WILLINGNESS TO PAY FOR IMPROVING URBAN WATER SUPPLY IN A DEVELOPING COUNTRY: A SAMPLE-SELECTION MODEL

Salvador del SAZ-SALAZAR
Department of Applied Economics II
Faculty of Economics
University of Valencia, Spain
Edifici Oriental, Avda. dels Tarongers s/n,
46022 València , Spain.
Tel. +34 96 382 83 49
Email: Salvador.Saz@uv.es

Francisco GONZÁLEZ-GÓMEZ
Department of Applied Economics
Institute of Water Research
University of Granada, Spain
Faculty of Economics and Business Administration
Campus de Cartuja s/n
18071 Granada, Spain
Phone-Fax: +34 958244046
Email: fcojose@ugr.es

Jorge GUARDIOLA
Department of Applied Economics
Institute of Water Research
University of Granada, Spain
Faculty of Economics and Business Administration
Campus de Cartuja s/n
18071 Granada, Spain
Phone-Fax: +34 958244046
Email: jguardiola@ugr.es

Abstract.- In this study the Contingent Valuation Method (CVM) is applied in order to estimate the willingness to pay (WTP) of the inhabitants of Sucre (Bolivia) for an improvement in the urban water supply system. The study finds that about 55 per cent of households would be willing to pay an increase in their water bill for an improvement in the service. Hence, in order to deal with the problem of protest responses and the possible presence of a sample selection bias, a Heckman's two-step model was estimated. More specifically, the econometric analysis undertaken reveals that there is no evidence of sample selection bias and that WTP is positively related with the respondents' household income, their level of education, the continuity of the water supply service, and the fact of being forced to carry water to cover their basic needs of drinking, cooking and hygiene.

JEL: Q25, Q51, C35.

Keywords.- Contingent Valuation Method; Sucre, Bolivia; Urban water management; Willingness to Pay; Sample selection model.

1. INTRODUCTION

Considerable effort has been made in recent years to improve access to water worldwide since the situation is far from perfect particularly in less developed countries in which about 884 million people do not have access to an improved water source (WHO/UNICEF, 2012). In order to create a water supply system and maintain and improve the service, there must be sufficient financial resources. Regardless of how each country decides to meet the cost of the investment necessary to accomplish this goal, the users of the service must contribute either partially or in full to the cost of the service through the water bill (Lee and Floris, 2003). The problem in developing countries is the low cost recovery rates of these services as a consequence of the extra effort required, in relative terms, from households. Therefore, in this particular context, when water improvement projects are going to be implemented they face serious difficulties to recover investment costs since there is a huge gap between the finance required to improve the water supply system, and the revenue generated by the existing water tariff system (Tarfasa & Brouwer, 2013).

Before making an investment, the local public and private authorities responsible for the urban water service will be interested in ascertaining users' willingness to pay for the service. The literature on this topic has focused on various issues: improving access to water (Venkatachalam 2006; Wang et al. 2010; Lee et al. 2013), service continuity (Hensher et al. 2006; Genius et al. 2008), water quality (Nallathiga, 2009; Bilgic 2010; Polyzou et al. 2011) and wastewater treatment (Kontogianni et al. 2003; Genius et al. 2005).

This paper applies the Contingent Valuation Method (CVM) (Mitchell and Carson, 1989) to estimate how much are willing to pay the inhabitants of Sucre (Bolivia),[1] for benefiting from an improvement in the water supply system. In a typical CVM survey, respondents are asked about their willingness to pay (WTP) for the hypothetical provision of a public good or their willingness to accept (WTA) for its hypothetical loss. The measures of value obtained represent the economic benefits (or costs) of the proposed change and therefore should be aggregated in a cost-benefit framework to obtain the social benefits (or costs) from public policies that usually improve (or worsen) social wellbeing (Hanley & Barbier, 2009). However, CVM is not a free-of-controversy method since critics argue that this technique is unable to generate reliable estimates of value given its hypothetical nature and other sources of error (Hausman, 2012). Nevertheless, and despite these limitations, today a considerable body of evidence supports the view that contingent valuation done appropriately can provide a reliable basis for valuing well defined public goods (Carson, 2012).

The case study presented is based on information gathered from 324 households. In order to deal with the problem of the large number of zero responses obtained, a sample-selection model was estimated following Calia and Strazzera (2001) and Strazzera et al. (2003). Another interesting feature of this research is that we analyse household WTP in a climate of confrontation between the community, the local

[1] A better access to water and sanitation is necessary in Bolivia, not only in Sucre, as it is an important factor in explaining the high risk of death (OMS, 2011). Bolivia, jointly with Guatemala, Honduras and Nicaragua are the South American countries with the higher risk for inefficient access to water and sanitation (OMS, 2011). In Bolivia, the death ratio derived from diseases related to water is around 0.05 per 100,000 inhabitants (Prüss-Üstün et al., 2008). In the infant population the risk is even greater. Each year, around thirty thousand children die in Bolivia because of diarrhoea caused mainly by diseases or parasites from unsafe water. Moreover, a 46 per cent of the Bolivian children younger than five years suffer diarrhoea caused by lack of safe water access and lack of hygienic habits such as washing hands with soap (UNICEF, 2009).

government and the company that manages the water service. Thus, the study is interesting because it explores respondents' WTP in a city where the urban water supply system is deficient and people are discontent with the company that manages the service. A priori, WTP is expected to be lower than in other circumstances. The reason for this is that if the population is dissatisfied with the company that manages the service, they will react negatively to an increase in the water bill, thus the people of Sucre could decide that the company should improve the management of the service provided before they are asked to pay more for it.

The reminder of the paper is organised as follows. Section two analyses the causes behind the conflict in the management of the water service in Sucre that are influencing the decisions taken by the water utility. Section three explains the survey process, the data and the methodology used in the study. Section four presents the results, while the last section concludes presenting the policy implications.

2. CAUSES OF THE WATER MANAGEMENT CONFLICT IN SUCRE

The Municipal Drinking Water and Sewerage Company of Sucre [Empresa Local de Agua Potable y Alcantarillado de Sucre (ELAPAS)] runs the water service in Sucre. ELAPAS is a decentralised municipal company that operates independently, although the city mayor is the general director of this company. A concession contract between the Water Supply and Sanitation Taxation and Social Control Authority, an independent public body attached to the Ministry of the Environment and Water, and ELAPAS, transferred in 1999 the management of the service for a period of 40 years to this latter.

The water service can clearly be improved since serious shortcomings remain (Guidi et al., 2013). However, the current climate of confrontation can hamper the implementation of the required improvements. Several factors contribute to the tense relationship between the company, the local government and the people of Sucre.

The first factor to highlight is the dispute over the area where the service is provided. According to the contract signed by both parties, ELAPAS must provide the service to five of the eight districts in the city, which account for close to 94% of the population. The remaining 6% of the population who do not reside in the districts covered by the service area, oblivious to those who signed the contract, demand that the local government and ELAPAS provide them with access to water. Meanwhile the problem is mitigated by distributing water in tankers.

The second cause for conflict is related to the supply cuts suffered by the neighbourhoods in the higher part of the city, which accounts for approximately the 25% of the population. The water supply is mainly based on a gravity system. As a result, service regularity to these neighbourhoods depends on the water level of the 8 storage tanks located in the highest part of the city. When there is a shortage of water in the upper part of the city, the solution provided by the company is to distribute water in tankers.

Another source of frequent tension between the people of Sucre and ELAPAS is that due to the lack of investment in improving and old and obsolete supply network, pipes burst frequently causing water supply cuts in the lower part of the city. The temporary solution, once again, is to distribute water through tankers until the pipe is repaired.

The lack of dialogue and understanding between ELAPAS and the community has already produced significant confrontations and social conflicts in the city, giving rise to demonstrations outside the ELAPAS main office (Unidad de Análisis y Conflictos, 2010).

In order to improve the poor service provided to the public, ELAPAS could consider, among other strategies, raising water prices in the city of Sucre. Thus, an increase in water bills could generate enough revenue to improve the service. The question we raise is what would happen if the company decided to increase the price of water bearing in mind the current climate of confrontation described above? Would the people of Sucre be willing to pay more for water if the company promised to improve the service in the current climate of conflict?

3. SURVEY PROCESS, SAMPLING AND METHODOLOGY

3.1 Survey process and sampling

When implementing a CVM study, the design of the survey instrument is a crucial stage since the values obtained are dependent on the information provided to the respondents. Thus the pre-test of the questionnaire, along with focus groups and in-depth interviews, can be extremely valuable in determining the background information needed and how to effectively communicate it to the respondents (Chilton and Hutchinson, 1999). In this study, a random sample of 35 inhabitants of the city of Sucre was used for pre-testing the questionnaire. This was very useful to make sure that everything worked the way it was intended while allowing us to identify any potential problem. In any case, the pre-test should be as large as your budget and time constraints allow (Whitehead, 2006).

After the pre-test, a survey of 324 households was conducted in the six urban districts of the city of Sucre that ELAPAS must supply water to. According to the Bolivian Population Census, in 2012 the population of Sucre was 237,480 inhabitants while the number of households was 69,252, therefore the sample size represents approximately the 0.5% of the entire population of households. We did not take into account districts 7 and 8, which are predominantly rural and where approximately 16,000 people live on farm and handcraft activity. Quotas on numbers of respondents with particular characteristics were imposed to help ensure that the sample was representative of the entire population. Stratified sampling, compared to simple random sampling, requires smaller sample sizes for the same margin of error (Daniel, 2012).

The survey was carried out between the months of November 2010 and January 2011. The 52-question questionnaire used was divided into four sections as suggested by Bateman et al. (2002): (i) attitudes towards the environment, access to water at home, and level of satisfaction with the service provided; (ii) respondents' profile; (iii) contingent scenario with WTP elicitation mechanism, and (iv) a final section with the respondents' main demographic variables, which help to interpret and validate WTP estimates.

The specific wording of the valuation scenario read to respondents was as follows:

> *As previously explained, the ELAPAS is intended to invest in improvements to the urban water service. As a result of these investments, all the people of Sucre would be guaranteed access to tap water in their homes. Furthermore, the water would not smell, would be colourless and would not taste of anything and could be consumed directly from the tap without any*

danger to people's health. However, these improvement measures costs a great deal of money. Given limited public resources, in order to fund this policy all the citizens would be asked to pay a monthly increase on their current water bill. If the majority of households are in favour, this project will be carried out, while if a majority are against the proposal, then this service will remain as it is today.

Now, in a similar way to Polyzou et al. (2011), we used two valuation questions to ascertain respondents' WTP. The first question was the following one:

Considering all the benefits that stem from this project, would you willing to contribute financially to such a project?

1. Yes: ___ 2. No: ___ 3. Don't know: ___

Respondents who answered affirmatively to this previous question were asked the following open-ended question in order to obtain their maximum WTP:

How much more would you be willing to pay in your monthly water bill in exchange for an overall improvement in the service? ___________

The overall improvement in the service was defined as an improvement in each one of these three variables considered: the source of supply, the continuity in the service without cuts, and the quality of the water supplied.

Although the NOAA panel on Contingent Valuation (Arrow et al., 1993) recommended the use of dichotomous-choice questions for eliciting respondents' WTP, Genius et al. (2008) point out that is has long been recognized that the information conveyed by yes-no type questions is limited while requiring the collection of a large number of interviews to be statistically efficient. Hence, as we faced severe funding constraints, the open-ended question appeared as the most convenient despite its shortcomings (more difficult to answer, more prone to strategic behaviour, etc.). In the CVM literature on water resources, the use of open-ended questions is not an uncommon occurrence. For example, Birol et al. (2006) used this elicitation format to estimate the non-use values of a wetland in Greece while Cooper et al. (2004) addressed the issue of motivation for contingent values in a study about water quality improvement in a lake.

Following Ramajo-Hernández and Saz-Salazar (2012), the payment vehicle used was an increase in the current water bill since it was considered the most appropriate with regard to the credibility of the hypothetical market, while being plausible and familiar to the population surveyed. In addition, this obligatory payment avoids the free-rider behaviour typical of voluntary payments (Carson, 1997).

3.2 Methodology

A major concern in the CVM literature is the treatment of zero responses since non-participation can have a substantial impact on WTP estimates (Lindsey, 1994; Haab, 1999; Dziegielewska and Mendelsohn, 2007). Hence this problem is frequently viewed as a threat to the validity of the CVM in informing decision-making. In order to distinguish between "true zero" values and "protest" responses, CVM practitioners have long time used debriefing questions to clarify the reasons behind the refusal to participate in the hypothetical market created. The standard procedure has been to remove protest responses from the sample. However this may not be the correct procedure if protest responses induce a selectivity bias, i.e. this occurs when the group of protesters is significantly different from the rest of the sample, so when protesting these individuals are selecting themselves.

To test for the presence of sample selection bias in our data set, we apply a two-step Heckman selection model that has often used to check the existence of selection bias in CVM literature. This model basically consists of two steps: in the first step, the decision of the respondent to pay ("yes" response) or not to pay ("no" response) is modeled. In the second step, how much the respondents are willing to pay is modeled for all observations with a positive WTP. Thus the responses of the respondents can be modeled simultaneously using two equations: the first one is the "selection" equation and the second one is the "elicitation" or "valuation" equation.

Following Strazzera et al. (2003) and Messonnier et al. (2000), let Y_1 denote the amount and individual is WTP, let Y_2 be a dichotomous variable that takes the value 1 if the individual reveals it (participate) and 0 otherwise (do not participate), and let x and z be vectors of explanatory variables for the valuation and participation equations respectively. Then we can write for the valuation equation:

$$Y_{1i} = x'_i\beta + \sigma u_i \qquad (1)$$

where σ is a scale factor, Y_{1i} is observed only when the individual participates in the market ($Y_{2i} = 1$), and for the participation equation:

$$Y_{2i} = \begin{cases} 1 \; if \; z'_i\gamma + \varepsilon_i \geq 0 \\ 0 \; if \; z'_i\gamma + \varepsilon_i < 0 \end{cases} \qquad (2)$$

were u_i and ε_i are identically independently distributed (i.i.d.) normal errors. When estimating the model, in the first step the participation equation is estimated using a probit model, which in turn gives an estimate of the inverse Mills ratio (λ). The second step consists in an OLS regression for the valuation equation (Y_{1i}) where apart of x, λ is also included as an explanatory variable. If the coefficient of λ in this second regression equation is not significant, it indicates that selection bias may have not been present.

4. RESULTS AND DISCUSSION

The aim of this section is twofold. On the one hand, we try to identify the determinants of respondents' WTP through the construction of an equation that predicts WTP for the public good with reasonable explanatory power and coefficients with the expected signs, thus validating the results obtained from a theoretical point of view (Carson, 2000). And, on the other hand, in order to deal with the non-response problem a Heckman two-stage model is estimated.

The 54.63% of the respondents in the sample stated they would be willing to pay more for improving the water supply service (see table 1). The main reasons behind a "no" WTP response were that users believe they are already paying enough for water, that the company is inefficient or that it is the responsibility of the public sector. Respondents stated they were willing to pay an average of 10.53 Bolivian pesos more a month to improve the water service (1.47 US dollars). Regarding the spatial analysis of WTP, the lower value is obtained in district 1 (6.46 Bolivian pesos) since only 26.83% of the respondents were willing to pay, while district 3 exhibits the higher value (15.79 Bolivian pesos). This result will be reinforced when analysing WTP determinants in the next lines.

*** TABLE 1 ABOUT HERE ***

Taking this full-sample mean WTP as a benchmark, and considering that the average water bill paid in Sucre amounts to 88 Bolivian pesos, it implies that the hypothetical increase in water bill at the level of individual household would be of 12%. Although it is difficult to compare different contingent valuation studies since it is well known that the results of any contingent valuation study are sensitive to the assumed econometric specification (Bengochea-Morancho et al., 2005), we can say that WTP for an improvement in the water service in the city of Sucre is low in comparison to the results of similar research. In this sense, Casey et al. (2006) found that only 8% of the population of Manaus (Brazil) said they were not willing to pay for an improvement in the service. Genius et al. (2008) obtained that 29.4% of the sample interviewed in the Municipality of Rethymo (Crete) would not be willing to pay more to improve the water service. Arouna and Dabbert (2012) obtained that 94% of respondents are willing to pay to improve rural water supply in Benin. Nevertheless, there are also cases in which WTP is lower than in our study. For example, in the city of Mytilene (Greece), Polyzou et al. (2009) found that only 40% of the respondents were willing to pay to improve water quality, while in the study conducted by Raje et al. (2002) nearly 50% of respondents were ready to pay partially more than their current bill amounts.

The explanation for this relatively low WTP could be the current climate of confrontation in the city of Sucre. If users are dissatisfied with the service provided by the company, they can be expected to provide greater opposition to an increase in the water bill. In any case, it must be said that the research provides no conclusive evidence of this relationship since the questionnaire did not include any question aimed at capturing the ‘degree of conflict’ between the community and the water management company.

Table 2 shows, sorted by groups of respondents, summary statistics of the data relevant to the analysis carried out considering both some of the main variables used in the estimation and other variables related to the socio-economic profile of the respondents. It can be seen that the number of “true zero” responses is 90, which amounts to 27.78% of the entire sample, while the number of “protest” responses is considerable lower (55) making up almost 17% of the sample. This latter result is very similar to the one obtained by Strazeera et al. (2003). A noticeable result is that for all the considered variables other than “bottled” and “howmuch” the differences between protesters and positive responses are negligible. These two latter variables indicate, respectively, whether the respondents buy or not bottled water and how much he spends in bottled water. In this case, respondents that protested show higher values than the rest of respondents. In the case that these two variables influence the WTP for improving the quality of the water supply service in Sucre, we could expect the existence of sample selection bias.

*** TABLE 2 ABOUT HERE ***

The whole set of explanatory variables used in the estimation of the Heckman’s two-step model and their main descriptive statistics are listed in table 3, while the estimated equations are shown in table 4 (participation equation) and 5 (valuation equation), respectively. The two-step model has been estimated using different covariate specifications and considering only those variables statistically significant at 10% level or higher. Model selection was done using a stepwise procedure. In the participation equation (table 4), the dependent variable takes the value "1" if the respondent decides to participate in the market and value "0" otherwise. The explanatory variables considered in this first equation are: the family income; a dummy variable indicating what characteristic of the water supply service (supply source, continuity of the service and water quality) would the respondent improve (water continuity =1); a dummy variable indicating whether the interview was carried out in district 1 or elsewhere[2]; a dummy variable indicating whether the respondents owns a plot or land or not; a dummy variable indicating whether the respondents buys or not bottled water for satisfying his consumption needs; and a dummy variable indicating whether the water pipes are installed outside the house or not.

The Probit coefficients show that, as expected, the probability of participating is positively related with the respondent's household income. In the same way, those individuals that, among the different characteristics of the current water supply service (source of supply, continuity in the service without cuts, and quality of the water supplied) they would give priority to improve the first one, are more willing to participate in the market. Owning a plot of land for cropping vegetables or raising cattle has also a positive effect on the probability of participating in the market. This result can suggest that these individuals consume a higher amount of water since, besides of their own needs, they also have to use water for irrigating the plants and watering the cattle, hence they are more interested in improving the overall quality of the water supplied. On the other hand, individuals that buy bottled water for satisfying their needs are more prone to protest. This is an unexpected result since an improvement of the

[2] Dummy variables for all the districts in which the interviews were carried out were considered, however only those ones statistically significant were kept in the estimated equations.

water supply service would imply not being forced to buy bottled water with its corresponding save of money. We think that maybe these individuals are showing some kind of reaction against the fact of paying for something that they have the right to have for free. Having the pipe system installed outside the house has also an effect on the probability to protest. This latter result can be ~~motivated because~~ explained by the fact that usually the public company is responsible to extend the distribution network to reach the building, but the costs of taking the network to the household is borne by the families. Hence ~~an improvement on the service is associated by an~~ the extra cost that this improvement implies for the families ~~that~~ is difficult to assume in the current circumstances. Finally, if the interview was conducted in the district 1 of Sucre the probability of participating in the market is lower than in the rest of districts since residents in this area have an easier access to public services whatever their nature. This result conforms to previous findings shown in table 1 where district 1 exhibited a mean WTP clearly lower than the full-sample value.

*** TABLE 3 ABOUT HERE ***

*** TABLE 4 ABOUT HERE ***

Table 5 reports the estimates pertaining to the valuation equation with the stated WTP as the dependent variable. As it has been explained previously, an OLS model has been estimated adding a new variable (λ) obtained from the probit model estimates at the first stage. If the coefficient of λ is significantly different from zero, there is evidence of sample selection bias. However, in this case there is no evidence of the referred bias since the inverse Mill's ratio (λ) was not significantly different from zero. Coefficients show that, as expected, stated WTP is positively related with the respondent's household income. The non-market valuation literature strongly suggests that income is positively related with environmental quality improvements (Hanley et al., 2009). Previous studies conducted by Virjee and Gaskin (2010) and Wang et al. (2010) are some examples that ratify this relationship. Another variable that also shows a positive coefficient is the level of education. This is a common result in the CVM literature since usually the higher the education of the respondent, the higher his WTP (see, for example, Birol et al., 2006 and Jones et al., 2008).

WCONTINUITY is a dummy variable that takes value 1 if the respondent stated that from the different characteristics of the current water supply service (source of supply, continuity in the service without cuts, and quality of the water supplied) they would give priority to improve the second one over the two other characteristics. Water supply continuity is a crucial factor when valuing the quality of the service provided to the community (Um et al., 2002). Supply cuts in Sucre are due to different causes and affect the entire city. The upper neighbourhoods suffer cuts because water storage tanks have insufficient capacity during periods of little rainfall, while lower neighbourhoods suffer strategic cuts in order to supply higher neighbourhoods at the times during the year when the city suffers the most shortages. Furthermore, the water supply is frequently interrupted due to breakages in the obsolete supply network. On the other hand, the positive coefficient the variable CARRYW implies that, as expected, respondents that do not have a direct access to water at home, hence they are forced to carry water, are more willing to pay to improve the service because they are aware of the trouble that it causes besides of the implicit opportunity cost of time.

*** TABLE 5 ABOUT HERE ***

Summarising, our results have been able of to past some minimal test of theoretical validity in explaining the determinants of the stated WTP, since the main variables were statistically significant and had the expected sign. In particular, WTP was positively related with respondents' household income, as expected. In the same way, respondents that have to carry water home were more willing to pay. It is also worthy to note that respondents give priority to the continuity of the service against an improvement in the perceived quality of water and the way of accessing to this resource. The low percentage of people willing to pay more and its causes permits to derive important policy implications that are addressed in next section.

5. CONCLUSIONS

The results of our research suggest that in a climate of confrontation between citizens and water utility managers, an increase in tariffs could be unsuccessful. A lack of governance and poor management are further contributing to worsen an already poor water service and create confrontation. Moreover, the recent demonstrations in Cochabamba and El Alto do not make raising the bill advisable. All this is reflected in the low percentage of households willing to pay extra for improving the water service that is found in this research. This result contrasts with the current shortcomings of the service provided regarding key factors affecting its quality, as are the network coverage, continuity of the service, and quality of the water supplied. Nevertheless, the current shortcomings of the water service may well explain the low WTP since users might be discontent with the water utility which they hold responsible for the poor service provided, hence that they are not willing to pay extra in their water bill. Accordingly, in the case that improvements measures were going to be implemented with the subsequent increase in water tariffs, the water utility should be very interested in foreseeing the response of the users. An increase in the bill was one of the reasons behind people's reaction in these cities.

In the present scenario of global crisis, which is particularly affecting developed countries (IMF, 2012), the public international aid, that has served in developing countries to improve water access, is likely to be reduced (Wippenny et al., 2009). In addition, the global financial situation since 2007 has discouraged new private investment in water infrastructure projects and impacted negatively on the supply of risk capital and loan financing (UN Water, 2012). In this scenario, countries should make an attempt to capture more internal resources in order to fund improvements in water access, increasing the water bill seems a reasonably way of doing so. This option is seen as the most sustainable long-term solution (UN Water, 2012). It also seems a logical solution if we take into account that in most countries the water bill in urban regions does not cover operating and maintenance costs, leaving less resources to invest in the modernization and expansion of the services, hence there is still room for paying these improvements (UNEP, 2012).

In this vein, it is recommended to perform studies on the impact of an increase in the water bill beforehand. In this sense, full reforms that included an increase in water rates have been successfully undertaken in Phnom Penh (Biswas & Tortajada, 2010) and Singapur (Tortajada, 2006). However, this has not always been the case. Increases in water tariffs could ~~raise~~ increase the percentage of people unwilling to pay as well as restrictions to water access in low-income households (see Wichelns, 2013). Extreme cases involving civil riots include Cochabamba, Buenos Aires and Tucumán (Ducci, 2007). Taking all this into consideration, in our opinion, in cases such as Sucre, a water bill is only understandable when it is part of broader reform aimed at helping people escape from material poverty so they can afford to pay a higher price for water without having to renounce to other needs.

REFERENCES

Arouna, A., & Dabbert, S. (2012). Estimating rural households' willingness to pay for water supply improvements: a Benin case study using a semi-nonparametric bivariate probit approach. *Water International*, *37*, 293 - 304.

Arrow, K., Solow, R., Portney, P.R., Leamer, E.E., Radner, R. & Schuman, H. (1993) *Report of the NOAA panel on contingent valuation*, National Oceanic and Atmospheric Administration. Federal Register 58, 4601 - 4614.

Bateman, I.J., Carson, R.T., Day, B., Hanemann, M., Hanley, N., Hett, T., Jones-Lee, M., Loomes, G., Mourato, S., Ozdemiroglu, E., Pearce, D.W., Sugden, R. & Swanson, J. (2002) *Economic Valuation with Stated Preference Techniques: A Manual*. Edward Elgar Ltd., Cheltenham.

Bengochea-Morancho, A., Fuertes-Eugenio, A.M. & Saz-Salazar, S. del, (2005) A comparison of empirical models used to infer the willingness to pay in contingent valuation. *Empirical Economics*, *30*, 235 - 244.

Bilgic, A. (2010). Measuring willingness to pay to improve municipal water in southeast Anatolia, Turkey. *Water Resources Research*, *46*, W12545, doi:10.1029/2009WR009010

Birol, E., Karousakis, K., Koundouri, P. (2006) Using Choice Experiment to Account for Preference Heterogeneity in Wetland Attributes: The Case of Cheimaditita Wetland in Greece. *Ecological Economics*, 60, 145–56.

Biswas, A.K. & Tortajada, C. (2010) Water Supply of Phnom Penh: An Example of Good Governance. *International Journal of Water Resources Development, 26,* 157 - 172.

Calia, P., Strazzera, E. (2001) A sample selection model for protest responses in contingent valuation analysis. *Statistica* 61, 473–485.

Carson, R.T. (1997) Contingent valuation: theoretical advances and empirical tests since the NOAA panel. *American Journal of Agricultural Economics*, *79*, 1501 – 1507.

Carson, R.T. (2000) Contingent valuation: a user’s guide. *Environmental Science & Technology, 34,* 1413 – 1418.

Carson, R.T. (2012) Contingent valuation: a practical alternative when prices aren’t available. *Journal of Economic Perspectives*, 26, 27 - 42.

Casey, J.F., Kahn, J.R. & Rivas, A. (2006) Willingness to pay for improved water service in Manaus, Amazonas, Brazil. *Ecological Economics, 58,* 365 – 372.

Chilton, S.M. and Hutchinson, W.G. (1999) Do Focus Groups Contribute Anything to the Contingent Valuation Process? *Journal of Economic Psychology*, 20, 465-483.

Cooper, F., Poe, G.L., Bateman, I.J. (2004) The structure of motivation for contingent values: a case study of lake water quality improvement. Ecological Economics, 50, 69-82.

Cragg, J. (1971) Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica, 39,* 829 – 844.

Daniel, J. (2012). *Sampling Essentials: Practical Guidelines for Making Sampling Choices*. SAGE Publications, Thousand Oaks, California, USA.

Dziegielewska, D.A., Mendelsohn, R., (2007). Does no mean no? A protest methodology. *Environmental and Resource Economics* 38, 71–87.

Ducci, J. (2007) *Salida de operadores privados internacionales de agua en América Latina.* Inter-American Development Bank. Washington.

Genius, M., Manioudaki, M., Mokas, E., Pantagakis, E., Tampakakis, D. & Tsagarakis, K.P. (2005). Estimation of willingness to pay for wastewater treatment. *Water Science Technology: Water Supply*, *5,* 105–113.

Genius, M., Hatzaki, E., Kouromichelaki, E.M., Kouvakis, G., Nikiforaki, S. & Tsagarakis, K.P. (2008) Evaluating Consumers' Willingness to Pay for Improved Potable Water Quality and Quantity. *Water Resources Management, 22,* 1825 – 1834.

Guidi, E., González-Gómez, F. & Guardiola, J. (2013) Water Access in Sucre, Bolivia: a Case of Governance Deficit. *International Journal of Water Resources Development*, *29,* 636 - 649.

Haab, T.C. (1999). Nonparticipation or Misspecification? The Impacts of Nonparticipation on Dichotomous Choice Contingent Valuation. *Environmental and Resource Economics*, 14, 443-461.

Hanley, N. & Barbier, E.B. (2009) *Pricing nature. Cost-Benefit analysis and environmental policy.* Edward Elgar, Cheltenham, UK.

Hanley, N., Colombo, S., Kriström, B. & Watson, F. (2009) Accounting for negative, zero and positive willingness to pay for landscape change in a national park. *Journal of Agricultural Economics, 60*, 1 - 16.

Hausman, J. (2012) Contingent valuation: from dubious to hopeless. *Journal of Economic Perspectives, 26*, 43 - 56.

Hensher, D., Shore, N. & Train, K. (2006). Water Supply Security and Willingness to Pay to Avoid Drought Restrictions. *Economic Record, 82,* 56–66.

IMF (2012) *World Economic Outlook. Coping with High Debt and Sluggish Growth*. World Economic and Financial Surveys. Washington D.C.

Jones N., Sophoulis C.M., Malesios C. (2008). Economic valuation of coastal water quality andprotest responses: a case study in Mitilini, Greece. *Journal of Socio-Economics*, 37, 2478–2491.

Kontogianni, A., Langford, I.H., Papandreou, A. & Skourtos, M.S. (2003). Social preferences for improving water quality: An economic analysis of benefits from wastewater treatment. *Water Resources Management, 17,* 317-336.

Lee, T. and Floris, V. (2003) Universal access to water and sanitation: Why the private sector must participate. *Natural Resources Forum, 27,* 279–290.

Lee, W-S., Yoo, S-H., Kim, J. (2013). Measuring the Economic Benefits of the Tap Water Supply Service in Urban Areas: The Case of Korea. *Water Resources Management, 27,* 619–627.

Lindsey, G. (1994). Market models, protest bids, and outliers in contingent valuation. *Journal of Water Resources Planning and Management*, 120, 121–129.

Messonnier, M.L., Bergstrom, J.C., Cornwell, C.M., Teasley, R.J., Cordell, H.K. (2000). Survey response-related biases in Contingent Valuation: concepts, remedies an empirical valuation to valuing aquatic plan management. *American Journal of Agricultural Economics*, 83, 438-450.

Mitchell, R.C. & Carson, R.T. (1989) *Using surveys to value public goods: the contingent valuation method. Resources for the Future*, Washington DC.

Nallathiga, R. (2009). An assessment of the willingness to pay for reliable water supply in NCT-Delhi. *Water Policy, 11*, 320-329.

OMS (2011) *Agua y saneamiento: Evidencias para políticas públicas con enfoque en derechos humanos y resultados en salud pública.* Organización Panamericana de la Salud. Washington D.C.

Polyzou, E., Jones, N., Evangelinos, K.I. & Halvadakis, C.P. (2011) Willingness to pay for drinking water quality improvement and the influence of social capital. *Journal of Socio-Economics*, *40,* 74 – 80.

Prüss-Üstün, A., Bos, R., Gore, F. & Bartram, J. (2008) *Safer water, better health*. Costs, benefits and sustainability of interventions to protect and promote health. World Health Organization. Geneva.

Raje, D.V., Dhobe, P.S. and Deshpande, A.W. (2002) Consumer’s willingness to pay more for municipal supplied water: a case study. *Ecological Economics, 42,* 391 – 400

Ramajo-Hernández, J. & Saz-Salazar, S. del (2012) Estimating the non-market benefits of water quality improvement for a case study in Spain: A contingent valuation approach. *Environmental Science & Policy, 22,* 47 - 59.

Tarfasa, S. & Brouwer, R. (2013) Estimation of the public benefits of urban water supply improvements in Ethiopia: a choice experiment. *Applied Economics, 45,* 1099 - 1108.

Tortajada, C. (2006) Water Management in Singapore. *International Journal of Water Resources Development*, *22*, 227 - 240.

Um, M-J., Kwak, S-J. & Kim, T-Y. (2002) Estimating willingness to pay for improved drinking water quality using averting behavior method with perception measure. *Environmental & Resource Economics*, *21*, 287 - 302.

Unidad de Análisis de Conflictos (2010) *Informe de seguimiento y análisis de la conflictividad en Bolivia, septiembre de 2010.* Fundación UNIR. Cochabamba, Bolivia.

UNEP (2012) *Status report on The Application of Integrated Approached to Water Resources Management.* Nairobi, Kenya.

UNICEF (2009) *Día mundial de lavado de manos. Bolivia, panorama nacional*. Resumen informativo.

UN Water (2012) *Managing Water under Uncertainty and Risk. The United Nations World Water Report Development Report 4.* World Water Assessment Programme. UNESCO. Paris.

Venkatachalam, L. (2006) Factors influencing household willingness to pay (WTP) for drinking water in peri-urban areas: a case study in the Indian context. *Water Policy, 8,* 461–473.

Virjee, K., & Gaskin, S. (2010) Coping with poor water services and the demand for change in Trinidad and Tobago. *Water International*, 35, 285 - 297.

Wang, H., Xie, J. & Li, H. (2010) Water pricing with household surveys: A study of acceptability and willingness to pay in Chongqing, China. *China Economic Review, 21*, 136 – 149.

Whitehead, J.C. (2006) A practitioner's primer on contingent valuation. In: Alberini, A., Kahn. J. (Eds.), Contingent valuation handbook. Edward Elgar Publishing, Cheltenham, UK.

Wichelns, D. (2013) Enhancing the performance of water prices and tariff structures in achieving socially desirable outcomes. *International Journal of Water Resources Development, 29*, 310 - 326.

Winpenny, J., Bullock, A., Granit, J. & Rebecca, L. (2009) *The Global Finance and Economic Crisis and the Water Sector.* Report for the Stockholm International Water Institute. Stockholm, SIWI.

WHO/UNICEF (2012) *Progress on Drinking Water and Sanitation. Joint Monitoring Programme for Water Supply and Sanitation.* UNICEF, New York and WHO, Geneva.

Table 1: Mean WTP and percentage of respondents with WTP>0 by district

District	Mean WTP (Bolivian pesos)	Std. Dev.	% WTP>0
1	6.46	16.93	26.83
2	10.17	17.07	56.39
3	15.79	20.56	62.07
4	8.65	11.63	56.82
5	10.13	14.33	57.89
6	11.3	8.18	80.00
Full sample	10.53	16.75	54.63

Table 2: Means and standard deviations (in parenthesis) by groups of respondents

	Type of respondent			
	All	True zeros	Protester	Yes response
Mean WTP	10.53	0.00	-	19.28
(Bolivian pesos)	(16.75)	(0.00)	-	(18.57)
Income	2.48	2.55	2.33	2.49
	(1.02)	(1.05)	(1.00)	(1.00)
Education	3.77	3.87	3.85	3.69
	(1.11)	(1.06)	(1.11)	(1.15)
Age	41.27	43.77	45.14	38.90
	(15.58)	(14.98)	(16.74)	(15.20)
Sex	0.43	0.41	0.42	0.43
(male = 1)	(0.49)	(0.49)	(0.49)	(0.42)
Familysize	5.87	5.83	5.44	6.03
	(2.53)	(2.32)	(2.42)	(2.66)
Children	2.50	2.47	2.58	2.50
	(1.70)	(1.64)	(1.90)	(1.66)
Bottled	0.26	0.25	0.38	0.23
	(0.44)	(0.44)	(0.49)	(0.42)
Howmuch	4.38	4.37	5.6	3.94
(Bolivian pesos)	(10.30)	(9.48)	(10.23)	(10.75)
N	324	90	55	179

Table 3: Descriptive statistics of the explanatory variables

Variable	Description	Mean	Stan. Dev.
Income	Respondent's household monthly income after taxes in five different intervals ranging from 0 to 8,000 Bolivian pesos	2.48	1.02
Education	Respondent's education in 5 levels (from illiterate to University degree)	3.77	1.12
Age	Respondent's age	41.27	15.58
Sex	Respondent's sex (male=1)	0.43	0.49
Familiysize	Number of family members	5.87	2.53
Children	Number of children under 18	2.51	1.69
Enoughwater	Dummy variable about the respondent's perception related to the quantity of water supplied (enough water=1)	0.59	0.49
Tap	Dummy variable about the source of water supply (tap connected to the supply net =1)	0.81	0.40
Pump	Dummy variable about the source of water supply (tap connected to a water pump =1)	0.04	0.81
Publictap	Dummy variable about the source of water supply (public tap =1)	0.02	0.13
Tanker	Dummy variable about the source of water supply (water tanker =1)	0.11	0.31
Waterwell	Dummy variable about the source of water supply (water well or waterwheel =1)	0.03	0.17
River	Dummy variable about the source of water supply (river =1)	0.00	0.09
Rain	Dummy variable about the source of water supply (rain =1)	0.00	0.09
Transparency	Dummy variable about the transparency of the water (transparent=1)	0.76	0.43
Taste	Dummy variable about the taste of the water (good=1)	0.68	0.47
Smell	Dummy variable about the smell of the water (smells=1)	0.69	0.46
Turbidity	Dummy variable about the turbidity of the water (turbidity or solids in suspension=1)	0.66	0.47
Pipesinside	Dummy variable about where the water pipes are installed (inside house=1)	0.86	0.35
Externalpipes	Dummy variable about where the water pipes are installed (outside house=1)	0.12	0.33
Wquality	Dummy variable about what characteristic of the water supply	0.64	0.48

	service -supply source, continuity of the service and water quality- would the respondent improve (water quality =1)		
Wsource	Dummy variable about what characteristic of the water supply service -supply source, continuity of the service and water quality- would the respondent improve (water source =1)	0.45	0.49
Wcontinuity	Dummy variable about what characteristic of the water supply service -supply source, continuity of the service and water quality- would the respondent improve (water continuity =1)	0.55	0.50
Carrywater	Dummy variable related to the fact that the respondent has to carry water home to cover the basic needs of drinking and hygiene (yes = 1)	0.09	0.29
Trips	Number of trips per day made to collect water outside home	2.77	3.41
Time	Time spent in collecting water outside home (minutes)	24.36	47.32
Litres	Litres of water collected outside home per day	112.53	145.60
Wexpense	Water expenses (Bolivian pesos)		
Watercuts	Dummy variable related to the quality of the water supply (if respondent suffers water cuts = 1)	0.52	0.50
Satisfaction	Level of satisfaction related to the water supply service (from 1=very satisfied to 5= not satisfied at all)	3.25	0.95
Bottled	Dummy variable about the purchase of bottled water (yes=1)	0.26	0.44
Bottledexpense	Water bottled expenses (Bolivian pesos)	4.38	10.29
Floor	4-category variable related with the quality of the house (floor= parquet flooring, tile flooring, concrete flooring, rough flooring)	2.71	0.70
Roof	3-category variable related to the quality of the house (roof= tiled roof, concrete roof, straw roof)	1.44	0.51
Wall	4-category variable related to the quality of the house (walls= concrete or stone, wood, adobe bricks, straw)	1.59	0.92
Kitchen	Dummy variable about where is located the kitchen (inside the house=1)	0.89	0.31
Bathroom	3-category variable about the type of bathroom (bathroom = complete bathroom, latrine, outdoor)	1.24	0.63

Carowner	Dummy variable about car ownership (yes=1)	0.42	0.49
Landowner	Dummy variable about land ownership (yes=1). The land is used for cropping plants or for raising cattle.	0.17	0.38
Abundance	5-category variable about the respondent's perception related to the family's abundance of resources (from 1=very scarce to 5=very abundant)	3.54	0.75
Lifesatisfact	Level of satisfaction related to the life (from 1=very satisfied to 5= not satisfied at all)	3.14	0.87
District	6-category variable related to the district of the city in which the interview was conducted (from district 1 = 1 to district 6 = 6)	2.80	1.33

Table 4: Heckman's two-step model - Participation equation

	Probit model	
	Coefficients	T-statistic
Constant	-0.1273	-0.42
Income	0.3598***	2.91
Wcontinuity	1.2967***	5.05
District1	-0.6417**	-2.04
Landowner	0.6485*	1.74
Bottled	-0.4709*	-1.87
Externalpipes	-0.7594**	-2.35
LR chi2(6) = 59.08		
Prob > chi2 = 0.0000		
Pseudo R^2 = 0.2720		
% Correctly Predicted = 85.04		
N = 324		

***, **, * Indicate significance at 1%, 5%, and 10% levels respectively.

Table 5: Heckman's two-step model – Valuation equation

	OLS		OLS with selectivity	
	Coefficients	T-statistic	Coefficients	T-statistic
Constant	-7.7033	-1.87	-12.9037*	-1.71
Income	1.6758*	1.81	2.2194*	1.72
Wcontinuity	10.6289***	5.47	12.6749**	3.05
Education	1.6406*	1.90	1.9880**	1.96
Carrywater	11.4635***	3.54	13.6484***	3.62
Adjusted R^2	0.1950		-	
λ (Inverse Mills ratio)			8.3882	0.317
σ			0.5310	
ρ			15.7944	
Wald chi2(4)			28.63	
Prob > chi2			0.0000	
N	234		234	

***, **, * Indicate significance at 1%, 5%, and 10% levels respectively.