Social Interaction and Public Goods Provision: A Case of Waste Management in Bandung, Indonesia

Martin Daniel Siyaranamual
(Center for Economics and Development Studies CEDS)

May, 2013
Social Interaction and Public Goods Provision: A Case of Waste Management in Bandung, Indonesia*

Martin Daniel Siyaranamual†
Advanced School of Economics, Ca’ Foscari University of Venice
Center of Economics and Development Studies, Padjadjaran University
May 2013

Abstract. Successful minimisation of the gap between hypothetical and actual behaviours requires to consider the dimension of individual social interaction in the decision process. While this dimension has been acknowledged to play an important role in the construction of private good preferences, however, in the context of public good, the role of social interaction has not been adequately examined. Therefore, to shed a light on the role of social interaction in shaping preferences toward public good, I conduct a contingent valuation (CV) study in which the respondents are enabled to have social interactions prior their willingness to pay (WTP) elicitation question. And in order to do this, I construct a sampling design where respondents are divided into three different groups, namely treated, untreated, and control groups. The respondents in the treated and untreated groups were allowed to interact/discuss with each other, within and across groups, prior to the WTP elicitation question. I find that treated and untreated respondents with social interactions have higher and significant likelihood to purchase the public good relatively to control respondents. While those who did not have interaction have a lower WTP for the improvement of waste management.

Keywords: Social interactions; Contingent valuation; Bandung; Solid waste management.

JEL: Q51, R11, R22

---

*This research is part of the author doctoral dissertation under supervision of Michele Bernasconi and was supported by EEPSEA (Economy and Environment Program for Southeast Asia) Doctoral Fieldwork. The opinions expressed in this article are solely those of the author.
†e-mail: siyaranamual.martin@fe.unpad.ac.id
1 Introduction

The present article aims to investigate the role of social interaction on respondents’ willingness to pay (WTP) for a proposed improvement in urban solid waste management (SWM). The empirical study was conducted in Bandung, Indonesia. To elicit respondents’ WTP, I used a contingent valuation method (CVM), a method that is widely used to construct consumers’ preferences toward public or quasi-public goods/services, by asking people to directly report their willingness to pay (WTP) to obtain a specified good, or willingness to accept (WTA) to give up a good, rather than inferring them from observed behaviours in regular market places. In other words, CVM circumvents the absence of markets for public goods by presenting consumers with hypothetical markets in which they have the opportunity to buy the good in question. Although CVM is widely used to construct preferences toward public good, nonetheless since CVM relies on hypothetical behaviours in hypothetical marketplaces where there is no actual transactions are made, many economists regard the preferences from CV studies with scepticisms, for example Diamond and Hausman [1994] conclude that CVM does not measure the preferences they attempt to measure because of the non-existence of people preferences for the public good in question and from the failure of respondents to consider the effect of their budget constraints.

By integrating the role of social interaction in WTP responses, my study brings a novel routine to minimise the gap between actual and hypothetical behaviours. This seems entirely plausible that to make informed choices, people often consult with their social ties for information gathering or conforming what they think with social norms, especially when they are not familiar with the condition they are confronted. And since one is not often asked a WTP elicitation question in everyday life, hence a standard assumption of CV studies that says respondents can provide a rapid answer to this type of question may create the gap between actual and hypothetical behaviours. The routine that I propose here is based on routine that has been employed in the CV studies, namely, time to think feature. Using this feature, the respondents are divided into treatment and control group. For the control group, the respondents follow a standard CV survey, meaning that the respondents answer directly the WTP elicitation question. While for the respondents in the treatment group, they are given time to think (usually over a night) about the answer that they will give for the WTP elicitation question. Some recent studies that employ this feature are Cook et al. [2007], Lucas et al. [2007], Islam et al. [2008], and Whittington et al. [2009].

1Beside CVM, there is a relatively new valuation method for non-market benefits, known as choice experiment (CE). Unlike CVM, the choice experiment method allows the identification of the trade-offs that each individual makes between attributes of a specific public good or service.
Unlike those recent studies, the respondents in my study were divided into three different groups, namely treated, untreated and control respondents (I provide a detailed explanation in the methodological section). The respondents who were categorised as the treated respondents were asked to think about the current condition of SWM in Bandung and the hypothetical solution that I proposed, and the possible amount of money that they are willing to pay as their contribution for the hypothetical solution. There are two aspects that are significantly different from the time to think feature. First, while the normal time to think is usually one night, here, the treated respondents had 4-6 days time to think. Second, instead of thinking about the answer for the WTP elicitation question, I was asking them to think about the problem, the hypothetical solution and the possible amount of money as contribution. Moreover, I was telling them that they are allowed to discuss this matter with their family members or friends. The respondents who were categorised as untreated respondents were following a standard CV survey, however, these respondents had one distinguished feature compared to the control respondents, they were neighbours of treated respondents. By allowing the treated and untreated respondents to be neighbours, I was expecting that there will be social interactions among themselves that in the end will shape their preferences toward public good provision. My expectation is a fair expectation since Bandung has already experienced the negative impacts of ill-managed municipal SMW (the detail explanation is provided in the Section 3). The last category, the control respondents, they followed a standard CV survey similar to the recent studies from the previous paragraph. The way I split my respondents is inspired by the study of Duflo and Saez [2003, 2004].

Recently, there has been a growth of field experimental literature that tries to measure the effect of social interaction. Examples in this literature include Miguel and Kremer [2003]. They analyse an experimental design to evaluate own and external effects of a medical treatment against intestinal worms for children in schools in Kenya, and obtain evidence of spillover effects. They show that children in treated schools who did not get the medicine were positively affected. However, in their case, variation in treatment status within a school was not randomised but occurred because some children were not present on treatment day. Katz et al. [2001] use random assignment to a housing voucher program for households living in high poverty public housing projects in the Boston area and find improvement of treated families in safety, health, and exposure to crime. Sacerdote [2001] uses random assignment of first-year students in Dartmouth college dorms and finds peer effects strongly influence levels of academic effort as well as decisions to join social groups. Duflo and Saez [2003, 2004] randomised the members of the departments who receive encouragement invitation to join pension and welfare presentations. They find that those who received encouragement have higher probability
to join pension and welfare plan (treated sample) relatively to those who did not receive the encouragement. Moreover, those who did not receive the encouragement but belong to the same department as those who received the encouragement (untreated sample) have a higher probability to join the pension and welfare plans relatively to those who belong to the department when none of them received the encouragement invitation (control sample). The Katz et al. [2001] and Sacerdote [2001] studies on social interactions differ from Duflo and Saez [2003, 2004] and mine as well, mainly because they study the effect of assigning individuals to different peer groups, whereas in our studies, peer groups are fixed, and we analyse how individual decisions are affected by an exogenous change on the information set of some members of the peer group.

Beside proposing a novel routine to minimise the gap between actual and hypothetical behaviours, my study also has an implication on public policy regarding urban SWM in the developing countries, particularly in Bandung. Understanding and evaluating the attitudes and opinions of Bandung residents toward the issues surrounding the SWM and the economic valuation of the perceived benefits of improvements in SWM are crucial in determining the desirability and the feasibility of adopting the proposed program. In urban areas, especially in the rapidly urbanizing cities of the developing world, problems and issues of SWM are of immediate importance. Most municipal governments have acknowledged the importance of solid waste issue, however rapid population growth overwhelms the capacity of most municipal authorities to provide even the most basic services. Moreover, most of SWM are often under-priced or non-priced due to public good characteristics that are inhibited in the SWM, therefore it is difficult to infer the economic benefits of improving SWM, even though the generation of solid waste could pose serious threats to environment and public health.

The valuation studies on solid waste services could be categorised into two groups based on where the study took place. In the first group are studies that were conducted in developed countries where solid waste management is relatively well established, hence these studies focus more on the benefits of introducing new SWM approaches, such as kerbside/drop-off recycling, composting and incineration, which aim to reduce landfill. While the other group is the studies that were conducted in the developing countries where the adequate solid waste management is relatively have been neglected, thus these studies focus more on the benefits of providing/improving the basic or traditional solid waste disposal methods such as collection, transportation and landfills with better pollution control measures.

From the previous SWM valuation studies, generally, people in developing countries are willing to pay for SWM programs, and the requirements for improvement in SWM services are very often placed ahead of other major social concerns such as improvements
in water and sewer services, housing, indoor air pollution and insect pests, etc. [Altaf and Deshazo, 1996, Othman, 2002, Osumanu, 2008]. Moreover, Altaf and Deshazo [1996] also found that the WTP value increases in general with income and education level. Beside income and education level, there are some other factors that also influence significantly on the WTP decision. Huang and Ho [2005], Ichoku et al. [2009] report that awareness about the seriousness of solid waste related problems has positive impact on the demand to improved SWM. Beside that, Afroz et al. [2009], past positive experience in receiving the SWM services and trust in the proposed project also influence positively on respondents’ WTP. This suggests that SWM service is a normal economic good. Female respondents have a general tendency to be willing to pay more than the male respondents [Fonta et al., 2008, Ichoku et al., 2009].

Although people from developing countries rank improper solid waste disposal as the top environmental problem, the user fee that they are willing to pay can only partially cover the cost of the service. Bluffstone and Deshazo [2003] concluded that the WTP for upgraded landfills covers only about 80-90% of the cost for a project in Lithuania to upgrade their SWM system to European level. Naz and Naz [2008] found the ratio of WTP over the total cost to be only 22-35% in the Philippines. Palatnik et al. [2005] also mentioned the necessity of subsidy to achieve an efficient level of recycling for the case of Israel. A general impression is that the WTP for the improvements in SWM do not occupy an important share in household income, since it only counts 0.1-0.9% of household income.

The paper is organized as follows. The next section, I discuss my research methodology, in which I start form the discussion on my CV questionnaire, followed by the sampling strategy, then completed by the discussion on the estimation method. In Section 3, I provide a brief explanation about the current condition of SWM in Bandung. Section 4 is the result section of my study and started with the descriptive statistics of the respondents, which includes socio-economics characteristics, attitudes and awareness toward SWM issues. Then followed by household demand estimation for improved SWM. The final section concludes.

**Theoretical background.** The main objective of a CV study is typically to obtain an accurate estimate of the benefits of a change in the level of provision of a public good. And depending on the nature of the public good being discussed, the new level can be interpreted as quality or quantity. Then the estimated benefits obtained can be used in a benefit-cost analysis. In order to obtain meaningful estimated benefits, the CV study must meet not only its methodological imperatives, but also the requirements of economic theory. Based on microeconomic theory, consumer benefits can be measured
by Marshallian consumer surplus or Hicksian consumer surplus. For the CV studies, the benefits are measured by the Hicksian consumer surplus, since the Marshallian consumer surplus varies as price or quantity changes.\(^2\)

Let \(V(Y, P, X, g)\) be a representative household’s indirect utility function, with \(Y\) as the income, \(P\) is a price vector of other goods, \(X\) denotes the vector of socio-economic characteristics that might influence the household’s ability to pay or constrain its behaviour, and \(g\) as the characteristic of the commodity of the interest, or in this case the improvement of the SWM. The household’s WTP for the improvement of the SWM is defined as the following:

\[
V(Y_0 - \text{WTP}, P_0, X_0, g_1) = V(Y_0, P_0, X_0, g_0)
\]

\(\text{(1)}\)

Where the subscript 0 and 1 indicate the old and new conditions respectively. The equation above implies that WTP will be a function of the proposed change in \(g\) as well as the other factors hypothesised to influence a household’s value for a change in \(g\),

\[
\text{WTP} = f(g_1, g_0, Y_0, P_0, X_0)
\]

\(\text{(2)}\)

Clearly that WTP Calculation uses estimated parameters depends on the covariates chosen, and is also a function of the random component assumed for preferences. In general, willingness to pay is the amount of money that makes the respondent indifferent between the status quo and the proposed CV scenario.

Since my sampling strategy as well as my social interaction question are used to measure the possible variation of households’ WTP based on the characteristics in which they are belonging. Therefore, if there is no statistical difference of the independent variables, used in the equation above, across groups, then the variation of households’ WTP must be explained by either the sampling strategy or the social interaction. Hence I can define the WTP based on the sampling strategy like the following,

\[
\text{WTP}_\text{treated} = f(g_1, g_0, Y_0, P_0, X_0, t)
\]

\(\text{(3)}\)

\[
\text{WTP}_\text{untreated} = f(g_1, g_0, Y_0, P_0, X_0, n)
\]

\[
\text{WTP}_\text{control} = f(g_1, g_0, Y_0, P_0, X_0)
\]

where \(t\) and \(n\) denote the characteristic of treated and untreated groups respectively.

I can also define the WTP based on the sampling strategy and the social interaction

---

\(^2\)The microeconomics textbook by Mas-Colell et al. [1995] provides a detailed explanation on measuring consumer benefits using Marshallian and Hicksian consumer surplus
simultaneously.

\[
\begin{align*}
    WTP_{treated}^{SI} &= f(g_1, g_0, Y_0, P_0, X_0, t, \iota) \\
    WTP_{treated} &= f(g_1, g_0, Y_0, P_0, X_0, t) \\
    WTP_{untreated}^{SI} &= f(g_1, g_0, Y_0, P_0, X_0, n, \iota) \\
    WTP_{untreated} &= f(g_1, g_0, Y_0, P_0, X_0, n) \\
    WTP_{control} &= f(g_1, g_0, Y_0, P_0, X_0)
\end{align*}
\] (4)

The superscript \(SI\) indicates that the household had social interaction prior the WTP elicitation question and \(\iota\) denotes the social interaction. The Equation 3 and Equation 4 will be a guidance on the building of my parametric estimation.

2 The Research Methodology

Prior to the survey, I conducted several activities that provided important inputs in the formulation of the CV questionnaire. The First activity was meeting with stakeholders. From government agencies, there were PD. Kebersihan, a municipal-owned company that responsible on waste management in Bandung and BAPPEDAL, the government body which in charge on environmental issues on the city level. Beside government agencies, there were two environmental non-governmental organizations (NGOs) that joined the meetings, Greeneration Indonesia and WALHI. This meeting was conducted on June 3rd 2011. Following the meeting was a focus group discussion (FGD) on June 10th 2011. Then, using the information that I obtained from the meeting and the FGD, I conducted a pre-test survey, using 100 samples (conducted between June 20th - 23rd 2011).

The actual survey was conducted from July 1st to September 30th, 2011 with 3 weeks break from July 24th to August 15th, 2011 due to the Moslem fasting period and the celebration following it. During the break period, I found that there was no major even that might change the respondents interviewed after the break period. Moreover, the break was started after I had finished interviewed all respondent within one neighbourhood, in order to avoid the information spillover from one household to another. For the pre-test and actual surveys, I employed 20 enumerators. These enumerators were final year undergraduate students from Department of Economics, Padjadjaran University, who received a short training on how to conduct this CV survey. The training was conducted on June 17th and 30th 2011.
2.1 CV Questionnaire

The contingent valuation method uses survey questions to elicit individuals’ preferences for non-market goods. The essential task of a contingent valuation exercise is to design a questionnaire which elicits respondents’ preference for the good being valued. In this study, the questionnaire consists four parts:

1. Questions about respondents socio-economic characteristics and other factors that might influence their preferences toward the improvement of SWM.
2. A detailed description of SWM in Bandung and the hypothetical circumstance under which it is made available to the respondent.
3. Questions that elicit the respondents’ WTP for improving the quality of SWM.
4. Questions about respondent’s social interaction.

The first three parts are following the construction that Mitchell and Carson [1989] propose. To be precise, in the first part, socio-economic and others interested information questions are placed, such as sex, marital status, occupation, level of education, community involvement, household size, and household monthly income. The second part begins with the purpose of this research and an explanation of the task and statement that respondents’ opinions will be used as inputs for policy determination. Afterwards, respondents are provided with a brief outline of the solid waste problem in Bandung and the consequences thereof. A solution to this problem, MaSUK RT program, will be then described. A justification for collecting funds through a referendum will also be provided, with neighbourhood contribution as a payment vehicle. To provide balance to the information provided earlier, the respondents will also be given reasons why they might not want to donate and will be reminded of their budget constraint. After the respondents have understood about the second part, then the enumerators elicit the respondents’ WTP. For the elicitation question format, I use the dichotomous choice as presented in the Box 1.\(^3\)

\(^3\)Note that the respondents already explained about respondents’ selection process, confidentiality of responses and time commitment to finalise the questionnaire, before the interview was started.
Box 1: Dichotomous Elicitation Question Used in The Questionnaire

13. Proposal: Bandung Municipality residents will contribute Rp. X for the improvement of municipal solid waste management under MaSUK RT program. This contribution will be levied on monthly neighbourhood association solid waste retribution.

- I would vote YES to the MaSUK RT program with a fee of Rp. X would be added on my monthly neighbourhood association solid waste retribution.
- I support the MaSUK RT program and the use of a fee on my monthly neighbourhood association solid waste retribution but it is not worth Rp. X to me and thus I would vote NO.
- I support the MaSUK RT program and the use of a fee that would be added on my monthly neighbourhood association solid waste retribution but I cannot afford Rp. X and thus would vote NO.
- I support the MaSUK RT program with a fee of Rp. X that would be added on my monthly neighbourhood association solid waste retribution, but I would vote NO for the following reason:
  - The money is unlikely to be used as stated.
  - Not enough money will be mobilized.
  - I think it should be Bandung Municipality government that should finance the improvements of municipal solid waste management.
  - I do not trust that the government body who will administer the fund.
  - Others, please specify ____________________________
- I would vote NO to the MaSUK RT program even if there were no cost to my monthly household since its existence does not have any impact to my household.

In the dichotomous choice elicitation format, respondents are provided two alternatives with one alternative typically being the status quo, and asked to choose one of them. The dichotomous choice question has several advantages and is now the most commonly used elicitation format since it was popularized by Bishop and Heberlein [1979]. In particular, the take-it-or-leave-it question simplifies the respondents’ task by asking respondents to decide whether to vote for or against the proposal at the fixed price provided. More importantly, the dichotomous choice question circumvents the potential for strategic voting behaviour and is incentive compatible. Indeed, one of the core theoretical results in mechanism design, derived independently by Gibbard [1973] and Satterthwaite [1975], is that no response method involving more than two choices can be incentive compatible without restrictions on the agents’ preferences.

Beside dichotomous choice format, there are other elicitation formats that widely used. The earliest elicitation question used is an open-ended question where respondents are asked directly to state their WTP for a given public good. While straightforward,
respondents may find it difficult to answer an open-ended question for an environmental change they are not familiar with, and they may skip the valuation question or give unreliable answers. Therefore, the open-ended question often leads to a large number of non-responses and outliers [Desvousges et al. [1983] as found in the Mitchell and Carson [1989]]. Another alternative is the payment card format. In this elicitation format, respondents are provided a list of monetary amounts and are asked to choose the level of payment that most closely approximates their WTP [Mitchell and Carson, 1981, 1984]. This method reduces the number of non-responses and outliers. However, the payment card question is sensitive to biases relating to the range of the numbers listed on the payment card [Mitchell and Carson, 1989]. In addition to the potential biases embedded in the open-ended and payment card formats, a fundamental issue about respondents’ strategic behaviour exists in both elicitation formats Mitchell and Carson [1989].

Besides the three common parts, I also add social interaction part. In this part, I asked respondents to name 5 of their friends, with whom they usually spend their spare time together. The variable social interaction is drew from this part. I assume that the treated respondents have social interaction if, at least, one of her friends mentioned in this part belongs to the same neighbourhood like herself and had a discussion about solid waste management prior to the WTP elicitation question and must be as either treated or untreated respondent. Similarly to the untreated respondents, they are assumed to have social interaction if they can fulfil all the three requirements, with the exception on the third requirement, her friend must be a treated respondent only. Obviously, using this assumption, I cannot capture the friends-of-friends type of social interaction. The detail questions in this part is presented in Box 2.
## Box 2: Social Interaction Questions Used in The Questionnaire

<table>
<thead>
<tr>
<th>Question</th>
<th>Name 1</th>
<th>Name 2</th>
<th>Name 3</th>
<th>Name 4</th>
<th>Name 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Does he/she live within 1 kilometre from your house?</td>
<td>![Yes/No]</td>
<td>![Yes/No]</td>
<td>![Yes/No]</td>
<td>![Yes/No]</td>
<td>![Yes/No]</td>
</tr>
<tr>
<td>b. How long have been known each other?</td>
<td>![&lt; 1 year]</td>
<td>![1-2 years]</td>
<td>![&gt; 2 years]</td>
<td>![&lt; 1 year]</td>
<td>![1-2 years]</td>
</tr>
<tr>
<td>d. For the last 4-6 days, did you discuss the solid waste problem with he/she?</td>
<td>![No]</td>
<td>![Yes]</td>
<td>![No]</td>
<td>![No]</td>
<td>![No]</td>
</tr>
<tr>
<td>e. In a week, how many hours you usually spent to talk?</td>
<td>![&lt; 3 hours]</td>
<td>![3-5 hours]</td>
<td>![&gt; 5 hours]</td>
<td>![&lt; 3 hours]</td>
<td>![3-5 hours]</td>
</tr>
<tr>
<td>f. Do you usually talk to each other in a group or individually?</td>
<td>![Individually]</td>
<td>![In a group]</td>
<td>![Individually]</td>
<td>![Individually]</td>
<td>![In a group]</td>
</tr>
<tr>
<td>g. Does he/she has a keen interest on environmental issues?</td>
<td>![No]</td>
<td>![Yes]</td>
<td>![No]</td>
<td>![No]</td>
<td>![No]</td>
</tr>
<tr>
<td>h. Is he/she a member of environmental NGO?</td>
<td>![No]</td>
<td>![Yes]</td>
<td>![No]</td>
<td>![No]</td>
<td>![No]</td>
</tr>
<tr>
<td>i. Is he/she actively involved in the neighbourhood activities?</td>
<td>![Not active]</td>
<td>![Rarely]</td>
<td>![Often]</td>
<td>![Active]</td>
<td>![Not active]</td>
</tr>
<tr>
<td>j. If he/she were asked the willingness to pay question, do you think that he/she will give the same answer like yours?</td>
<td>![No]</td>
<td>![I do not know]</td>
<td>![Yes]</td>
<td>![No]</td>
<td>![I do not know]</td>
</tr>
</tbody>
</table>
2.2 Sampling Strategy

I split my respondents into two different groups, treatment and control groups, whom were belong to different neighbourhoods. To collect the sample of neighbourhoods, I used a simple random sampling strategy, in which the area is based on the administrative jurisdiction area, not by imposing virtual grid on the area of Bandung. There are 151 sub-districts, from which I randomly collected 5 sub-districts. Then I randomly selected two neighbourhoods from each sub-district sample, thus, there were 10 neighbourhoods that belong to my sample set. Finally, these neighbourhoods were equally distributed to each group, treatment and control groups.

On average, each neighbourhood in Bandung consists of 300 households. I then randomly selected 60 households from each neighbourhood that belong to the control group. Therefore, in total there were 300 respondents that belong to the control group, and these respondents were called as control respondents. While for each neighbourhood that belong to the treatment group, I randomly collected 120 households, from which 40 households were assigned into the treated respondents and 80 households were assigned into the untreated respondents. Therefore, the total respondents in the treatment group were 600 respondents, of whom 200 of them were treated respondents and 400 respondents were untreated respondents.

The control respondents followed a standard CV survey, where they answered all questions in one interview session. While the treated respondents were interviewed in two sessions. In the first session, these respondents were answering the first and the second parts of the CV questionnaire. Before the first session ended, the enumerator had explained the current condition of SWM in Bandung and the hypothetical solution to improve its quality, and these respondents had been asked to think about this issue for about 4-6 days. They had been told that they were allowed to discuss or share the information that they received from the enumerator with the other members of their family or with their neighbours. After 4-6 days, the same enumerator came back and finished the interview. For the untreated respondents, they followed standard CV survey like the control respondents, with one exception, they finished the interview on the same day that the treated respondents finished their second interview.
Using this sampling strategy, I can measure two direct treatment effects, which are the time to think and being neighbour effects. And in order to achieve the main objective, which is measuring the social interaction effect, I combine this sampling strategy with the information obtained from the Part 4 of the questionnaire, the social interaction part. As I explained before, from the social interaction part, I can determine whether the treatment respondents discussed or not prior their elicitation question. Therefore, by comparing the behaviours of between the treated respondents who discussed or shared their information with other treated or untreated respondents, and those who did not share nor discuss the information, I can measure the effect of social interaction on the likelihood to purchase public good. Moreover, the social interaction effect can also be measured from the untreated respondents side. We can regard this as sender-receiver relationship between the treated and treated respondents.

It is worth to emphasize that in the information given to the treated respondents, there was no information regarding the proposed price of the hypothetical solution. This
is significantly different from the standard CV studies that use time to think feature. In these studies, the respondents were asked to think about the proposed price of the hypothetical public good, while in mine, the respondents we asked to think about the problem and the hypothetical solution. I did not provide the proposed price as a part of information given, in order to avoid respondents’ protest due to the fact that they might comparing different price level.

2.3 Estimation Method

For the households’ WTP estimation, I use a linear logit model, which is among the most common parametric models employed in the CV literature with dichotomous choice. This specification assumes that

\[
\Pr(\text{yes}) = \Pr(\epsilon_j < \alpha_i z_j - \beta t_j) \tag{5}
\]

where \( z_j \) is an \( m \)-dimensional vector of variables related to individual \( j \), and \( \alpha_i \) denotes an \( m \)-dimensional vector of parameters, such that \( \alpha_i z_j = \sum_{k=1}^{m} \alpha_{ik} z_{jk} \) and \( \epsilon_j \sim \text{logistic}(0, \frac{\sigma_L^2}{3}) \). And the corresponding maximum likelihood function is given by:

\[
L(\alpha, \beta | y, z, t) = \prod_{j=1}^{T} \left[ \left[ 1 + \exp\left( -\frac{\alpha_i z_j - \beta t_j}{\sigma_L} \right) \right]^{-1} \right]^{I_j} \cdot \left[ \left[ 1 + \exp\left( -\frac{\alpha_i z_j - \beta t_j}{\sigma_L} \right) \right]^{-1} \right]^{1-I_j} \tag{6}
\]

An important attribute of the linear logit model in the CV study is that, unlike most logit applications, the dispersion of WTP in the population (captured by \( \sigma_L \)) can be separately identified [Cameron, 1988]. This is accomplished by varying the price offered, which is the \( t_j \), across observations. In particular, if \( \hat{\sigma}_{L_k} \) denotes the \( k \)th element of the maximum likelihood estimate of \( \sigma_L \), then \( \hat{\sigma}_L = \hat{\sigma}_{L_0}^{-1} \). The original parameter vector can likewise be recovered using \( \hat{\beta}_{L_k} = \frac{\hat{\alpha}_{L_k}}{\hat{\sigma}_{L_k}} \). Finally, in the logit framework both the conditional mean WTP \( E_{\epsilon}(\text{WTP}|\alpha, \beta, z_j) \) and the conditional median WTP \( \text{median}_{\epsilon}(\text{WTP}|\alpha, \beta, z_j) \) are given by

\[
E_{\epsilon} = \text{median}_{\epsilon} = \frac{\alpha_i z_j}{\beta} \tag{7}
\]

---

\(^4\) The subsequent presentation follows Haab and McConnell [2002]

\(^5\) Crocker and Herriges [2004] provide a comparison of several methods that generally used to derive WTP estimation.
and the conditional dispersion of WTP in the population is given by

\[ d_{WTP} = \text{Std.Dev.}(WTP|\alpha, \beta, z_j) = \sigma_L \] (8)

3 Overview Of The Study Area

The study was conducted in Bandung, the capital of West Java province, located about 180 km south-east Jakarta, is the fourth largest city in Indonesia. With over 2.9 million populations in 2007, it's one of the most densely populated cities in Asia and It is also rated as one of the fastest-growing major cities/metropolitan in South-east Asia. Beside that, Bandung acts as the capital of West Java Province and the core for Greater Bandung Metropolitan Area, which is rated as one of the fastest-growing major cities/metropolitan regions in Southeast Asia.

In 1955, the first Asian-African Conference—also known as the Bandung Conference held in Bandung, attended by head of states representing twenty-nine countries and colonies from Asia and Africa. The conference was also the first international conference, which encouraged nationalism movements around the globe and remapping the world politics.

SWM in Bandung falls under the jurisdiction of the municipal-owned company called PD. Kebersihan. Its main responsibilities consist collection, street cleansing, and disposal. However, PD. Kebersihan cannot cover most of the collection service for the residential area due to its financial and manpower constraints. The manpower is become an issue because many urban residential area in Bandung, and in any other Indonesian cities, are located in a narrow alley, hence the only means to collect the waste is using a handcart. And to overcome this issue, many residential areas organise their own informal collection service, which is funded by monthly communal contribution or directly levied on the household. Beside the coverage problem in the residential area, one to two thirds of the solid waste generated do not leave temporary disposal sites; sites that located close to the poor residential area or traditional markets. As a result, the uncollected waste spills indiscriminately in the streets and in drains, so contributing to flooding, breeding of insect and rodent vectors and the spread of diseases. Another waste related issue is the ill-managed final disposal site. The composting and recycling process of the collected waste that can be transported to the final disposal site is running least optimal due to the fact that the organic and inorganic wastes are not properly separated.

Because of this ill-managed SWM, Bandung already experienced two disasters. First, on February 21st, 2005, there was a landslide at Leuwigajah final disposal site.\(^6\) After

\(^6\)Leuwigjah final disposal site was the biggest site for Bandung solid waste; it was located in the
3 days of heavy rain, 2.7 million cubic meters of waste started sliding down the valley. The waste covered a 200-250 m wide stripe on a length of 900 m causing 143 victims and hundreds injured. According to Kölsch et al. [2005], the landslide were due to acute drainage problem coming along with pore water pressure in soft soils or high water tables inside landfills. Second, on December 15th 2010, due to the unpaid compensation problem, neighbourhoods who live surrounding the Sarimukti final disposal site created a road blockage at the site entrance for about three days. As the result, Bandung was inundated by its own solid waste, about 3000 tons of solid waste was piling-up at the temporary/collecting sites around the urban area and trickling-out to the streets.

Based on the current condition of Bandung SWM, especially for the residential area, this study proposed a hypothetical program called MaSUK RT (Manajemen Sampah Untuk Kawasan Rumah Tangga or solid waste management for residential area). Under this program, municipal government provides garbage bins and daily waste collection service. Each garbage bin consists three different compartments; green (for organic waste), yellow (for non-organic waste) and red (for glass and metal). The residents needs to pay for these services, levied on their monthly electricity bill. The MaSUK RT program is solving two most important problem, the financial constraint and low awareness level about the importance to separate between organic and non-organic waste. This awareness is importance because, when solid waste is properly separated, then it is easier to recycle the non-organic waste and to compost the organic one. Hence, if final disposal able to recycle and to compose properly, there will be no pile of waste, which at the end we can prevent these two disaster to happen again in the future.

4 Results

This section is divided into two parts. First I will present the survey results that consist of socio-economics profile, and other characteristics of respondents toward municipal solid waste management problem in Bandung, then in second part, I will discuss about household demand estimation for SWM improvements.

4.1 Survey Results

As I mentioned before, the actual survey was conducted from the beginning of July to the end September 2011, with three weeks break in between. From 900 respondents peri-urban of Bandung urban area and about 1500 tons municipal solid waste per day was delivered to the site. Before the Leuwigajah disaster, Bandung had four disposal sites, however due to the disaster all those site were closed and Bandung relocated final disposal site to the Sarimukti site.
interviewed, there were 20 observations eliminated for missing values in the relevant questions, therefore the response rate was 98%.

Table 1 summarises the descriptive statistics of respondents characteristics that are relevant for the parametric estimation of household WTP. The majority of the respondents from each group are female respondents, in total there were 431 female respondents from three different groups. Although male-female ratio in Bandung according Indonesia 2010 census is 1.03, nonetheless because most of the interviewed conducted in the day time, then it was reasonable if the majority of the respondents was female, since most of Indonesian women work as housewives or the owner of small family business. Moreover, from each group, more than 80% of respondents are married couple who live in a household consists of 5 members on average, where two of the household members are working members.

The minimum age from treated and control groups is 19 years old, while from the untreated group is 20 years old. According to Mann-Whitney Wilcoxon test, there is a statistically difference between the mean age for treated and control groups. Beside that, the statistically difference also appears between treatment (combining treated and untreated) and control groups for communal contribution. This difference is justifiable since the communal contribution is determined through communal discussion and amount of contribution can be difference from one household to another. Furthermore, respondents’ monthly income and negative experience related to the ill-managed SWM also show that there are statistically differences between treatment and control groups. These differences might due to the simple random strategy that I employed to determine the neighbourhood sample. However, there is a clear intuition about the relationship between those variables, although it is statistically insignificant based on Pearson correlation test. Most of the control and untreated respondents earn USD242.3 per month (29.17% and 23.92% respectively), while for treated respondents, 21.83% earn USD403.83. Senior high school (equivalent to 12 years of study) is the highest level of education completed by the majority of the respondents from each group (44.79% for control respondents, 40.61% for treated respondents, and 45.57% for untreated respondents).

8 USD 1 = IDR 6,190.77 (PPP)
Table 1: Descriptive Statistics, by groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Treatment Groups</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>response</td>
<td>= 1 if agree to purchase</td>
<td>0.519 (0.5)</td>
<td>0.441 (0.497)</td>
</tr>
<tr>
<td></td>
<td>= 0 otherwise</td>
<td>0.487 (0.501)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.534 (0.499)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.441 (0.497)</td>
<td></td>
</tr>
<tr>
<td>price</td>
<td>The offered price</td>
<td>13853.040 (6355.675)</td>
<td>14750 (6144.599)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14022.840 (5966.380)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>13768.350 (6546.893)</td>
<td></td>
</tr>
<tr>
<td>sex</td>
<td>= 1 if male</td>
<td>0.446 (0.497)</td>
<td>0.434 (0.496)</td>
</tr>
<tr>
<td></td>
<td>= 0 otherwise</td>
<td>0.462 (0.499)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.438 (0.498)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.434 (0.496)</td>
<td></td>
</tr>
<tr>
<td>age</td>
<td></td>
<td>46.505 (12.054)</td>
<td>43.757 (12.331)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.904 (12.891)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>45.808 (11.569)</td>
<td></td>
</tr>
<tr>
<td>marital</td>
<td>= 2 if divorce</td>
<td>1.015 (0.331)</td>
<td>0.976 (0.317)</td>
</tr>
<tr>
<td></td>
<td>= 1 if married</td>
<td>1.02 (0.364)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>= 0 if single</td>
<td>1.013 (0.314)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.976 (0.317)</td>
<td></td>
</tr>
<tr>
<td>education</td>
<td>Years of schooling</td>
<td>11.654 (3.453)</td>
<td>11.42 (3.312)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.594 (3.846)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.683 (3.244)</td>
<td></td>
</tr>
<tr>
<td>size</td>
<td>Household size</td>
<td>4.743 (1.739)</td>
<td>4.712 (2.116)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.949 (1.87)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.641 (1.662)</td>
<td></td>
</tr>
<tr>
<td>fee</td>
<td>Monthly fee for community informal waste collection service</td>
<td>1539.696 (3799.06)</td>
<td>2822.917 (5243.037)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1748.731 (3544.406)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1435.443 (3920.078)</td>
<td></td>
</tr>
<tr>
<td>income</td>
<td>Monthly income</td>
<td>3848395 (3552056)</td>
<td>3073785 (2953174)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4574873 (4624598)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3486076 (2809090)</td>
<td></td>
</tr>
<tr>
<td>knowledge</td>
<td>SWM knowledge and awareness</td>
<td>8.618 (1.972)</td>
<td>8.313 (2.17)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.508 (1.963)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.673 (1.976)</td>
<td></td>
</tr>
<tr>
<td>experience</td>
<td>= 1 if having negative experience(s)</td>
<td>0.272 (0.445)</td>
<td>0.444 (0.498)</td>
</tr>
<tr>
<td></td>
<td>= 0 otherwise</td>
<td>0.244 (0.43)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.286 (0.452)</td>
<td></td>
</tr>
<tr>
<td>perception on municipal government</td>
<td>= 1 if positive perception</td>
<td>0.753 (0.431)</td>
<td>0.778 (0.416)</td>
</tr>
<tr>
<td></td>
<td>= 0 otherwise</td>
<td>0.695 (0.461)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.782 (0.413)</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Total respondents</td>
<td>592</td>
<td>288</td>
</tr>
<tr>
<td></td>
<td></td>
<td>197</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>395</td>
<td></td>
</tr>
</tbody>
</table>

Standard deviations in parentheses

Respondents’ knowledge and the awareness about municipal SWM problems are roughly similar across groups, where 8 out of 12 test questions can be answered correctly. Table 6 provides a clear picture about the distribution of the correct answer for each question. More than 40% of the control respondents are having negative experiences due to the ill-managed solid waste, while for treated and untreated groups, the number
of respondents who have negative experiences is less than 30%. However, only 69.54% of treated respondents believe that the proposed program can be well-implemented by the municipal government, while for untreated and control respondents, more than 70% believe that municipal government can implement the proposed program.

From 197 respondents who went to the treated respondents, 83.76% (165 respondents) were actually discussing the information that they received in their first interview sessions prior the second interview sessions, either with another treated or with untreated respondents. While for untreated respondents, 309 out of 395 respondents were discussing with treated respondents about solid waste problems prior their interview sessions.

As expected, issues related to the environmental condition are less important, relatively to economic issues. 51.02% of respondents consider that economic issues are the most urgent issues that need to be solved first by the municipal government. Nonetheless, there are 34.66% of respondents believe that the most urgent problem need to be solved in Bandung is the environmental issues. The reverse situation can be found in responses for the second urgent problem that need to be solved. 38.3% of respondents answered that environmental issues are the second urgent problem and 18.64% answered that economic issues are the second urgent problem.

<table>
<thead>
<tr>
<th>List of Problems</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic issues</td>
<td>449</td>
<td>51.02%</td>
</tr>
<tr>
<td>Environmental issues</td>
<td>305</td>
<td>34.66%</td>
</tr>
<tr>
<td>Security issues</td>
<td>23</td>
<td>2.61%</td>
</tr>
<tr>
<td>Public transportation</td>
<td>16</td>
<td>1.82%</td>
</tr>
<tr>
<td>Public education</td>
<td>38</td>
<td>4.32%</td>
</tr>
<tr>
<td>City infrastructures</td>
<td>44</td>
<td>5%</td>
</tr>
<tr>
<td>Others</td>
<td>5</td>
<td>0.57%</td>
</tr>
<tr>
<td>Total</td>
<td>880</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2: Two Most Urgent Problems (Pooled Data)

<table>
<thead>
<tr>
<th>List of Problems</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic issues</td>
<td>164</td>
<td>18.64%</td>
</tr>
<tr>
<td>Environmental issues</td>
<td>337</td>
<td>38.3%</td>
</tr>
<tr>
<td>Security issues</td>
<td>83</td>
<td>9.43%</td>
</tr>
<tr>
<td>Public transportation</td>
<td>52</td>
<td>5.91%</td>
</tr>
<tr>
<td>Public education</td>
<td>114</td>
<td>12.95%</td>
</tr>
<tr>
<td>City infrastructures</td>
<td>114</td>
<td>12.95%</td>
</tr>
<tr>
<td>Others</td>
<td>16</td>
<td>1.82%</td>
</tr>
<tr>
<td>Total</td>
<td>880</td>
<td>100</td>
</tr>
</tbody>
</table>

Among environmental issues, inadequate municipal solid waste management is ranked as the first most pressing environmental problem by the largest proportion of respondents (66.71%), followed by water/river pollution (20.91%), air pollution (5.91%) and green open space deterioration (5.11%). For the second most pressing environmental problem, 30.23% of respondent rank water/river pollution as the first, followed by solid waste management problem (21.7%). These results are in accordance with the fact that some of the respondents have been experienced the negative impacts of the inadequate of the solid waste management and the respondents’ perception about the seriousness of solid waste management problem.
Table 3: Two most urgent environmental problems (Pooled Data)

<table>
<thead>
<tr>
<th>First Environmental Problem</th>
<th>List of Problems</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water/river pollution</td>
<td>184</td>
<td>20.91</td>
<td></td>
</tr>
<tr>
<td>Solid waste management</td>
<td>587</td>
<td>66.71</td>
<td></td>
</tr>
<tr>
<td>Air pollution</td>
<td>52</td>
<td>5.91</td>
<td></td>
</tr>
<tr>
<td>Green open space deterioration</td>
<td>45</td>
<td>5.11</td>
<td></td>
</tr>
<tr>
<td>Don’t know/not sure</td>
<td>9</td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>880</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Environmental Problem</th>
<th>List of Problems</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water/river pollution</td>
<td>266</td>
<td>30.23</td>
<td></td>
</tr>
<tr>
<td>Solid waste management</td>
<td>191</td>
<td>21.7</td>
<td></td>
</tr>
<tr>
<td>Air pollution</td>
<td>171</td>
<td>19.43</td>
<td></td>
</tr>
<tr>
<td>Green open space deterioration</td>
<td>164</td>
<td>18.64</td>
<td></td>
</tr>
<tr>
<td>Don’t know/not sure</td>
<td>68</td>
<td>7.73</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>20</td>
<td>2.27</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>880</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

As I mentioned before, some of the respondent are actually have negative experiences because of the improper and inadequate municipal solid waste management. However, the first municipal problem that directly gives a negative impact to the households’ well being is the lack of access to clean water (28.63%), followed by the low quality of drainage system that cause a flood (17.5%), and the solid waste collection problem (15.8%), and then the water quality (14.89%). For the second municipal problem that has direct negative impact on households’ well being, 17.05% of respondents choose that it is the solid waste collection problem, followed by the low quality of drainage system that can cause a flood (15.45%), inadequate public services (11.82%) on the third place. These negative experiences have an implication on how respondents consider the seriousness of solid waste management problem. 54.66% of respondents agree that municipal solid waste problem is a serious problem.
Table 4: Problems that directly impact on household well being (Pooled Data)

<table>
<thead>
<tr>
<th>First Experienced Municipal Problem</th>
<th>List of Problems</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to clean water</td>
<td>252</td>
<td>28.63</td>
<td></td>
</tr>
<tr>
<td>Quality of water</td>
<td>131</td>
<td>14.89</td>
<td></td>
</tr>
<tr>
<td>Low quality drainage system</td>
<td>154</td>
<td>17.5</td>
<td></td>
</tr>
<tr>
<td>Access for motor vehicle</td>
<td>43</td>
<td>4.89</td>
<td></td>
</tr>
<tr>
<td>Inadequate public services</td>
<td>61</td>
<td>6.92</td>
<td></td>
</tr>
<tr>
<td>Solid waste collection issue</td>
<td>139</td>
<td>15.8</td>
<td></td>
</tr>
<tr>
<td>Low quality of public health</td>
<td>35</td>
<td>3.98</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>65</td>
<td>7.39</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>880</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Experienced Municipal Problem</th>
<th>List of Problems</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to clean water</td>
<td>68</td>
<td>7.73</td>
<td></td>
</tr>
<tr>
<td>Quality of water</td>
<td>98</td>
<td>11.14</td>
<td></td>
</tr>
<tr>
<td>Low quality drainage system</td>
<td>136</td>
<td>15.45</td>
<td></td>
</tr>
<tr>
<td>Access for motor vehicle</td>
<td>75</td>
<td>8.52</td>
<td></td>
</tr>
<tr>
<td>Inadequate public services</td>
<td>104</td>
<td>11.82</td>
<td></td>
</tr>
<tr>
<td>Solid waste collection issue</td>
<td>150</td>
<td>17.05</td>
<td></td>
</tr>
<tr>
<td>Low quality of public health</td>
<td>85</td>
<td>9.65</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>164</td>
<td>18.64</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>880</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Table 5: The Seriousness of Solid Waste Management Problem (Pooled Data)

<table>
<thead>
<tr>
<th>According to you how serious is the problem of solid waste management in Bandung?</th>
<th>Freq.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly serious</td>
<td>481</td>
<td>54.66</td>
</tr>
<tr>
<td>Serious</td>
<td>329</td>
<td>37.39</td>
</tr>
<tr>
<td>Not serious</td>
<td>38</td>
<td>4.31</td>
</tr>
<tr>
<td>Don’t know/not sure</td>
<td>32</td>
<td>3.64</td>
</tr>
<tr>
<td>Total</td>
<td>880</td>
<td>100</td>
</tr>
</tbody>
</table>

There are 12 questions used to capture the level of knowledge and awareness. Survey results show that respondents adequate knowledge about solid waste. About 47.5% of respondents know that the remaining vegetables and fruits can be categorised as organic solid waste, while wrapping plastic is categorised as non-organic solid waste, and about 92.5% of respondents know the solid waste can be categorised as degradable and non degradable solid waste. Moreover for the awareness questions, 60.11% of respondent can answered correctly on the question about the management of municipal solid waste is under the control of state-owned enterprise or municipal government. While for the question about daily production of solid waste in Bandung Muncipality, 61.48% of respondents gave a correct answer. Moreover, the respondents are also well aware that Bandung was inundated with solid waste for three days because of the ill-managed solid waste. However, only 2.16% of respondents are aware that the current dumping site will be closed
at the end of year 2012. It is an alarming situation since Bandung residents might not realise that Bandung is at the edge of a catastrophic problem due to the inadequate solid waste management.

Table 6: Knowledge and Awareness (Pooled Data)

<table>
<thead>
<tr>
<th>No.</th>
<th>Question or Statement</th>
<th>Correct answer (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The remaining vegetables and fruits can be categorised as organic solid waste, while wrapping plastic is categorised as non organic solid waste.</td>
<td>47.5</td>
</tr>
<tr>
<td>2</td>
<td>Solid waste can be categorised into two types: degradable and non degradable.</td>
<td>92.5</td>
</tr>
<tr>
<td>3</td>
<td>Organic solid waste is the degradable solid waste.</td>
<td>87.27</td>
</tr>
<tr>
<td>4</td>
<td>Compost is made from organic solid waste.</td>
<td>89.2</td>
</tr>
<tr>
<td>5</td>
<td>Organic and non organic solid waste should be properly separate in order to make a composting process goes efficiently.</td>
<td>94.77</td>
</tr>
<tr>
<td>6</td>
<td>Most of the non organic solid waste is recyclable.</td>
<td>89.09</td>
</tr>
<tr>
<td>7</td>
<td>Currently, the final dumpsite for Bandung solid waste is no longer at Leuwigajah.</td>
<td>76.02</td>
</tr>
<tr>
<td>8</td>
<td>In Bandung, solid waste and its related issues are under the management of municipal owned enterprise or municipal government.</td>
<td>60.11</td>
</tr>
<tr>
<td>9</td>
<td>Bandung produces 1000 tonnes solid waste per day.</td>
<td>61.48</td>
</tr>
<tr>
<td>10</td>
<td>In the end of year 2010, Bandung was inundated by the solid waste because of the blockade in the access to the Sarimukti final dumpsite.</td>
<td>91.7</td>
</tr>
<tr>
<td>11</td>
<td>Currently, Bandung has only one final dumpsite, Sarimukti dumpsite. Do you know when is the termination date for this site?</td>
<td>2.16</td>
</tr>
<tr>
<td>12</td>
<td>Have you heard about Leuwigajah tragedy (February 25, 2005)?</td>
<td>60</td>
</tr>
</tbody>
</table>

4.2 Household Willingness to Pay Estimation

Figure 2 shows the percentage of yes responses for a given price across groups. As one would expect, in the CV study with a single price component, the percentage of respondents who are willing to purchase the improvement SWM decreases as the price offered increases.
Moreover, the two-sample Wilcoxon Mann-Whitney test shows that there is no significant difference of yes responses across groups, which means, neither having time to think (treated) nor being a neighbour of treated respondents (untreated) have a significant impact on the likelihood to purchase the public good. The insignificant difference between treated and control respondents is in line with the result of Whittington et al. [1993], but contradicting with the study of Lauria et al. [1999]. In Whittington et al. [1993], they find that giving time to think to Ghanian households does not significantly influence their WTP on the improvement of sanitation services. While Lauria et al. [1999] find that giving respondents time to think will actually reduced the likelihood to purchase the improved sanitation services in Philippines.

<table>
<thead>
<tr>
<th>Two samples of yes response</th>
<th>control vs. treated</th>
<th>control vs. untreated</th>
<th>treated vs. untreated</th>
</tr>
</thead>
<tbody>
<tr>
<td>z-value</td>
<td>-1.005</td>
<td>-2.404</td>
<td>-1.074</td>
</tr>
<tr>
<td>p-value</td>
<td>0.3151</td>
<td>0.0162</td>
<td>0.2826</td>
</tr>
</tbody>
</table>

To analyse further on the respondents behaviours, I employ three linear logit models with the yes response as the dependent variable, and the results are presented in the following table.
Table 8: Multivariate Models Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>y</td>
<td>y</td>
<td>y</td>
</tr>
<tr>
<td>price</td>
<td>-1.57E-04***</td>
<td>-1.51E-04***</td>
<td>-1.49E-04***</td>
</tr>
<tr>
<td></td>
<td>(1.45e-05)</td>
<td>(1.65e-05)</td>
<td>(1.62e-05)</td>
</tr>
<tr>
<td>income</td>
<td>1.84e-07***</td>
<td>1.26e-07***</td>
<td>1.29e-07***</td>
</tr>
<tr>
<td></td>
<td>(3.32e-08)</td>
<td>(3.59e-08)</td>
<td>(3.55e-08)</td>
</tr>
<tr>
<td>education</td>
<td>0.0966***</td>
<td>0.0926***</td>
<td>0.0868***</td>
</tr>
<tr>
<td></td>
<td>(0.0283)</td>
<td>(0.0319)</td>
<td>(0.0299)</td>
</tr>
<tr>
<td>fee</td>
<td>4.63e-05**</td>
<td>4.02e-05*</td>
<td>3.74e-05*</td>
</tr>
<tr>
<td></td>
<td>(2.08e-05)</td>
<td>(2.23e-05)</td>
<td>(2.22e-05)</td>
</tr>
<tr>
<td>knowledge</td>
<td>0.124***</td>
<td>0.112**</td>
<td>0.107**</td>
</tr>
<tr>
<td></td>
<td>(0.0411)</td>
<td>(0.0464)</td>
<td>(0.0461)</td>
</tr>
<tr>
<td>experience</td>
<td>0.387**</td>
<td>0.458**</td>
<td>0.481**</td>
</tr>
<tr>
<td></td>
<td>(0.172)</td>
<td>(0.194)</td>
<td>(0.193)</td>
</tr>
<tr>
<td>perception</td>
<td>1.030***</td>
<td>0.899***</td>
<td>0.912***</td>
</tr>
<tr>
<td></td>
<td>(0.197)</td>
<td>(0.227)</td>
<td>(0.226)</td>
</tr>
<tr>
<td>sex</td>
<td>-0.223</td>
<td>-0.174</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.178)</td>
<td>(0.206)</td>
<td></td>
</tr>
<tr>
<td>age</td>
<td>0.00338</td>
<td>-0.00374</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00761)</td>
<td>(0.00869)</td>
<td></td>
</tr>
<tr>
<td>marital</td>
<td>-0.151</td>
<td>-0.0526</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.280)</td>
<td>(0.323)</td>
<td></td>
</tr>
<tr>
<td>size</td>
<td>0.0504</td>
<td>0.0413</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0443)</td>
<td>(0.0490)</td>
<td></td>
</tr>
<tr>
<td>treated group</td>
<td>0.0436</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.224)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>untreated group</td>
<td>0.286</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.187)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>1.276***</td>
<td>1.251***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.284)</td>
<td>(0.280)</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>-2.484***</td>
<td>-2.498***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.532)</td>
<td>(0.532)</td>
<td></td>
</tr>
<tr>
<td>D3</td>
<td>1.613***</td>
<td>1.601***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.240)</td>
<td>(0.238)</td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>-1.521***</td>
<td>-1.522***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.286)</td>
<td>(0.285)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-1.919***</td>
<td>-1.360*</td>
<td>-1.406***</td>
</tr>
<tr>
<td></td>
<td>(0.642)</td>
<td>(0.725)</td>
<td>(0.521)</td>
</tr>
</tbody>
</table>

Observations 880 880 880
LR $\chi^2$ 263.4 464.3 462.2
Prob < $\chi^2$ 0 0 0

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
In the first model, I use two dummy variables to capture the treatment effect, namely treated and untreated. And again, these two dummy variables confirm that there is significance effect on the respondents behaviours due to the sampling design. In the second and the third models, I use dummy variables to differentiate the treated and untreated respondents who had social interactions prior elicitation question, D1 and D3 respectively, with treated and untreated respondent who did not have, D2 and D4 respectively. The main difference between Model 2 and Model 3 lies on the explanatory variables used. I drop four variables that seem do not have significant effect on the decision to purchase public good. Moreover, even though the number of the explanatory variables is different, I find that the result does not change significantly.

From the result table, we can see that there are five variables, namely price, income, education, negative experience and perception that have stable coefficient value across models and have a consistent sign with theoretical prediction, where price has price has a negative impact on the likelihood to purchase public good and the rest gives positive effects. Beside that, the corresponding marginal effect on variable price, presented in Table 9 also imply that, a Rp.1000 increase in the price offered decreases the probability of giving a yes response by -1.88E-05, -2.02E-05 and -2.31E-05 at price equal to Rp.3000, Rp.24500, and at the mean price respectively, which means that respondents are more responsive to the increasing in price when they already pay a higher price. Furthermore, I also find that income, education and perception have positive influences on the decision to support the project proposed at 1% of significance level, while knowledge and experience have significance level at $p < 0.05$, and variable fee at $p < 0.1$. 

\footnote{Here, I only present 5 explanatory variables, however the results are coming using all explanatory variables in Model 3}
Table 9: The Marginal Effects of Explanatory Variables

<table>
<thead>
<tr>
<th>Change in variable</th>
<th>Household demand at different price level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rp.3000</td>
</tr>
<tr>
<td>price</td>
<td>-1.88E-05***</td>
</tr>
<tr>
<td></td>
<td>(1.47E-06)</td>
</tr>
<tr>
<td>D1</td>
<td>0.1586***</td>
</tr>
<tr>
<td></td>
<td>(0.0367)</td>
</tr>
<tr>
<td>D2</td>
<td>-0.3167***</td>
</tr>
<tr>
<td></td>
<td>(0.0595)</td>
</tr>
<tr>
<td>D3</td>
<td>0.2030***</td>
</tr>
<tr>
<td></td>
<td>(0.0323)</td>
</tr>
<tr>
<td>D4</td>
<td>-0.1930***</td>
</tr>
<tr>
<td></td>
<td>(0.0329)</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
*** p<0.01

The interesting part of my result lies on the treatment parameters. In the first model, neither belong to the treated nor to the untreated respondents has any significant on the decision to purchase the local public good. However, when I control for the social interactions effect (Model 2 and Model 3), with 1% significance level, treated and untreated respondents with social interactions have higher probability to respond "yes" with respect to the control respondents. And with the same significance level, those who do not have social interactions will less likely to respond "yes". Using the third model, the marginal treatments effects also show that being a treated or untreated respondent who had social interaction prior WTP elicitation question will improve the likelihood to support the proposed program to improve the municipal waste management in all three different prices, namely Rp. 3000, Rp. 24500 and the average price. There one possible reason why my result differs from the previous CV studies that employed time-to-think feature. The positive effect of social interaction in influencing the likelihood to purchase public good can be regarded as the positive effect of communication in sustaining cooperative behaviours found in the experimental economics literature.

The large experimental literature has found that there are significant contribution levels in early periods, but contributions decline both over time and with the experience level of experiment participants, however Isaac and Walker [1988] seminal paper shows that this declining trend can be averted if experiment participants have the opportunity for face-to-face communication before making their (private) individual contribution decisions. Even with experienced participants. Moreover, their result also shows that
communication not only improves cooperation in the round immediately following it, but its effect carries over to a number of subsequent iterations. The positive effect of communication on cooperative behaviours also prevails in many different experimental contexts, for example, Cason and Khan [1999] find that improved contribution monitoring does not increase contributions without face-to-face verbal communication, and that communication (even with imperfect monitoring) dramatically improves subjects’ ability to efficiently provide the public good. Communication also helps to overcome free-riding in common-pool resource experiments under conditions of heterogeneity in resource endowment and payoffs [Hackett et al., 1994, Ostrom et al., 1994]. The one-way communication from treated respondents who endowed with information and communicate it to untreated respondents has been analysed by Koukoumelis et al. [2012a,b]. The results of those two papers show that cooperative behaviours are sustained even under one-way communication.

After we analysed the respondents’ behaviours across groups, the next step of CV study is to calculate the mean willingness to pay (MWTP) for the proposed public good. The Calculation of MWTP uses estimated parameters depends on the covariates chosen, and is also a function of the random component assumed for preferences. In this case, the MWTP calculation is based on the third model, and the method to derive the MWTP is following equation (7):

\[ WTP_j = \frac{\alpha z_j}{\beta} + \frac{\epsilon_j}{\beta} \]

where, \( \alpha \) is the vector of coefficients other than price offered coefficient, including constant, and \( \beta \) is the price offered coefficient. \( \alpha z_j \) is the mean value of the corresponding variable, with the mean value of the constant is equal to one and \( \epsilon \) is the error term.

With respect to the uncertainty of \( \epsilon_j \), the mean willingness to pay is:

\[ E(\epsilon_j | WTP_j, z_j) = \frac{\alpha z_j}{\beta} \]

MWTPs across groups for the improvements of SWM are presented in the following table
Table 10: Estimates of Mean Willingness to Pay

<table>
<thead>
<tr>
<th></th>
<th>Mean WTP (Rp.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Respondents</td>
<td>12761.37</td>
</tr>
<tr>
<td>Treated Respondents without Social Interactions</td>
<td>11290.59</td>
</tr>
<tr>
<td>Untreated Respondents without Social Interactions</td>
<td>10852.41</td>
</tr>
<tr>
<td>Treated Respondents with Social Interactions</td>
<td>13909.40</td>
</tr>
<tr>
<td>Untreated Respondents with Social Interactions</td>
<td>15589.02</td>
</tr>
</tbody>
</table>

Paralleling with the results from Table 8 and Table 9, the MWTP of treated respondents with social interaction is 9% higher than the control respondents, while those without social interaction, their MWTP is reduced by 12% relatively to the control respondents. And the difference between treated respondents with and without social interactions is about Rp. 2618.80 equivalently we can say that MWTP of the former group is 23% higher than the latter one. The effect of social interaction on MWTP to the untreated group is slightly higher than for the treated group. The untreated respondents with social interaction have 22% higher MWTP compared to the MWTP of the control respondents, while those respondents without social interaction, their MWTP is 15% less than the control MWTP. While MWTP difference within untreated respondents is 44%.

5 Conclusion

After conducting this study, there are several important facts related to the municipal waste management, especially in Bandung. First of all this study reveals that waste collection service is a normal good, meaning that demand is negatively influenced by price and positively influenced by income. Although, there already exists a communal collection service, nonetheless Bandung residents are willing to pay more to have a better collection service. Moreover, the priority of waste management problem, according to Bandung residents, is higher than any other environmental issues, such as water pollution or the deterioration of green open space. And regarding to the separation between organic and non-organic waste, this study reveals that Bandung residents do understand about the importance and the benefit of having organic and non-organic waste is properly separated, nonetheless, their knowledge does not reflect the current situation found in the final dumping site.

Alongside with common explanatory variables found in CV study, the results of present contingent valuation study indicate a substantial effect of social interactions
in the decision of willingness to pay to improve a solid waste management services in Bandung. Similar to the results found in Whittington et al. [1993], when respondents were given time to think and information (treated respondents), the probability of them respond "yes" is not significantly different with those who did not have time to think. Interestingly, the effect of social interaction also appear to untreated respondents, whom are respondents who reside in the same community like treated respondents. One possible reason that can be used to explain the social interaction effect is communication effect. In this study, similar to experimental economics literature, there is a positive effect of communicating the information that treated respondents endowed, although it is a one-way communication, but similar to Koukoumelis et al. [2012a,b] studies, the effect of communication influences the behaviours of sender and receiver simultaneously.

The positive effect of social interaction examined in my study suggests that development projects requiring collective action should stress social interaction between participants to improve cooperation and attain socially desirable outcomes. The result indicates that social interaction is very powerful in increasing voluntary public goods contribution levels. Drawing policy implications of my findings beyond the specific institutional setting studied should be done with caution. With that caveat in mind, the policy recommendation suggested by this study is that development programs which feature an important role for collective action should emphasize social interaction for group cohesion-building.

The experience of several specific development programs also supports this policy recommendation. For example, the highly successful Grameen Bank in Bangladesh, which provides no-collateral loans at market interest rates to the poorest Bangladeshis, relies on small group social interaction to ensure repayment. I do not argue, however, that social interaction will always solve collective action problems, and neither do I argue that Grameen Bank type credit programs can be replicated in all environments. Instead of implementing costly monitoring programs or educating all citizens, more might be gained at a lower cost by emphasizing the role of social interactions among themselves. My result and the experience of the Grameen Bank indicate that social interaction is often an effective tool in eliciting socially desirable outcomes in projects requiring a great deal of collective action from beneficiaries.
References


