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Households' Willingness to Pay for Improved Solid Waste Collection Services in Kampala City, Uganda

by

Margaret Banga, Razack Lokina, Adolf Mkenda and Kassim Kulindwa

Abstract

This study identifies the determinants of households' willingness to pay for an improvement in solid waste collection services basing on 381 households in Kampala. Employing the double-bounded contingent valuation method, households' mean willingness to pay for improved solid waste collection service was estimated to be Ushs 2439 per month. Both the decision to pay and the amount households are willing to pay for improved solid waste collection services are influenced by income, education, age and home ownership. A socially acceptable fee which the majority of people are willing to pay should be set in order to avoid the free rider problem.

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Outline

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1. Introduction

The economic and demographic growth of cities in Uganda, is posing serious challenges to the urban local authorities. With rapidly swelling urban population, the requirement for infrastructure and services increase manifold. Solid Waste Management (SWM) is one such service that needs to be adequately provided to ensure an urban environment conducive to the well-being and productivity of the residents. The solid waste problem is due to high waste generation, inadequate waste collection and poor disposal habits by the households/individuals. In Uganda, the local government authorities are responsible for SWM services, but these services are only at secondary level (collection from dumping grounds/skips). Primary collection (waste removal from houses) is neglected by Kampala City Council (KCC) and yet a poor primary collection means exposed waste in the vicinity and an unhealthy environment. Lack of infrastructure, an inefficient institutional setup, and limited financial and technical resources, have led to an inadequate and inefficient level of provision of services even at the secondary level and yet the rate of waste generation is increasing each day. Kampala city, with a population of about 2 million people (projected from the 2002 census), generates about 1580 tones of solid waste per day. Of the total waste generated, about 53% is residential solid waste (Banga, 2008). However, only 40 percent of the total waste generated is collected by both KCC and the private sector[1]. Therefore, the significant amount of solid waste generated is either burnt on the streets or ends up in drainage channels, marshy areas and empty plots. In addition to the low collection rate, there is inequality in the geographical distribution of the service. High-income residential areas and the city center receive better services from both KCC and private companies, while low-income areas and the informal settlements receive little (and in some areas) no waste collection services.

In an attempt to reduce the burden facing KCC in solid waste management, KCC has decided to explore the alternative of privatizing solid waste management services, whereby, people pay for the services, i.e the collection of the waste that they themselves generate. Indeed, in 1999, following the establishment of the solid waste management ordinance, which empowers the participation of the private sector in solid waste management services, KCC started contracting private firms in order to improve on solid waste collection services. While privatization may be a viable option to the solid waste

1 City Mayor, Personal communication

problem, in most cases it is done hurriedly and not given much thought and as a result its intended purpose may not be achieved. There is lack of information on whether households are willing to pay for the services that private firms provide, and if so, how much they are willing to pay to have the services provided to them. To answer these questions, this study undertook a contingent valuation (CVM) survey to assess the households' willingness to pay for solid waste collection services in Kampala.

Contingent Valuation method is a non-market valuation method commonly used to find the economic value of environmental commodities. It is a method that uses hypothetical survey questions to elicit people's preferences for public goods by finding out what they are willing to pay for specified improvements in them (Mitchell and Carson, 1989). The contingent valuation method has been used by several scholars to study willingness to pay for solid waste management services (Altaf *et al*., 1996; Zain, 1999; Fonta *et al*., 2008, Jin *et al.*, 2006, Basili *et al.*,2006). These studies used the random Utility approach proposed by Hanemann (1984) and did not go further to re-parameterize the coefficients in order to explain the marginal contributions of the independent variables to the underlying WTP. This study takes the approach proposed by Cameron and James (1987) and Cameroon (1988), which give two separate estimates for the location and scale variable, and the coefficients of the explanatory variables can be easily interpreted as marginal contributions to the dependent variable.

2. Data

Kampala is divided into five administrative units (Divisions). However, only four divisions (Nakawa, Kawempe, Rubaga and Makindye) were considered for this study because the fifth division (Central Division) is better serviced by both Kampala City Council (KCC) and a private company.[2] From each of the four divisions, one parish was chosen to participate in the survey, each with an equal allocation of 100 households. Within each parish, 5 Local Councils (LCs) were sampled from which households for interviews were randomly selected.[3] The enumerators were instructed to interview household heads, and in cases where the household head was not around, they

2 It is also the administrative division and houses most of the wealthier households, including the Statehouse.

3 Sampling frames were obtained from the local council leaders.

interviewed someone who is involved in decision-making or one with knowledge about household expenditures and commitments.

The survey was carried out using a face-to-face interview approach in accordance with the NOAA Panel recommendation (Arrow *et al.*, 1993). Five graduates were recruited and thoroughly trained to carry out the survey. To ensure quality control, the enumerators were not split into groups; they all visited each parish together. This was done to prevent the respondents who had been interviewed from discussing the content of the questionnaire with other respondents who were yet to be interviewed.

3. Empirical Design and Methodology

The elicitation method used in this study was a close-ended format (double-bounded) and the payment vehicle was a monthly garbage fee to be paid directly to the private company (the service provider). In designing the questionnaire used in this study, focus group discussions and a pilot survey of 80 respondents were first conducted. The aim of the focus groups was to help determine how much information to present, as well as to refine the questions used in the valuation section. Four focus group sessions of eight people were organised and conducted in July 2007.[4] The findings from the focus groups were used in the development of a draft contingent valuation survey questionnaire, which was subsequently used in the pilot survey. The draft questionnaire was pre-tested on a sample of 80 respondents. The pretest was divided into two; the first 50 respondents were presented with an open-ended question in order to get the bid design, and since the final survey was to be carried out using the close-ended elicitation format, the last 30 respondents were presented with a close-ended valuation question. The final version of the questionnaire was based on the results from the pilot survey. Information from the focus group and pilot survey exercises suggested a bid vector of 1000, 2000, 3000 and 4000 Uganda Shillings (Ushs).[5]

Following on from the pilot testing of the questionnaire, the main survey was carried out for a period of 8 weeks on a sample of 400 households from four divisions of Kampala City. These divisions included Nakawa, Naguru, Kawempe and Rubaga.

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4 Four parishes (Naguru, Nakulabye, Mulago and Nsambya) were used in the study. Therefore, there was one focus group for each parish.

5 At the time of the survey, 1 USD = 1820 Ushs

Recent research (Fujita *et al.*, 2005) indicates that at least 600 samples are needed for a single-bounded format and at least 400 samples for a double-bounded format in order to ensure statistical reliability of WTP estimations. Also, for each type of community or area to be surveyed, a sample of between 100 and 200 respondents is desired (Cointreau-Levine *et al*., 2000). Taking this into account and given the budget constraint, we decided to take a sample of 400 households.

The households were first informed about the current waste management situation before the scenario for the planned improvement in waste management was presented. The respondents were also reminded about their budget constraint in relation to the responses they give to the valuation questions. In doing so, it is assumed that the respondents would take into consideration their ability to pay if the described improvement is implemented. To reduce the hypothetical bias, which is inherent in the CVM survey mechanism, a "cheap talk[6]" section that reminds respondents about the importance of truthfulness in their answers was included. Cummings and Taylor (1999), List (2001), and Lusk (2003) have found cheap talk to effectively remove hypothetical bias for respondents.

In this study, respondents were first asked if they would be willing to pay anything, even a small amount for the improvement explained to them in the scenario. For those who said yes to the participation question, a dichotomous format (double-bounded) of the valuation question was asked. In this case, the respondent was presented with an initial bid and asked whether he/she was willing to pay that amount or not. If the response to the initial bid was "yes", the respondent was then presented with a higher bid (twice the initial bid) and asked if she/he was willing to pay the offered amount. If the response to the initial bid was "no", the respondent was presented with a lower bid (half the initial amount) and asked if he was willing to pay that amount. The double-bounded format was finally followed by an open-ended follow-up question soliciting the maximum amount that the household was willing to pay. The follow-up question helps in identifying inconsistent responses and outliers. Four different bids (1000, 2000, 3000 and 4000) were used in this study and households were assigned randomly to any one of these bids. For those who said "no"

6 Cheap talk is a non-binding communication between a researcher and the respondent prior to administration of the CVM valuation questions.

to the participation question, they were asked to give reasons why they were not willing to pay anything.

4. Theoretical Model

Dichotomous choice CVM is based on random utility theory, which assumes that choices are based on utility comparisons between the available alternatives, and the alternative that provides the highest utility will be the preferred choice (McFadden, 1974; Louviere *et al*., 2000). This study follows the approach to modelling CV data by Cameron *et al*. (1987) and Cameron (1988) which bypasses the underlying utility model and estimates the parameters of the latent WTP distribution directly. This approach permits the straightforward calculation of marginal values for all arguments in the WTP function and are easy to interpret.

Cameron's approach is derived from the expenditure function as follows:

$$WTP\left(z^0, z^1, u^0; s\right) = e(z^0, u^0, s) - e(z^1, u^0, s) \quad \text{..... (4.1)}$$

where z^1 is the situation with improvement in solid waste management, z^0 is the current solid waste management situation, s is a vector of socio-economic variables and u^0 is the utility level before the introduction of improved solid waste management service.

Assuming a linear functional form for the WTP, the econometric model is

$$Y_i = x_i'\beta + \varepsilon_i, \quad \text{..... (4.2)}$$

where Y_i is the unobserved true individual willingness to pay (WTP) for the environmental resource in question at the moment the dichotomous choice question is posed. Y_i is assumed to depend on individual socio-economic characteristics contained in the vector x_i plus an unobservable random component ε_i (distributed $N(0, \sigma^2)$), which absorbs all unmeasured determinants of the value of the resource to this individual. Y_i is considered a latent continuous censored variable: the observed variable is the answer "yes" or "no" regarding whether or not the individual would be willing to pay a given amount t_i. The individual will state that he is willing to pay the offered amount $(I_i = 1)$ if $Y_i \geq t_i$ and unwilling to pay the offered amount $(I_i = 0)$ if $Y_i < t_i$. The discrete response indicator variable I_i is the single endogenous (dependent) variable in this framework.

Let P_1 be the probability that $Y_i > t_i$ and P_0 be the complementary probability. In the double-bounded model, we have four response probabilities because each participant is presented with two bids. The level of the second bid is contingent upon the response to the first bid. If the respondent says "yes" to the first bid (t_i^I), meaning that he is willing to pay the amount of the first bid, he is presented with a second bid (t_i^H) that is some amount greater than the first bid ($t_i^I < t_i^H$) . If the individual responds with a "no" to the first bid, the second bid (t_i^L) is some amount smaller than the first bid ($t_i^I > t_i^L$) . In this case we observe two dichotomous variables; the answers to the first question and its follow-up. The outcomes to this method are (i) "no" to both bids; (ii) a "no" followed by a "yes"; (iii) a "yes" followed by a "no"; (iv) "yes" to both bids. The second offered threshold is clearly not independent of valuation information, which the respondent has revealed in answering the first WTP question. The sequence of questions isolates the range in which the respondent's true WTP lies, placing it into one of the following four intervals: $(-\infty, t_i^L)$, $(t_i^L, t_i^I), (t_i^I, t_i^H)$ or $(t_i^u, +\infty)$.

The second bid, in conjunction with the response to the initial preference decision, allows both an upper and a lower bound to be placed on the respondent's unobservable true WTP. If the second decision is in the same direction as the first (yes, yes; no, no), it raises the lower bound or lowers the upper bound, respectively. We therefore have the following response probabilities:

$$\Pr(\text{yes, yes}) = \Pr(Y_i \geq t_i^H \geq t_i^I) = 1 - F(t_i^H) \quad \text{..... (4.3)}$$

$$\Pr(\text{yes, no}) = P_r(t_i^I \leq Y_i \leq t_i^H) = F(t_i^H) - F(t_i^I) \quad \text{..... (4.4)}$$

$$\Pr(\text{no, yes}) = P_r(t_i^L \leq Y_i \leq t_i^I) = F(t_i^I) - F(t_i^L) \quad \text{..... (4.5)}$$

$$\Pr(\text{no, no}) = P_r(Y_i \leq t_i^L \leq t_i^I) = F(t_i^L) \quad \text{..... (4.6)}$$

Given this data, a log-likelihood formulation of the double-bounded model is applicable.

$$LogL = \sum_{i=1}^{n} \left\{ \left(I_i I_i^H \right) \log\left[F\left(\left(t_i^H - x_i' \beta \right) / \sigma \right) \right] + \right.$$

$$\left. + I_i \left(1 - I_i^H \right) \log\left[F\left(\left(t_i^H - x_i' \beta \right) / \sigma \right) - F\left(\left(t_i^I - x_i' B \right) / \sigma \right) \right] \right.$$

$$+ \quad I_i^L (1 - I_i) \log\left[F\left((t_i^I - x_i'\beta)/\sigma\right) - F\left((t_i^L - x_i'B)/\sigma\right)\right]$$

$$+ \quad (1 - I_i)(1 - I_i^L) \log\left[F\left((t_i^L - x_i'\beta)/\sigma\right)\right] \ \} \quad \text{..... (4.7)}$$

where t_i^I is the bid offered in the first question; I_i, I_i^H, I_i^L are dichotomous variables with value one if the answer to the initial bid or the corresponding follow-up has been positive, and zero otherwise. Maximisation of the log-likelihood will yield separate estimates of β and σ and their individual asymptotic standard errors. This is made possible because of the presence of t_i in the likelihood function.

The estimated parameters of Cameron's approach can be interpreted in the same way Ordinary Least Squares (OLS) results are interpreted. In other words, the β's can be interpreted as the marginal contribution to change in WTP resulting from a one unit change in the explanatory variable. In the same way, the transformations of Y_i commonly used in OLS models can readily be employed by applying them to t_i. This method also produces asymptotic standard error estimates directly, and no additional computations are required (Cameron and James, 1987). The advantage with this approach is that one is able to determine (systematically and easily) the effect upon the conditional expectations of WTP of changes in the levels of each explanatory variable (Cameron 1988).

As suggested by Kriström (1997), a participation question introduces a spike in the model, and this allows for a non-zero probability of zero WTP. If the respondent answers "no" to the participation question then his/her WTP is assumed to be zero with a positive nonzero probability *a*. If the response is positive, the second question asks whether the individual is willing to contribute t_i, where t_i is one of the possible bids in the study. For household *i*, let S_i=1(0) if the response to the first question is yes (no) and let I=1(0) if the response to the bid t_i is yes (no). Therefore, (S_i, I) can take on the values (1, 1), (1, 0) and (0, 0). The sample log likelihood function corresponding to these possibilities is:

$$\ln L = \sum_{i=1}^{N} [S_i I \ln(1 - G(t_i)) + S_i I \ln(G(t_i)) + (1 - S_i) \ln(1 - G(0))] \quad \text{..... (4.8)}$$

where N is the sample size, $G(0) = a \in (0,1)$ and the probability of a yes response (i.e. that the household accepts the bid (t_i) is assumed to be normally distributed N (0, σ^2).

In order to allow for the estimation of a double-bounded model with a spike and the incorporation of explanatory variables, we use the method proposed by Reiser *et al*. (1999) which suggests breaking up the likelihood function in (4.8) into two separate

parts. In the first part, the spike is estimated using a probit regression, where the dependent variable *w* for each household is 1 or 0 according to whether the WTP is greater or equal to zero.

$$probit\ w_i = \alpha + \gamma x_i \quad (4.9)$$

where *x* is the vector of household characteristics.

The second part consists of optimizing the cumulative distribution function $F(t_i)$ of the sub-population that is willing to pay. In this estimation, the log-likelihood function in equation (4.7) is estimated. The WTP distribution is assumed to be log-normal. The Mean WTP with a spike (unconditional mean i.e. taking into account those with zero WTP) is then calculated as

$$E(WTP) = E(WTP \mid WTP > 0) * \Pr(WTP > 0) + 0 * (\Pr(WTP = 0)) \quad (4.10)$$

5. Results and Discussion

5.1 Socioeconomic characteristics of respondents

Of the 400 questionnaires used in the survey, 381 were valid (with complete information). The sample characteristics are given in Table 5.1. Firstly, the majority of respondents (66.2 percent) were females and this was mainly because they were the ones found at home at the time of the interview. Secondly, even in cases where both husband and wife were at home, the husbands preferred their wives to be interviewed claiming that they are the ones concerned with handling waste. The average age of respondents was 36.7 years, and the average family size was 6 people (the national figure stands at 5). Education wise, 15% had at least a diploma. The monthly average income per household was Ushs 541563.80, with the majority of households (65.1%) having one person contributing to household income. In terms of ownership of the houses, 52.2% were staying in their own houses, 45.2% were renting normally, while only 2.6% were staying in houses rented by a relative or supplied free by the employer. About 41% of the houses had compounds. Households who stay in houses with compounds have alternative ways of disposing of waste such as digging pits or throwing it in their backyards.

Table 5.1: Description and Summary Statistics of Variables

Variables	*Description*	*Mean*	*Std deviation*
Age	Actual age of respondent in years	36.73	13.50
Hhsize	Household size measured by number of adults and children feeding from the same source	5.92	2.76
Education	Education level of the respondent; 1=Diploma and above, 0 otherwise	0.15	0.36
Income	Monthly household expenditure (in Uganda Shillings)	541563	457120
Gender	1=Male; 0 = Female	0.34	0.47
Pay	Whether household has ever paid for waste collection in any form(1= Yes, 0=No)	0.46	0.50
Tenure	Home ownership(1=Owned, 0= Renting)	0.52	0.50
Yard	Whether the house has a compound (yard) or not. (1= presence of a yard, 0= No yard)	0.41	0.49
Problem	Whether household reported solid waste as a major problem (1=Yes; 0=No)	0.55	0.50
Separate	Whether household separates solid waste or not (1=Yes, 2=No)	0.63	0.48

Source: Author's Computation from Survey Data.

5.2 Current Waste Management Practices

Respondents were asked how they store their household waste before disposal. Most of the respondents (81.1%) reported to be having containers where they store their solid waste before disposal. The containers are usually durable plastic bags (50-100 kg capacity) and the practice is to throw away the solid waste and re-use the plastic bags. The remaining 18.9 % who do not have containers throw their waste in the backyard, in pits or burn it in their compounds. In terms of the waste collection service to their households, 22.8% reported that a collection vehicle goes around and they take their waste at a particular pick-up point. The largest percentage (34.9%) however take their waste to communal containers supplied by Kampala City Council (KCC),[7] while 23.3% empty their waste onto an open pile. The results also show that 4% of the respondents hire informal private waste collectors who carry away the waste but they do not know where it is disposed of. Table 5.2 shows the different ways households dispose off solid waste.

7 We found communal containers in two of the parishes surveyed (Naguru and Nsambya). KCC had withdrawn the containers from the other areas studied.

Table 5.2: Current Major Waste Management (Collection Services) in the Surveyed Areas

Management Practices	No of respondents	Percentage
Collection vehicle at a pick-up point	87	22.8
Throwing in a communal container	135	35.4
Throwing in open field (illegal pile)	72	18.9
Throwing in backyard/pit or burying in own land	72	18.9
Don't know	15	4
Total	381	100

Source: Author's Computation from Survey Data.

The households which do not burn or throw their waste in their backyards were further asked who normally takes the waste bins out to be emptied. The results indicate that 32.4% of the households make use of private informal waste collectors within the community to take the waste bins out. This is followed by the housewives (20.7%) and by children between the age of 13 and 18 who constitute 17.5% (see Table 5.3). This result shows that the informal private sector plays a major role in solid waste management, and therefore, there is a need to integrate them into waste management planning.

Table 5.3: Who Normally Takes the Waste Bin Out to be Emptied?

Position in the household	Frequency	Percentage
Head of household	22	7.1
Spouse (female)	64	20.7
Any member of the household	33	10.7
Maid/Houseboy	19	6.2
Any child between the age of 6 and 12	16	5.2
Any child between the age of 13 and 18	54	17.5
Informal garbage collector (scavenger)	100	32.4
Don't know	1	0.3
Total	**309**	**100**

Source: Author's Computation from Survey Data.

Respondents were also asked about their perception towards the present garbage collection systems. Only 24% of the respondents were satisfied with the present waste collection systems. This result implies that there is an urgent need for improvement in solid waste management services in the study areas. The main reasons why people were not satisfied with the current waste collection services in order of importance were; the interval between collections is too long (40.3%), persistent squalor at the

communal containers/illegal piles (27.1%), service being unreliable (12.5%) and the location of the communal container or pickup point is unsatisfactory (11.1%). Some of those who take their solid waste to the garbage collection truck complained of the irregularity of the truck, which results into it getting too full whenever it comes to collect garbage. This is what one of the respondents had to say:

" The vehicle takes long to come. Some times it comes after 2 weeks and at times even after a month. When it comes, everyone rushes to have her waste taken. Unfortunately the vehicle cannot take all the waste. They over fill it such that even as it moves some waste falls off back to the road. In fact some people remain at the pickup point with their waste. So what do you expect? Do you expect me to carry back the waste and keep it in my home for another two or three weeks? All I can do is leave it at the pick up point."

5.3 Valuation Results

The majority (79.8%) of the 381 households considered in this study were willing to pay for a door-to-door waste collection service (their WTP>0). The main reasons given by the 20.2% who were not willing to pay (WTP=0) were; they could not afford to pay for garbage collection (40.5%), it is a responsibility of KCC (29.1%), satisfied with the current way they dispose of their garbage (16.3%), and they do not believe the service will be reliable (13.9%).

Of the 77 respondents with a zero valuation for WTP, thirty two (41.6%) were considered to be protest responses to the valuation question, constituting 8.4% of the whole sample. Two inconsistent responses were also identified. Thus, in total we had 34 invalid responses.

Ordinarily, in estimating the determinants of willingness to pay for a project, the most convenient approach would be to discard the invalid responses and use the valid ones. However, simply discarding the invalid responses could lead to sample selection bias, which may possibly affect the validity of the estimates obtained from the given sample for the purpose of policy inference. This is because the sample remaining after excluding the invalid responses may not be a random sample (although the initial sample was a random one) (see Mekonnen, 2000; Calia and Strazzera, 2000; Strazzera *et al*., 2003a and 2003b; Fonta and Ichoku, 2005).

Removal of invalid responses can be justified if the group of respondents with invalid responses is not significantly different from the remainder of the sample, at least in terms of the covariates employed in the WTP model. The means of the variables of the valid and invalid response groups are compared and any significant difference between these two groups of respondents is an indicator of the presence of sample selection bias and justifies the use of a sample selection WTP model (Vella, 1998; Strazzera *et al*., 2003a, 2003b). Vella (1992, 1998) argues that once there is no significant difference in the characteristics of the two sub-samples, then there is no need of using a sample selection model.

To test whether the respondents with valid responses and those with invalid responses differ significantly in characteristics, the individual t-test is used. The null hypothesis is that there is no difference in means of variables between the valid responses and invalid responses. That is, the t-statistic is calculated for the null hypothesis $\bar{x}^{valid} - \bar{x}^{invalid} = 0$, where $\bar{x}^{valid}$ is the mean characteristic of respondents with valid responses and $\bar{x}^{invalid}$ is the mean characteristic of those with invalid responses. All the absolute values of t-statistics for the variables did not exceed the critical value (1.96) at the 5% level, thus the null hypotheses could not be rejected. This study therefore uses only the valid responses since there is no significant difference between the characteristics of the valid sub-sample from the invalid sub-sample.

5.3.1 Sample Frequencies to Willingness to Pay

Table 5.4 column 2 shows that the share of "yes" responses decreases as the bid amount increases ranging between 93% and 14%. Ninety three percent of the respondents who were asked a bid amount of 1000/= answered "yes", at bid amount 2000/=, the percentage of those who said "yes" decreased to 56.8 percent, and at the highest bid amount 4000/=, only 13.9 percent answered "yes". In a well developed CVM survey, the number of "yes" answers should decline as the bid amount increases (Carson, 2000).

Table 5.4: Sample Frequencies to the WTP Questions for Door-to-Door Solid Waste Collection[8] (n = 302)

Initial Bid (UGX)	Yes[a]	Yes-Yes[b]	Yes-No	No-Yes	No-No	Number asked
1000	92.8	35 (50.7)	29 (42)	5 (7.2)	0.0	69
2000	56.8	15 (20.3)	27 (36.5)	26 (35.1)	6 (8.1)	74
3000	33.8	9 (11.3)	18 (22.5)	30 (37.5)	23 (28.8)	80
4000	13.9	7 (8.9)	4 (5.1)	34 (43.0)	34 (43.0)	79

Source: Authors' Computation

Notes: a*:* Column two refers to a yes response to the initial bid only

b: In parenthesis are percentages

Furthermore, the proportion of "yes-yes" answering pattern falls as the bid amount is increased. For example, of those who were asked an initial bid of 1000/=, around 50.7% were willing to pay at least 2000/= for a door-to-door solid waste collection system, while only 8.9% were willing to pay at least 8000/=. The proportion of "no-no" answers increases as the bid amounts on the WTP question are increased. At bid amount 1000/=, there is no "no-no" respondents, implying that all the households (who are willing to pay something) are willing to pay at least 500/=[9] for door-to-door solid waste collection service, while 43% answered "no-no" to the highest bid. The remaining answering patterns, "yes-no" and "no-yes" responses indicate that the respondents' maximum WTP lies between the initial bid amount and the increased, and decreased, bid amounts respectively. These results can therefore be interpreted as a signal of the internal validity of the CVM answers, confirming the selection of an efficient bid design. Table 5.5 and Figure 5.1 show the survival probabilities from the non-parametric analysis of the double-bounded responses.

8 This table shows only those who were willing to pay. Since there was a participation question, the bid values were presented to only those respondents who were willing to contribute something.

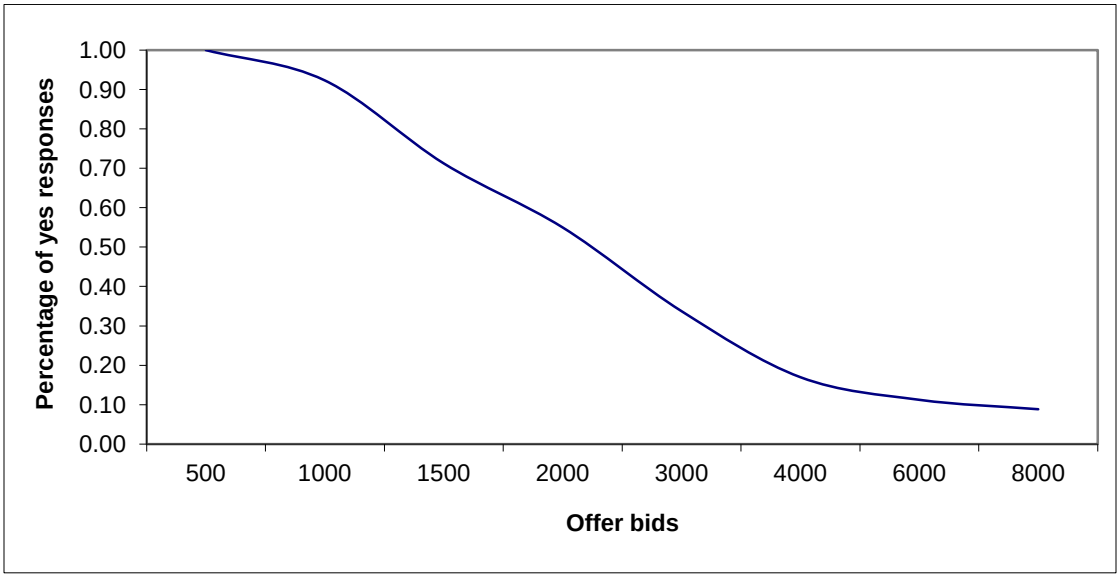
9 Since 1000/= was the lowest bid in the bid design and the follow-up bid was halved if the response to the initial bid was no, then the lowest follow–up bid asked was 500/=.

Table 5.5: Survival Probabilities Estimated for Double-Bounded Responses[10]

Bid (Ushs)	Number of Available Subjects	Number of subjects who are willing to pay the Bid	Probability of saying yes
500	69	69	1
1000	143	132	0.923
1500	80	57	0.713
2000	222	122	0.549
3000	80	27	0.338
4000	153	26	0.169
6000	80	9	0.113
8000	79	7	0.089

Source: Author's Computations

Fig. 5.1: Survival Function for the Double-Bounded Responses



.

Source: Authors' own compilation

The distribution of the WTP helps us to know the percentage of the sample that would be willing to pay for the service at each particular bid value. For example, from Fig 5.1, it can be seen that at bid amount 500, all the sample respondents (who are ready to participate in the programme) are willing to pay for the service. At bid amount 1000, 92% of the respondents would be willing to pay to have the service. At 1500, only 71% of the households will be willing to pay for the service. The median WTP is 2100/= and

10 We use Terawaki's (2003) Second Nonparametric Approach for Double- Bounded Dichotomous Contingent Valuation. For an extensive discussion of the method, see Terawaki (2003).

at this price, 50% of the households would be willing to pay.[11] This information is necessary for the policy makers and private companies when deciding on tariffs.

5.3.2 Determinants of willingness to pay

Before estimation of the WTP function, a starting point bias test was performed to check if the double-bounded model was the most appropriate model to estimate. Alberini (1995a) and Alberini *et al*. (2005) show that when there is no starting point bias, the double-bounded model is the correct model, and the estimates of the mean WTP are virtually unbiased. To test for the presence of starting point bias, 3 bid set dummy variables[12] were included among the regressors of the double-bounded model, and then the null hypothesis that the coefficients on these dummies are jointly equal to zero was tested.[13] Using the Wald test statistic, the null hypothesis that all the coefficients of the bid set dummies in the model are not significantly different from zero could not be rejected, implying that there is no evidence of starting point bias on the bid amounts. The final results of the estimations are shown in Table 5.6. Column two presents the results of the spike probit in which the dependent variable is either 1 or 0 corresponding to whether the household's willingness to pay is greater than or equal to zero. The third column shows the results of the double-bounded estimation for only those with a positive willingness to pay.

The hypothesis that all coefficients except the constant terms (in the two models) are simultaneously equal to zero was tested using the Wald statistic. The calculated Wald chi-squares are 52.40 and 81.17 in column 2 and column 3 respectively, leading to the rejection of the hypothesis at a 0.01 probability level with 11 and 10 degrees of freedom respectively. This indicates the capability of the models to explain the variation in WTP for improved solid waste management services.

11 The median is the value of the WTP at which the survival function equates to 0.5.

12 Bid set dummies mean a set of dummies where the first dummy takes on a value of one if the respondent was assigned to the first bid set used in the survey, and 0 otherwise etc.

13 This method was also used by Whittington et al, 1990; Green and Tunstall, 1991; Cameron and Quiggin, 1994; Altaf et al, 1996 and Chien et al, 2005

Table 5.6: Estimation Results for the Double-Bounded Model.

Variables[a]	The Spike (Probit)	Participants (Double-Bounded)
Constant	-1.99 (-0.04)	3.49 (3.26)***
Lincome	0.26 (2.70)**	0.36 (4.10)***
Gender	0.16 (0.55)	0.16 (1.18)
Tenure	0.52 (1.99)**	0.21 (1.88)*
Education	0.58 (1.71)*	0.25 (1.90)*
Age	-0.03 (-3.17)***	-0.01 (-3.05)***
Pay	0.64 (2.77)**	0.18 (1.63)
Problem	0.44 (2.06)**	-0.08 (-0.83)
Waste		-0.03 (-0.79)
Household size		-0.003 (-0.12)
Separate	-0.01 (-0.03)	-0.17 (-2.33)**
Kawempe	0.73 (2.11)**	
Makindye	0.09 (0.30)	
Rubaga	0.01 (0.03)	
Log pseudo-likelihood	-113.13	-316.57
Sample size	347	302
Wald Chi2 (11)	52.40	Wald Chi2 (10) = 81.17
Prob>Chi2	0.0000	0.0000
Pseudo R^2	0.19	

Notes:

[a] The dependent variable in column 2 is 1 or 0 resulting from the participation question.

[b] The dependent variable in column 3 is the interval in which the WTP falls.

[c] The numbers in Parentheses are z-statistics.

[d] *, ** and *** indicate significance at the 10%, 5% and 1% levels respectively.

[e] Kawempe, Makindye, and Rubaga are location dummies. Nakawa is the reference. These are the four divisions that were surveyed.

From the results in Column 2, it can be seen that household income, tenure, education level of the respondent, age of the respondent, whether the household has ever paid for garbage collection, whether solid waste is viewed by the household as a major problem, and household being located in Kawempe are the main factors determining the household's decision of whether to pay or not to pay for the proposed door-to-door solid waste collection service. The negative coefficient on the age variable implies that the young respondents are more willing to pay for the improvement than the old. Income, education and whether solid waste is viewed by the household as a major problem, tenure, and pay positively affect the decision to pay for the improved solid waste management service, implying that richer households, the educated, those who perceive solid waste as a major problem and those who have ever paid for solid waste collection

are more willing to pay for the improvement than the poorer, the less educated and those household who perceive solid waste as not being a major problem to them.

The more educated being more willing to pay may be explained by the fact that educated people can access information about the environment and health more easily than the less educated. Educated people are more likely to read newspapers and magazines, and therefore have a higher awareness of the dangers of poor waste management and the benefits of proper waste disposal.

From the coefficients of the location dummies, only Kawempe has a positive and significant coefficient implying that households in Kawempe Division are more willing to pay for solid waste collection service than those in Nakawa. There is no significant difference between Makindye, Rubanga and Nakawa. This result is not surprising given the fact that among all the divisions, there were no KCC communal containers in Kawempe. Thus, the households depended on the garbage trucks (which were irregular) and the informal waste collectors.

Despite the fact that solid waste related issues are handled by females in the home, the results show that gender does not significantly influence willingness to pay. Fonta *et al. (*2008*)* found gender to significantly influence household's willingness to pay. Also, the amount of waste generated by a household and whether the household practices some form of waste separation at source have no significant influence on the decision to pay for solid waste collection.

Column 3 gives the results of the double-bounded estimation for only those respondents who have a positive willingness to pay. Household income has a statistically significant and positive effect on the amount a household is willingness to pay; the amount of money a household is willing to pay for door-to-door solid waste collection service increases with household income. For example, if monthly household income increases by 10%, the amount of money a household is willing to pay for door-to-door solid waste collection will increase by 3.6% per month.[14]

The coefficient on the age variable has a negative sign, which means that monetary valuation decreases with age of the respondent. Younger respondents are found to be willing to pay more for door-to-door solid waste collection service. This could be

14 As explained in section 4, when the Cameron Approach is used, the resulting coefficients can be interpreted in the same way OLS estimates are interpreted. Since we have assumed a log-normal distribution and the income variable is in logs, the income coefficient can be interpreted as a percentage change.

explained by the fact that older people are more resistant to changing the ways of doing things around their houses, and since paying for waste collection service is relatively new in Kampala, older respondents are less likely to be willing to pay more. For each additional year in age, the willingness to pay for door-to-door solid waste collection decreases by 1.4%. Altaf *et al*. (1996) also found a negative relationship between age of respondent and willingness to pay for improved solid waste management for Gujranwala (Pakistan).

As expected, households who are staying in their own homes (*Tenure*) are willing to pay more than those who are renting. This may reflect a security aspect of willingness to pay, where the homeowners know that they will be staying in their homes for long, or if they decide to move, the waste collection service in the area will have increased the value of the home. Homeowners are willing to pay 21% more for solid waste collection service than those who are renting. The implication of this result is that since those who are renting are willing to pay less for door-to-door solid waste collection service, the garbage fee can be included in their house rent so that it becomes the responsibility of the landlord to pay to the service provider.

In this model, the reference education level is those with below diploma. The sign on the education variable is positive and significant. This implies that the higher the education level of the respondent, the more amount he is willing to pay for door-to-door solid waste collection service. The finding that a higher educational level increases the amount that a household is willingness to pay for solid waste management is not surprising as more education enhances an individual's willingness to take responsibility for his/her own health. Those who have attained at least a diploma are willing to pay 25% more than those with an education level below diploma.

As anticipated, households who do separate their waste are willing to pay less than those who do not separate. They are willing to pay 17% less than their counterparts. This finding is not surprising because households find other uses for the separated waste. For example, they give peelings to domestic animals, some metals are sold, and plastic containers are used as flowerpots. In this way, the amount of waste available for disposal reduces and therefore the household will not be willing to pay more for the available solid waste.

The variables *Problem, Pay, Gender, Waste and Hsize* are found not to significantly affect the amount a household is willing to pay for solid waste collection services.

The results in Column 2 and column 3 show that some variables may not influence a household's decision to pay, but do influence the amount that the household is willing to pay for a door-to-door solid waste collection service, for example *separate*. On the other hand, some variables may influence the decision to pay for solid waste collection but not the amount the household is willing to pay, for example, *problem* and *pay*.

5.4 Welfare Analysis

The main purpose of conducting a CVM study is to obtain a welfare measure, such as mean or median WTP. In this study, the welfare measure refers to the amount that households are willing to pay monthly for a door-to-door solid waste collection service. The results can be used as a guide for policy makers concerning issues such as tariff and is also an indication of the benefits of improving solid waste management. For the open-ended question, the mean is obtained as Ushs 2288. Table 5.7 presents the welfare estimates with the corresponding 95% confidence interval. The unconditional mean WTP estimate was obtained using equation (4.10) and is Ushs 2439. This implies that on average, each household is willing to pay 2439/= ($1.34) per month to have a door-to-door solid waste collection service. Also, the mean WTP of the double-bounded model is greater than the mean WTP from the open-ended question.

Table 5.7: Mean WTP per Household per Month and their Confidence Intervals (in Uganda Shillings)

	Double bounded without a Spike	Double bounded with a spike
Mean without covariates	3089.4 [2796.4, 3382.4][a]	2409.7 [2181.2, 2638.3]
Mean with covariates	2678.5 [2366.9, 2990]	2438.6 [2154.9, 2722.3]

Source: Author's own computation.

Note: a: the confidence intervals are estimated using the delta method.

5.5 Analysis of Cost and Revenue Generated from Garbage Fees

In this section, the revenues and costs of residential garbage collection are discussed. The cost of 100% collection of solid waste from Kampala is said to be about Ushs 500 millions per month (Kasozi, 2008). Residential solid waste generation is estimated to be 840 tonnes per day, which is about 53% of the total solid waste generated in Kampala

(Banga, 2008). Therefore, the cost of collection of residential solid waste would be Ushs 265 millions. The total number of households in the surveyed divisions is 283404. Taking the bid value as the amount to be charged and the percentage of households' willing to pay at each bid value as the compliance rate, we find that the least amount of revenue will be generated when the garbage fee is Ushs 500, and the highest revenue will be generated when the fee is Ushs 2000. At Ushs 500, there is total compliance, but the revenue generated does not cover the cost of collection. At Ushs 2000, the revenue and thus the profits are maximum, but with only 55% compliance. At the mean WTP of Ushs 2439, the compliance rate would be 45%. The firm will break even if the fee is between Ushs 500 and Ushs 1000. At Ushs 1000, there will be profits realized and the compliance rate is also high (92%).

6. Conclusion

The results show that a high percentage of households are willing to pay for a door-to-door solid waste collection service. This is contrary to the common belief that people are opposed to paying for solid waste management services, and that it is the responsibility of government. The mean WTP obtained is 2439 ($1.3), and is an indicator of what people are willing to pay on average, for a door-to-door solid waste collection service per month. However, although it is important to calculate the mean WTP, the mean alone does not convey much information to the policy maker. From the distribution of the WTP values, we see that at the mean WTP, about 45% of the sample (those willing to pay something) would be willing to pay that amount. This would imply that the garbage problem is not solved. The question is, should the garbage charge be based on the mean WTP? To avoid the free rider problem, a socially acceptable fee should be set in which the majority of people are willing to pay. The government could then come in to subsidize the private company if need be.

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