Rp 100,000 was set too high, shifting many respondents to the status quo condition.

In Model 2, explanatory variables were added to observe other possible explanations for variations in choices. All explanatory variables were grouped into: socio-demographic variables (age, gender, number of children, education and income); air-pollution-related illnesses (fever, colds, coughs, asthma), habits (smoking, average number of hours spent outdoors) and location-specific conditions (pollutant concentration: PM10 total, dispersion and emissions as well as respondents’ home distance from the JMA centre). All these variables were interacted with all *ASCs*.

The socio-demographic variables, *Age*, *Gender*, *Education* and *Income* consistently appeared as significant variables. Young women with relatively high levels of education and income were more likely to choose improvement over current conditions.

For PM10-related illnesses, none consistently appeared as significant determinants of choice. Asthma was significant only for RD policy while *Coughs* were significant for *TS* and *RO* policies. Respondents who suffered from asthma in the past month of the survey appeared to choose improvement over current conditions. Unexpectedly, respondents who suffered coughs did not appear to choose improvement.

The third group of explanatory variables were respondents’ habits. *Smoke* was not significantly different from zero for the *RD* policy but significant for both the *TS* and *RO* policies (at 1% and 5% respectively) indicating that people who smoke tend to choose improvement. The average number of hours spent outdoors, was not significantly different from zero for *RO* policy but significant for *TS* and *RD* policies. The negative signs were unexpected since they indicated that the more average hours spent outdoor the less respondents wanted the improvement.

The fourth group of explanatory variables were location-specific conditions: PM10 concentration in the respondents’ living area and distance to JMA city centre. The three different concentrations were added to the model to test their significance. They were: *PMTotal*, *PMDispersion* and *PMEmission*. *PMTotal* and *PMDispersion* were PM10 concentration as a result of dispersion modelling while *PMEmission* was PM10 concentration as a result of calculated emissions. PM10 emissions are easy to observe because people can see the sources of the emissions: vehicles, industry, households and construction sites. The dispersion of pollutants, on the other hand, is more difficult to observe. Dispersion can be detected by readings produced by monitoring stations and is highly influenced by meteorological conditions, especially wind direction and wind velocity. As expected, only PM10 concentration is caused by immediate emissions, *PMEmission* was a significant variable across different policies. The *Distance* variable turned out to be a significant variable, indicating that respondents who lived relatively close to the centre of the JMA were more likely to choose improvement from current conditions.

Insignificant explanatory variables were excluded and different combinations of CL models were estimated to find the best fit models according to the rho-squared statistic and the significance of variables. Model 3 was the best model formulated with 0.203 rho-squared and significant explanatory variables. In this final model, the explanatory variables were: *Age, Gender, Education, Income, Cough, Distance* and *PMEmission.*

To see whether or not the IIA assumption was met in the CL model, the Hausman test was conducted by restricting one utility function at a time using the steps detailed in Section 3.8. The results are presented in Table 27. Model 1 was an attributes-only model while Model 3 was found to fit the data best with significant explanatory variables. The Hausman and McFadden test could not be conducted for Model 2 since the command for matrix operation exceed 2,500 characters, which was the limit for matrix operation in NLOGIT4.0. The Hausman test for Model 1 showed that the IIA assumption could be rejected for all ‘new policies’ options. While for Model 3, the test showed that the IIA assumption cannot be rejected for *RD Policy*. Since the overall results failed to reject the IIA assumption, other models, the Random Parameter Logit (RPL) model, which relaxed IIA assumption, was estimated. The RPL model can also be used to observe taste heterogeneity (Morey et al., 2006).

Table 27. Hausman test results for model 1 and model 3

CL Model		Excluded choices		
		TS	RD	RO
Model 1	p-value	0.009	0.004	0.010
Model 3	p-value	0.000	0.984	0.071

4.4 Modelling Utility Function using Random Parameter Logit Models

The RPL model was applied to investigate possible dispersion around the coefficients’ mean, indicating heterogeneity among respondents. The number of replications was set to 500 after the final specification model was identified. The distributions of random parameters were assumed to be normal.

Two models were estimated: Model 4 included all possible explanatory variables and Model 5 was a simpler model including explanatory variables found to be significant in Model 3 (CL model) (Appendix A, Table A-2). After testing for different combinations of random parameters, as suggested by Hensher et al. (2005, p.627), only the parameters that consistently appeared to have significant standard deviation were set as random. Initially, all attributes, except *Cost*, were set as random parameters. Then, *Visibility* and

Odour 2 were set as fixed parameters since both consistently showed insignificant standard deviations. All *ASCs* (*ATS*, *ARD* and *ARO*) were also set as fixed parameters since in the 10 replication tests none of them had significant standard deviation. Correlation among random parameters was tested and found to be low. The final models were estimated without allowing for correlation among parameters.

For both Model 4 and Model 5, all *ASCs* were negative and significant. Significant attributes for both models were *Illness*, *Odour 1* and *Cost*. *Visibility* and *Odour 2* were insignificantly different from zero. All standard deviation for attributes set as random parameters were significant, indicating that unconditional unobserved heterogeneity existed for these attributes. Individual characteristics, interacted with *ASCs*, were added into the model to improve model fit. As for the CL specification, Model 5 was simpler than Model 4 with a slightly lower rho-squared.

4.5 Comparing Model Fit

4.5.1 Model fit and implicit prices

Both RPL models, Model 4 (rho-squared = 0.233) and Model 5 (rho-squared = 0.222) were better than CL Model 2 (rho-squared = 0.215 and 0.203). Model 4 with interaction has the highest overall fit (rho-squared = 0.233) compared to both CL models and RPL Model 4. However, RPL Model 5 was simpler and had significant variables. This model was found to fit the data best compared to the other models tested.

The implicit prices were calculated using Equation 6 in section 2.4.4. The implicit prices revealed that respondents in the JMA were willing to pay for changes in health and environmental conditions. Implicit prices estimated using CL and RPL were not significantly different except for *Odour 2* since it was significant in the CL Model but insignificant in the RPL Model (Table 28).

Table 28. Comparison of implicit prices (in thousand Rupiahs)

Variables	CL (Model 3)		RPL (Model 5)		Proportion of difference
	IP	CI (95%)	IP	CI (95%)	
Illness	-97.716	± 0.946	-88.857	± 1.069	0.491
Visibility	--	--	--	--	--
D to ND	-360.955	± 1.125	-324.786	± 2.190	0.781
SD to ND	-234.841	± 1.029	--	--	0.873
Rho-squared	0.203	12.5	13 0.222	13.5	13.6 13.7

Note: D = disturbing, SD = slightly disturbing, ND = not disturbing

4.5.2 Compensating surplus

To calculate compensating surplus, each 'change' scenario and the status quo needed to be specified. The change scenarios were based on attribute levels defined in Table 1: *Low Impact*, *Medium Impact* and *High Impact* using first, second and third levels for all the attributes respectively. The three change scenarios for each of the three new transport policies, *Improvement of the transportation facilities (TS), Reduction in vehicle numbers in the city centre (RD)* and *Reduction of old vehicles (RO),* were investigated:

1 *Low Impact*: an average of three sick leave days caused by respiratory-related illnesses, 30-km range of visibility and disturbing odour from the transport sector.

2 *Medium Impact*: an average of two sick leave days caused by respiratory-related illnesses, 50-km range of visibility and slightly disturbing odour from the transport sector.

3 *High Impact*: an average of one sick leave day caused by respiratory-related illnesses, 70-km range of visibility and no disturbing odour from the transport sector.

The status quo scenario was defined by an average of four sick leave days per month caused by respiratory-related illnesses, 10-km range of visibility and disturbing odour from the transport sector. Since generic parameters were estimated for all three new policies, respondents' preferences for policy differences were only captured by the *ASCs*.

As stated in section 2.4.4, the compensating surplus for each household was calculated using Equation 7 where β_c is the marginal utilities of income represented by the coefficient of the cost attribute, V_o is the utility of the current condition and V_1 is the utility of the new proposed condition, *ASC* for each policy is used in the calculation. The compensating surplus represents respondents' willingness to pay for the proposed transport policies. Using the above four scenarios, three compensating surpluses were estimated for each new transport policy.

Using estimation results from the RPL model, on average (using *Medium Impact* scenario), respondents in the JMA were willing to pay Rp 477,940 (USD 54.40), Rp 489,258 (USD 55.46) and Rp 503,555 (USD 57.32) per household per annum over a three-year period for the implementation of *TS*, *RD* or *RO* policies respectively (Table 29). Even though respondents tended to choose the status quo, their average willingness to pay for new transport policies was positive.

Table 29. Comparison of compensating surplus for each new transport policy (in thousand Rupiahs per household per annum over a three-year period)

Policies	CL (Model 3)			RPL (Model 5)		
3	High	Medium	Low	High	Medium	Low
TS	684.67	533.33	351.67	634.19	**447.94**	321.70
RD	684.33	533.00	351.33	643.50	**487.26**	331.02
RO	709.67	558.33	376.67	659.80	**503.56**	347.31
Rho-squared	0.203	3.0	3.1	0.222	3.2	3.3

The welfare estimates reported in Table 29 for the RPL model (*Medium Impact* scenario) were aggregated over the whole sampling frame to determine the total benefit for the three new policies using Equation 27 where *CSA* is the aggregate welfare estimate, *RR* is response rate, *P* is population, *r* is discount rate and *n* is number of years.

In the survey, the number of households contacted was 1,170 and the number of households that agreed to be interviewed was 647, therefore the fraction of the sample that agreed to take part in the survey was 55%. The number of households for the whole JMA in 2008 was approximately 6,310,790. Using these figures to extrapolate the total benefit for each policy per annum gives USD 230 million, USD 219 million and USD 228 million for *TS*, *RD* and *RO* respectively. The present value of the total benefit for each policy over a three-year period is presented in Table 30 (using three discount rates[22]). These benefit estimates can be compared with the present values of their costs.

$$CSA = CS \times RR \times P \times n \times \frac{1}{(1+r)^n} \qquad 27$$

Table 30. Present value of total benefit for three new transport policies for a three-year period

5	NPV in million USD			NPV in trillion Rp		
Discount rate (%)	6.75	9.51	12.75	6.75	9.51	12.75
Policies	6	7	8	9	10	11
TS	498	474	448	4,373	4,161	3,934
RD	507	483	456	4,459	4,242	4,010
RO	524	499	472	4,608	4,384	4,144

5.0 CONCLUSIONS

The results of this research help to understand JMA citizens' value for fewer sick leave days, better visibility and the reduction of odour as a result of decreasing air pollution concentration, using PM10 as an indicator. Since these values are non-marketed values, respondents' preferences were elicited using a household survey using the Choice Modelling method. This method was used because it can separate respondents' values toward air quality improvement into air quality attributes: sick leave days (*Illness*), *Visibility* and *Odour*.

Many lessons were learned during the implementation stage of the choice modelling method in the JMA. The problems were expected because most choice modelling studies have been conducted in developed countries and there are a limited number of examples available from developing countries. The main reasons for difficulties were the low education level of respondents and the characteristics of a society with a high dependency on oral presentation rather than written presentation. Consequently, respondents' reliance on the surveyors was very high. Three strategies were used to overcome the problem: (1) using show cards to describe the issues, proposed solutions to the issues and to present choice sets; (2) creating a 'story-like' questionnaire so that the respondents could be guided through the whole questionnaire by the surveyors. This was

[22] Discount rates used were 6.75%, 9.5% and 12.75% as minimum, average and maximum discount rates for Indonesia from July 2005 to July 2009 (www.bi.go.id, 30 July 2009).

done using conversational language in the written questionnaire read by surveyors; (3) training the surveyors so that they were capable of delivering the questionnaire using show cards and at the same time telling the ‘story’ so that respondents could understand the links between problems, alternative solutions and choice exercises.

In addition to the above main objective, this study also sought to understand whether or not the implementation of the Choice Modelling Method is incentive compatible. The hypothesis tested was that if the method is not incentive compatible, there is a significant difference between the two sub-samples: (1) without a provision rule and (2) with a provision rule. The wording of the provision rule was made so that the respondent cares about the outcome and feels that their response will actually influence the future outcome. Three different tests were used to investigate differences between the two sub-samples. The results showed that there were no significant differences between the two sub-samples, thereby proposing a rejection of the hypothesis.

Since there were no significant differences between the two sub-samples, both samples were combined to form one sample for further analysis. Survey results were analysed using two models: the Conditional Logit Model and the Random Parameter Logit Model. Initially, the CL model was used but because the IIA assumption was violated, the RPL model, which relaxes the assumption, was implemented.

Using results from the modelling stage, it can be concluded that the respondents in the JMA have significant non-market values for air quality attributes especially for the *Illnesses* and *Odour* caused by air pollution from the transport sector, and they were willing to pay for changes. All *ASCs* for three different policies were negative, suggesting that most of the respondents were reluctant to choose three proposed transportation policies. The main reasons might be because they did not believe that their contribution would be used to reduce air pollution from the transport sector since most of the policies implemented in the JMA have failed to remedy the problem. Another possible cause was that the lowest *Cost* level (Rp 100,000 per year) was too high, shifting respondents’ preference to the status quo condition. Nonetheless, on average, respondents in the JMA were willing to pay Rp 584,333 (USD 66.51), Rp 558,000 (USD 63.51) and Rp 579,333 (USD 65.94) per household per annum over a three-year period for the implementation of *TS, RD* or *RO* policies respectively.

The estimated net present value for the total benefit presented in Table 30 can be used in cost benefit analysis to estimate the total net benefit of implementation of the new transport policies. The results can assist local government in the JMA in providing a more precise understanding of JMA citizens’ preferences towards transport policies in the JMA and the total net benefit received by the citizen.

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APPENDIX A: Model Results

Table A-1 Estimation results CL model

Variables	Model 1		Model 2		Model 3	
Illness	-0.240	***	-0.247	***	-0.248	***
Visibility	0.002		0.002		0.002	
Odour1	-0.377	***	-0.426	***	-0.407	***
Odour2	-0.097	**	-0.087	**	-0.091	**
Cost	-0.002	***	-0.003	***	-0.003	***
ATS	-0.220	*	-1.480	***	-1.003	**
ATS*Age			-0.017	***	-0.015	**
ATS*Gender			-0.365	**	-0.351	***
ATS*Kids			0.096	**		
ATS*Education			0.458	***	0.415	***
ATS*Income			0.232	***	0.231	***
ATS*Fever			0.194			
ATS*Cold			0.308			
ATS*Cough			-0.506	**	-0.323	**
ATS*Asthma			-0.513			
ATS*Outdoor			-0.052	**		
ATS*Smoke			0.430	***		
ATS*Distance			-0.031	***	-0.035	***
ATS*PMTotal			-0.001			
ATS*PMDisperse			-0.001			
ATS*PMEmission			-11.896		-20.824	**
ARD	-0.382	***	-1.277	***	-1.002	**
ARD *Age			-0.019	***	-0.017	***
ARD *Gender			-0.480	***	-0.521	***
ARD *Kids			0.052			
ARD *Education			0.478	***	0.443	***
ARD *Income			0.227	***	0.231	***
ARD *Fever			0.109			
ARD *Cold			0.100			
ARD *Cough			-0.506	**	-0.441	***
ARD *Asthma			0.815	*		
ARD *Outdoor			-0.042	*		
ARD *Smoke			0.209			
ARD *Distance			-0.032	***	-0.036	***
ARD *PMTotal			0.001			
ARD *PMDisperse			-0.002	**		
ARD *PMEmission			-25.529	***	-38.490	***
ARO	-0.444	***	-1.663	***	-1.078	**
ARO *Age			-0.005		-0.005	
ARO *Gender			-0.475	***	-0.390	***
ARO *Kids			0.051			
ARO *Education			0.432	***	0.397	***
ARO *Income			0.201	***	0.188	***
ARO *Fever			0.344			
ARO *Cold			-0.019			
ARO *Cough			-0.303		-0.290	*
ARO *Asthma			-1.068			
ARO *Outdoor			-0.026			
ARO *Smoke			0.401	**		
ARO *Distance			-0.036	***	-0.042	***

Continued overleaf

Continuation of Table 10.26

Variables	Model 1		Model 2		Model 3	
ARO *PMTotal			-0.001			
ARO *PMDisperse			0.000			
ARO *PMEmission			-21.301	**	-27.128	***
LL	-3,090.273		-2754.680		-2799.018	
AIC	2.394		2.171		2.186	
BIC	2.412		2.293		2.251	
Chi-squared	839.764		1510.950		1422.274	
Probability chi-squared	0.000		0.000		0.000	
Rho-squared	0.120		0.215		0.203	

Note: significant at 10% (*), 5% (**) and 1% (***)

Table A-2 Estimation results for RPL Model

Variables	Model 4				Model 5			
	Coefficient		Standard deviation		Coefficient		Standard deviation	
Illness	-0.247	***	0.290	**	-0.247	***	0.324	***
Visibility	0.002				0.002			
Odour1	-0.451	***	0.595	***	-0.436	***	0.651	***
Odour2	-0.041				-0.037			
Cost	-0.003	***			-0.003	***		
ATS	-1.064	**			-0.868	*		
ATS*Age	-0.019	***			-0.018	***		
ATS*Gender	-0.402	**						
ATS*Kids	0.095	*						
ATS*Education	0.499	***			0.472	***		
ATS*Income	0.267	***			0.268	***		
ATS*Fever	0.228							
ATS*Cold	0.307							
ATS*Cough	-0.567	**			-0.393	**		
ATS*Asthma	-0.636							
ATS*Outdoor	-0.057	**						
ATS*Smoke	0.458	***						
ATS*Distance	-0.035	***			-0.042	***		
ATS*PMTotal	-0.001							
ATS*PMDisperse	-0.001							
ATS*PMEmission	-15.100				-25.880	***		
ARD	-0.877	*			-0.894	*		
ARD *Age	-0.022	***			-0.020	***		
ARD *Gender	-0.563	***			-0.612	***		
ARD *Kids	0.051							
ARD *Education	0.531	***			0.513	***		
ARD *Income	0.264	***			0.271	***		
ARD *Fever	0.130							
ARD *Cold	0.111							
ARD *Cough	-0.573	**			-0.517	***		
ARD *Asthma	0.839							
ARD *Outdoor	-0.046	*						
ARD *Smoke	0.239							
ARD *Distance	-0.037	***			-0.043	***		
ARD *PMTotal	0.000							

Continued overleaf

Continuation of Table 10.28

Variables	Model 4				Model 5			
	Coefficient		Standard deviation		Coefficient		Standard deviation	
ARD *PMDisperse	-0.003	**						
ARD *PMEmission	-28.941	***			-44.344	***		
ARO	-1.274	**			-0.940	*		
ARO *Age	-0.006				-0.007			
ARO *Gender	-0.515	**			-0.430	***		
ARO *Kids	0.043							
ARO *Education	0.466	***			0.447	***		
ARO *Income	0.241	***			0.229	***		
ARO *Fever	0.384							
ARO *Cold	-0.034							
ARO *Cough	-0.323				-0.327	*		
ARO *Asthma	-1.323							
ARO *Outdoor	-0.029							
ARO *Smoke	0.434	**						
ARO *Distance	-0.042	***			-0.050	***		
ARO *PMTotal	-0.002							
ARO *PMDisperse	0.001							
ARO *PMEmission	-25.400	**			-32.428	***		
LL function	-2751.400				-2791.552			
Restricted LL	-3587.730				-3587.730			
Rho-squared	0.233				0.222			
Chi-squared	1672.660				1592.356			
Prob chi-squared	0.000				0.000			
AIC	2.160				2.181			
BIC	2.290				2.251			

Note: significant at 10% (*), 5% (**) and 1% (***)

APPENDIX B: Questionnaire (Please do not distribute)

FIELD: QUESTIONNAIRE NO.					PROJECT: CLEAN AIR 2008	DP: QUESTIONNAIRE NO.				PSU NO.		

Respondent's name:		
Respondent's address:	RT:	RW:
Kelurahan:	*Kecamatan*:	
Phone Home: Cell:	No of observers :	
Interviewer's name:	Begin:	End:
Date of interview :	Supervisor:	

BLOCKS ROTATION	
BLOK 1	1
BLOK 2	2
BLOK 3	3
BLOK 4	4
BLOK 5	5
BLOK 6	6

GROUPS ROTATION	
GROUP 1	1
GROUP 2	2

SES (please circle)				
1	2	3	4	5
6	7	8	9	10

CITIES	
Jakarta	1
Bogor	2
Depok	3
Tangerang	4
Bekasi	5

INTERVIEWER: ASK TO MEET DECISION MAKER IN THE FAMILY AND **READ**:
Good morning/afternoon/night, my name is _______________ from PT. IMIC, a survey company in Jakarta. Would you please help by answering some questions about the effect of vehicles on air quality in JMA. In this interview we will ask your opinion and experience. There are no right and wrong answers. This interview is confidential, your identity such as name and address will not be related to your answer. It should take about 30 minutes of your time.

Do you agree to participate? IF AGREE, **CONTINUE TO S0**
IF REFUSE:
1. OFFER THEM ANOTHER TIME TO MEET
2. TAKE NOTE FOR THE PROPOSED MEETING TIME
3. SAY THANK YOU

S0 Please refer to CARD 1. Which of the following statement that closely describe your role to decide your family spending?

I decide it by myself	1	CONTINUE INTERVIEW
I decide it with one or other family member	2	
I do not involve in decision making process	3	TERMINATE INTERVIEW AND ASK TO MEET DECISION MAKER AND **REPEAT S0**

This survey is for student assignment. The University asks that every information are given voluntarily. Would you please sign the consent form? And please receive this information sheet. This is important if you need further information about this survey.

INTERVIEWER: CHECK				
Consent form, signed	yes	1	no	2
Information sheet, delivered	yes	1	no	2

INTERVIEWER: DO NOT CONTINUE THE INTERVIEW IF THE RESPONDENT HAS NOT SIGNED CONSENT FORM

INTERVIEWER: READ
Please remember that this interview would only ask your opinion and your experience. There are no right or wrong answers.

S1 Would you please tell me which of the following categories your age group is?

Below 20 thn	1	TERMINATE INTERVIEW
20-25 tahun	2	CONTINUE
26-30 tahun	3	
31-35 tahun	4	
36-40 tahun	5	
41-45 tahun	6	
46-55 tahun	7	
56-65 tahun	8	
Diatas 66 thn	9	TERMINATE INTERVIEW

S2 Would you please tell me all family members living in this address?

No	Family member	Gender		Age
		M	F	
1	Respondent	1	0	thn
2		1	0	thn
3		1	0	thn
4		1	0	thn
5		1	0	thn
6		1	0	thn
7		1	0	thn
	Number of children			orang
	Total number of family member			orang

PART 1 : IMPACT OF AIR POLLUTION

Q1 Have you heard or read information about air pollution in the Jakarta Metropolitan Area? **[S]**

Yes	1
No	0

INTERVIEWER: PRESENT **CARD 1** AND **READ**:
Now I will read you the information about problems associated with air pollution.

1. Air pollution in the form of ash can cause fever, cough, cold and asthma. 2004 survey reveals that people who report they are ill with fever, cough, cold and asthma cannot go to work or to school or doing their social activities for approximately 4 days per month

2. Air pollution in the form of smoke and ash can cause reduction of visibility. On average, current daylight visibility in Jakarta Metropolitan Area is approximately 10 kilometres.

3. Air pollution in the form of vehicle smoke can cause disturbing odour. Undesirable smell caused by transportation sector occur everyday caused by diesel machines such as trucks and buses, two stroke machines such as bajaj and some of the motorcycles as well as old vehicles.

Q2 Is your understanding of air pollution impacts similar with impacts in **CARD 1**? **[S]**

	ILLNESS	VISIBILITY	ODOUR
Yes	1	1	1
No	0	0	0

Q3 Please rank impacts from the most important to the least.

AIR POLLUTION IMPACT	RANK
Illness	
Visibility	
Odour	

PART 2: POLICIES TO REDUCE AIR POLLUTION

INTERVIEWER: PRESENT **CARD 2** AND **READ**:

One of the main sources of air pollution in the JMA is transportation sector.
POINT AT **PICTURE 1**. Currently, public transportation cannot accommodate JMA citizens' daily activities. People tend to use their private vehicle to transport them to school or work. Also, numbers of old vehicles operating in the street are high contributing to higher pollution. There are at least three alternatives to reduce air pollution from the transportation sector in JMA:

POINT AT **PICTURE 2**: **Improvement of public transport facilities** such as building bus corridors, monorails, light rails, providing pedestrian walking path and bike lanes

POINT AT **PICTURE 3**: **Restriction of vehicle number in busy areas** by raising parking fee and collecting entry fee to busy areas.

POINT AT **PICTURE 4**: **Reduction of old cars and motorcycles** by raising registration fees for old cars and motorcycles.

These policies would improve the JMA's air quality but their implementation would be expensive. Money to pay for the policies could come from the JMA's citizens in the form of: increased land and property taxes, higher vehicle tax and entry fee to busy areas as well as higher parking fee in busy areas. In return, the JMA citizens will experience lower pollution from the transportation sector.

INTERVIEWER, **CIRCLE ROTATION** AND **READ:**

ROTATION	STATEMENT
1	GRUP 1: without statement
2	GRUP 2: The program to be implemented by the local government and the amount of payment from your household will depend on the most popular program chosen by JMA citizens.

PART 3: MAIN QUESTIONNAIRE

INTERVIEWER, **READ**:

Now I will show you cards showing alternative choices to reduce air pollution from the transportation sector. You will be asked to choose an alternative. Please choose the one suited your condition. Every card is different because all options, except the 'no change' option, are different. This is because there are many possible mixtures of conditions. When deciding the options you prefer, keep in mind:

1. Your available income and all other things you have to spend money on.
2. Payment will be mad each year for three years starting 2010 to 2012.
3. Your answers are important to decide the way to improve air quality in the JMA.
4. Each question should be considered independently.

INTERVIEWER, PRESENT **CARD 3, READ AND POINT AT EACH SECTION**
This card consist of 4 options (POINT AT **COLUMNS**)

- Option 1: current condition:' no change'
- Option 2: improvement of public transport facilities
- Option 3: restriction of vehicle number in busy areas
- Option 4: reduction of old cars and motorcycles

Every options will be described in terms of their outcomes: (POINT AT **ROWS**):

- Condition 1: number of average sick leave day
- Condition 2: length of visibility range in day time
- Condition 3: odour from transportation sector
- Condition 4: cost to you in the form of additional fees or taxes

INTERVIEWER: PREPARE CARDS ACCORDING TO BLOCK ROTATION, **CIRCLE THE BLOCK**: 1 2 3 4 5 6

Q4 Consider each of the following four options in **CARD 4** to improve air quality in JMA. Suppose the four options in the table below are the only ones available, which one would you choose? Keep in mind that you should always consider the condition you want and your available income.

CARD 4	No change	Improvement of public transport facilities	Restriction of vehicle number in busy areas	Reduction of old cars and motorcycles
Option	1	2	3	4

INTERVIEWER: PRESENT **CARD 5** AND **READ**:
Now I will show you another card. The columns and the rows are the same with the previous one, but the conditions are different except for the first option. You don't need to consider your last choice, please consider only condition in this card.

Q5 Consider each of the four following options, which one would you choose?

CARD 5	No change	Improvement of public transport facilities	Restriction of vehicle number in busy areas	Reduction of old cars and motorcycles
Option	1	2	3	4

INTERVIEWER: PRESENT **CARD 6** AND **READ**:
Now I will show you another card. The columns and the rows are the same with the previous one, but the conditions are different except for the first option. You don't need to consider your last choice, please consider only condition in this card.

Q6 Consider each of the four following options, which one would you choose?

CARD 6	No change	Improvement of public transport facilities	Restriction of vehicle number in busy areas	Reduction of old cars and motorcycles
Option	1	2	3	4

INTERVIEWER: PRESENT **CARD 7** AND **READ**:
Now I will show you another card. The columns and the rows are the same with the previous one, but the conditions are different except for the first option. You don't need to consider your last choice, please consider only condition in this card.

Q7 Consider each of the four following options, which one would you choose?

CARD 7	No change	Improvement of public transport facilities	Restriction of vehicle number in busy areas	Reduction of old cars and motorcycles
Option	1	2	3	4

Q8 Is there any other way to get payment from the citizens?

INTERVIEWER: COUNT HOW MANY TIMES OPTION 1 IS CHOSEN FROM Q4 TO Q6
Option 1 is chosen **1, 2, 3** timeS → **CIRLE -999 di Q9, PROCEED TO PART 4**
Option 1 is chosen **4** times → **ASK Q9**

Q9 I see that you always choose Option 1, which of the following reason closely relate to your motivation?

Did not know which option was the best	1
Cannot afford the cost	2
I did not trust government will use the money to improve air quality in the JMA	3
Not answering Q9	-999

PART 4: VALIDATION

V1 Did you understand the information about air pollution impacts and ways to solve the problem?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

V2 Did you need more information than was provided?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

V3 Did you find answering the choice set questions confusing?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

V4 Was the information in the questionnaire biased in favour of air quality improvement?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

V5 If there is a conflict between development and environmental conservation, do you:

Favour development	1
Favour environmental conservation	2
Favour both equally	3

INTERVIEWER: **FILL UP** ACCORDING TO YOUR OBSERVATION

V6 Does the respondent understand the questionnaire content?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

V7 Which of the following statement match the respondent's effort in choosing the options?

Considering with efforts	1
Considering without efforts	2
Considering, looks confused	3
Not considering, choosing at random	4

PART 5: HEALTH CONDITION

INTERVIEWER: **TRANSFER** S2 DATA TO BOTH TABLES BELOW

K1 Did you and/or other member of the family have health complaint during the previous month caused by fever, cough, cold or asthma? Who was ill? What kind of illness? **[M]**

Ill → K2
Not ill → K4

K2 If you and/or other family member have health complaint, did it disrupt your work, school, or daily activity? **[M]**

Yes → K3
No → K4

K3 How many days was the duration of disrupted activities?

K4 Could you please estimate number of hours you spent outdoor per day? **[M]**

K5 Do you and/or other member of the family smoke? **[M]**

No	Family member	K1								K2							
		Fever		Cold		Cough		Asthma		Fever		Cold		Cough		Asthma	
		Y	T	Y	T	Y	T	Y	T	Y	T	Y	T	Y	T	Y	T
1	Respondent	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
2		1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
3		1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
4		1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
5		1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
6		1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
7		1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0

No	Anggota keluarga	K3				K4	K5	
		Fever	Cold	Cough	Asthma		Y	T
1	Respondent	day	day	day	day	hour	1	0
2		day	day	day	day	hour	1	0
3		day	day	day	day	hour	1	0
4		day	day	day	day	hour	1	0
5		day	day	day	day	hour	1	0
6		day	day	day	day	hour	1	0
7		day	day	day	day	hour	1	0

PART 6: DEMOGRAPHY

S6 What is the highest level of education you have obtained? **SA**

Never went to school	1
SD (not completed)	2
SD (completed)	3
SMP	4
SMA	5
Diploma	6
Bachelor	7
Postgraduate	8

INTERVIEWER: PRESENT **CARD 8**

S7 Which of the following categories does your total household expenditure per month in the last three months? Please consider all expenditures including food, electricity, water, telephone, gas, transport, helper's wage and children pocket money.

S8 Which of the following categories does your total household income per month? (salary, small business and other type of earnings).

	S7	S8
Below Rp 250,000	1	1
Rp 250,001 – Rp 600,000	2	2
Rp 600,001 – Rp 900,000	3	3
Rp 900,001 – Rp 1,250,000	4	4
Rp 1,250,001 – Rp 1,750,000	5	5
Rp 1,750,001 – Rp 2,500,000	6	6
Rp 2,500,001 – Rp 3,500,000	7	7
Rp 3,500,001 – Rp 5,000,000	8	8
Rp 5,000,001 – Rp 7,500,000	9	9
Above Rp 7,500,001	10	10

INTERVIEWER: END OF INTERVIEW, SAY **THANK YOU** TO THE RESPONDENT

INTERVIEWER	SUPERVISOR
I hereby certify that this questionnaire is filled up with the respondent's responses on all questions and that the interview was conducted in accordance with the instruction given in the briefing.	I hereby certify that I checked all answers to this questionnaire and that this questionnaire has been filled up according to the instruction given in the briefing.
____________________ ____________ Signature Date	____________________ ____________ Signature Date

APPENDIX C: Show cards for Block 1 (Please do not distribute)

Card 0

I decide it by myself	1	CONTINUE INTERVIEW
I decide it with one or other family member	2	
I do not involve in decision making process	3	TERMINATE INTERVIEW AND ASK TO MEET DECISION MAKER AND **REPEAT S0**

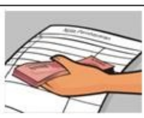
Card 1

Health problems	Visibility	Smell from cars and motorcycles smoke
		
Fever, cough, cold and asthma. 2004 Survey data shows that people who suffer fever, cough, cold and asthma could not go to work or to school for approximately 4 days per month.	Reduction of visibility range caused by smoke and dust. Current daylight visibility in the Jakarta Metropolitan Area is approximately 10 kilometres.	Diesel engines, two stroke engines and old cars and motorcycles produce disturbing smells.

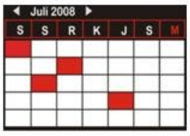
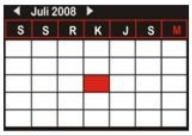
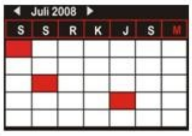
Card 2

Current condition	Improved public transport facilities
	
Restriction of vehicle number in busy areas	**Reduction of old cars and motorcycles**
	

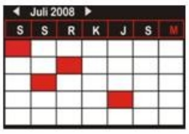
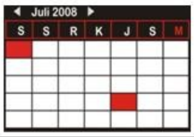
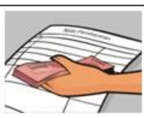
Card 3

Policies	Current condition	Improved public transport facilities	Restriction of vehicle numbers in busy areas	Reduction of old cars and motorcycles
Code	1	2	3	4
Health problems 				
Visibility 				
Smell from cars and motorcycle smoke 				
Cost per year 				

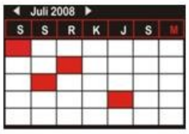
Block 1
Card 4

Policies		Current condition	Improved public transport facilities	Restriction of vehicle numbers in busy areas	Reduction of old cars and motorcycles
Code		1	2	3	4
Health problems					
		4 days per month	3 days per month	1 day per month	3 days per month
Visibility					
		10 kilometres	50 kilometres	30 kilometres	50 kilometres
Smell from cars and motorcycle smoke					
		Very disturbing	Slightly disturbing	Disturbing	Disturbing
Cost per year		Rp 0	Rp 500.000	Rp 900.000	Rp 500.000

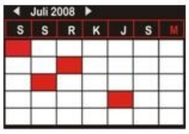
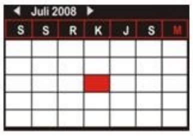
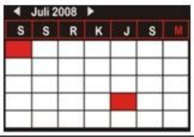
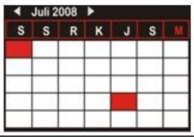
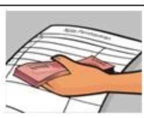
Block 1
Card 5

Policies		Current condition	Improved public transport facilities	Restriction of vehicle numbers in busy areas	Reduction of old cars and motorcycles
Code		1	2	3	4
Health problems					
		4 days per month	1 day per month	2 days per month	2 days per month
Visibility					
		10 kilometres	30 kilometres	50 kilometres	50 kilometres
Smell from cars and motorcycle smoke					
		Very disturbing	Disturbing	Slightly disturbing	Disturbing
Cost per year		Rp 0	Rp 500.000	Rp 500.000	Rp 100.000

Block 1
Card 6

Policies		Current condition	Improved public transport facilities	Restriction of vehicle numbers in busy areas	Reduction of old cars and motorcycles
Code		1	2	3	4
Health problems		 4 days per month	 3 days per month	 2 days per month	 3 days per month
Visibility		 10 kilometres	 50 kilometres	 50 kilometres	 50 kilometres
Smell from cars and motorcycle smoke		 Very disturbing	 Slightly disturbing	 Disturbing	 Disturbing
Cost per year		Rp 0	Rp 900,000	Rp 500,000	Rp 900,000

Block 1
Card 7

Policies		Current condition	Improved public transport facilities	Restriction of vehicle numbers in busy areas	Reduction of old cars and motorcycles
Code		1	2	3	4
Health problems		 4 days per month	 1 day per month	 2 days per month	 3 days per month
Visibility		 10 kilometres	 70 kilometres	 70 kilometres	 30 kilometres
Smell from cars and motorcycle smoke		 Very disturbing	 Slightly disturbing	 Slightly disturbing	 Disturbing
Cost per year		Rp 0	Rp 900.000	Rp 900.000	Rp 500.000

Card 8

	S7	S8
Below Rp 250,000	1	1
Rp 250,001 – Rp 600,000	2	2
Rp 600,001 – Rp 900,000	3	3
Rp 900,001 – Rp 1,250,000	4	4
Rp 1,250,001 – Rp 1,750,000	5	5
Rp 1,750,001 – Rp 2,500,000	6	6
Rp 2,500,001 – Rp 3,500,000	7	7
Rp 3,500,001 – Rp 5,000,000	8	8
Rp 5,000,001 – Rp 7,500,000	9	9
Above Rp 7,500,001	10	10

APPENDIX D: Show cards for focus group discussion

Health problems	Visibility	Vehicle's smoke smell
		
Fever, cough and cold. In 2004, number of sick leave days caused by air pollution was approximately 4 per month per unwell person.	Current daylight visibility range in Jakarta Metropolitan Area is approximately 10 kilometres.	Produced by diesel machines such as trucks and buses, two stroke machines such as bajaj and some of the motorcycles as well as old vehicles.

Figure D-1 Problem Description

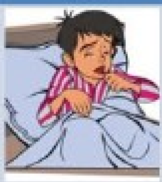
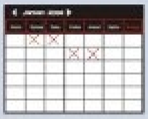
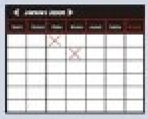
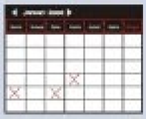
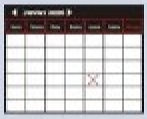
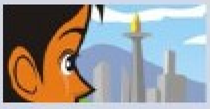
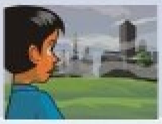
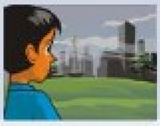
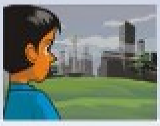
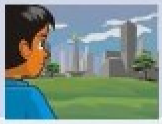
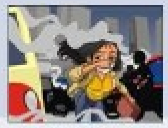
			New policies		
		No new policy	Improved public transport facilities	Restriction of vehicle number in busy areas	Reduced number of old vehicle
Illness		 4 days per month	 2 days per month	 3 days per month	 1 days per month
Visibility		 10 km	 30 km	 30 km	 50 km
Smell		 Very disturbing	 Not disturbing	 Not disturbing	 Disturbing
Cost		0	50.000	25.000	75.000

Figure D-2 Choice Sets