Private Sector Participation in the Provision of Quality Drinking Water in Ghana's Urban Areas: Are People Willing to Pay?

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List of abbreviations and acronyms

AVRL	Aqua Vitens Rand Limited
BOT	Build-Own-Operate-Train
BOTT	Build-Own-Train-Transfer
CWSA	Community Water and Sanitation Agency
CVM	Contingent Valuation Method
GWCL	Ghana Water Company Limited
GWSC	Ghana Water and Sewerage Corporation
GPRS	Growth and Poverty Reduction Strategy
MDG	Millennium Development Goal
NGOs	Non-Governmental Organizations
PSP	Private Sector Participation
PPP	Public Private Partnership
PWD	Public Works Department
WTP	Willingness To Pay

Abstract

Access to clean drinking water is not only a fundamental human right, but also claims a big stake in economic growth, poverty reduction and sustainable development. With an increase in population, rapid urbanization and increasing income levels, the demand for water outstrips public water supply in developing countries. As a result, private water production has been promoted in developing countries to achieve greater efficiency and expansion in order to supplement public water supply. This study used the contingent valuation method to survey households in three cities in Ghana to estimate their willingness to pay in a bid to evaluate a policy of better water supply for urban areas in Ghana. It was found that more than 80% of the respondents favour some form of private sector engagement in water quality improvement. Also, the mean willingness to pay for water quality improvement is about GH¢13.42 (US$12) per month. Given the mean household monthly water bill of GH¢10.82, these results indicate that there is demand for water quality improvement and the general view is that private sector engagement is likely to provide these services. However, the same policy measure will marginalize the poor in terms of access to water. Therefore, private sector participation in water delivery, with a corresponding complementary government programme to promote access to water among low income households, would deliver the double dividends of water quality and universal access, which characterize the debate on private sector engagement in water provision in Ghana.

Keywords: Willingness to pay, water quality, contingent valuation, Ghana

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1. Introduction

Rapid urbanization places greater demand on many utility services all over the world. Public water supplies are not spared, what with increased pressure (Bouselly et al., 2006). Access to clean drinking water is a fundamental human right that also claims a big stake in sustainable development, economic growth and poverty reduction (World Bank, 2003). According to Sobsey (2006), a lack of drinking water supplies continues to be a major source of human disease and death globally.

Meanwhile, although access to treated water sources in Ghana has increased, a lot has to be done if the supply of improved water is to be sustained (World Bank, 2003) and to meet the United Nations Millennium Development Goal (MDG) of sustainable access to safe drinking water and basic sanitation met. Water supply in terms of quantity and quality is inadequate in developing countries, including Ghana. Ghana faces a serious water crisis because the volume of water effectively sold (280,000m^3/day) is less than half of the daily demand of 763,300m^3/day (personal communication with Regional Manager of Ghana Water Company Limited, 2007).

Uninterrupted access to treated and piped water is a luxury in selected parts of urban Ghana. It has been estimated that 59% of the population in urban areas and about 35% in rural areas have access to potable water. However, many of those who have access to potable water are buying from intermediary providers because water supply is irregular. Complaints of water shortage in the country have escalated, with the hardest hit areas being Ashiaman, McCarthy Hill, Adenta, Nima, Nungua and Teshie, all in Accra, as well as in Cape Coast, Takoradi, Tamale, Sunyani and Kumasi. The situation in smaller communities is even worse with some of them not having access to treated drinking water at all.

Universal access to potable water remains a mirage because of the high population growth rates and the low levels of investment in rehabilitation and expansion of water infrastructure. At the turn of the millennium, 78% of the urban poor were reported not to have regular access to piped water. The World Health Organization's daily requirement for water is 20–40 litres a day per person, from a water source that should be located within a reasonable distance from the household. However, people outside the piped system or those within the piped

system whose pipes are not delivering water, have to walk long distances to get just a bucket of water priced at between GH¢0.06 and GH¢0.15, depending on the location. Others have to depend entirely on water tankers and power tillers for the provision of water.

Ghana needs to substantially increase access to water to 88% if the MDGs and the targets of the Growth and Poverty Reduction Strategy (GPRS) are to be met. This requires about $1.3 billion for the rehabilitation and expansion of urban water alone (African Development Bank, 2007).

Previous studies adopted stated preference methods to measure the value of improvement in water provision (Hensher et al., 2005; Akram and Olmstead, 2010; Casey et al., 2006; Whittington et al., 1990; Whittington and Lauria, 1991; Whittington et al., 1992; Whittington et al., 2002). The present study attributes the improvement in water quality to the participation of the private sector. This follows the existing evidence that the engagement of the private sector improves quality water delivery and a reduction in the incidence of health problems in urban areas (Barrera-Osorio et al., 2009). Moreover, Engel et al. (2005) also note that quality perceptions, preferences and opportunity determine households' choice of water source in Ghana. We believe the explicit inclusion of the private sector in improving water quality in contingent valuation method (CVM) studies will allow an assessment of how consumers would react to private sector participation in improving water quality in developing countries. This is because CVM presents a given scenario which can be used to assess how the respondents perceive the components of the scenario.

The closest study to ours is that by Whittington et al. (2002), conducted in Kathmandu, Nepal. In this study, respondents were requested to choose between the existing water supply and an improved water service provided by the private sector. The primary objective of the present study was to establish households' willingness to pay (WTP) for the provision of quality drinking water by private investors in urban areas in Ghana, and to determine how much these households would be prepared to pay towards a monthly water bill.

The secondary objectives were to:

- determine the willingness of urban households in Accra, Cape Coast and Sunyani to pay for quality water supply;
- estimate and analyse the determinants of the willingness to pay for quality drinking water in Accra, Cape Coast and Sunyani; and
- suggest policy recommendations to help government and private operators effectively manage the delivery of water to the urban areas in Ghana.

The remainder of the paper is structured as follows: The next section provides an overview of water supply in Ghana, whilst the third section discusses the theoretical and econometric models. The literature review is presented in Section 4. This is followed by the methodology and results in Sections 5 and 6, respectively. The paper concludes with a discussion of the policy implications and key conclusions.

2. An overview of water supply in Ghana

Ghana faces serious constraints in providing adequate water for all rural and urban residents. These include the dire and worsening financial condition of the urban utility provider, Ghana Water Company limited (GWCL), insufficient sector investment over the past 10 years, weak implementation capacity caused by staffing problems, and low salary levels. The current annual GWCL budget is too low to meet the level of investment required to provide a safe and accessible water supply. Fuest and Haffner (2007) provide a detailed description of the history of the development of the water supply system in Ghana, pointing out the history of foreign interventions in the water sector, problems with GWCL being the only public provider of water, and the option of having a public private partnership (PPP) being considered and implemented for the sector.

In Ghana, the main sources of water supply for households are pipes from treated water sources, untreated piped water from ground water sources, rivers, shallow bore-holes, wells and ponds, and lakes and streams. The development of public water supplies in Ghana began in the 1920s with a pilot pipe-borne system managed by the hydraulic division of the Public Works Department (PWD) in Cape Coast. Later a water supply division, with headquarters in Kumasi, was established within the Ministry of Works and Housing with responsibility for both rural and urban water supplies. In 1958, the Water Supplies Division of the PWD became an autonomous entity directly reporting to the Ministry of Works and Housing.

The investment in water infrastructure went through different stages. At Independence in 1957, there were about 35 pipe-borne water supply systems in the country. Concerning the government's programme for rapid urban water supply expansion and accelerated rural water development, there were 208 pipe-borne systems and over 6,000 drilled wells fitted with hand pumps by 1990.

There are two major dams that provide raw water for treatment in the Greater Accra Region, namely the Kpong and Weija dams. The estimated rural water supply coverage comprises 14,000 drilled boreholes with hand pumps, 12,000 hand-dug wells with hand pumps and 800 small piped systems.

The Ghana Water and Sewerage Corporation (GWSC) was established in 1965 to provide, distribute, conserve and supply water in Ghana for public, domestic and industrial purposes. It was also meant to establish, operate and control the sewerage system in the country. However, in 1999 the GWSC was converted to the GWCL, which was responsible for the planning and development of water

supply systems in all urban communities in the country. It was also in charge of the provision and maintenance of acceptable levels of service to consumers in respect of quantity and quality of water supplied, and the preparation of long-term plans in consultation with the appropriate coordinating authority. In 2006 the GWCL entered into a five-year management contract with Aqua Vitens Rand Limited (AVRL). The AVRL is a joint venture between public Dutch company Vitens and public South African company Rand Water. According to the management contract, the main objectives of AVRL were to expand a reliable supply of safe water in urban areas as well as ensure that low income consumers have access to potable water at affordable prices.

Despite these reforms to the water company, the inadequate supply of water has not changed. According to the Public Utilities Regulatory Commission of Ghana, many urban communities face shortfalls in water supply and the situation is even more critical in the smaller cities. These shortfalls are due to the obsolete equipment and limited capacity of the supply plants. A study on the national water sector assessment carried out in 2005 by WaterAid, a non-governmental organization, also showed that the perennial water shortage in most parts of the country is as a result of damaged and old pipes, high leakage rates, widespread illegal connections, increased demand for potable water for domestic and industrial use, and seasonal drought conditions along the catchment areas of the dams.

Due to the persistence of the water problem, households developed different measures to overcome it. Most households cope with the water shortage by engaging secondary service providers such as water tanker services, domestic vendors, harvesting rain water, digging wells, fetching water from streams, and using sachet water. These coping strategies deplete the incomes of the households that engage these strategies as the secondary service providers charge comparatively higher rates for water supplied. A 2002 report by the International Fact-finding Mission to Ghana within April and May 2002 on Water Sector Reform shows that purchasing a bucket of water a day can cost from ¢600 (6Gp) to ¢1500 (15Gp), or between 10% and 20% of the average daily income per capita. On average, a 2,100-gallon tanker of water in Accra sells for between GH¢40.00 and GH¢60.00, depending on how far the household is situated from the source of water supply. An average household of five persons may use this quantity for about a month. This excludes drinking water, for which most households depend on treated sachet water due to the poor quality of water from these secondary sources.

Lack of adequate funding for the provision of treated water to be supplied to the whole urban population seems to be a perennial problem for the GWCL. The possible sources of funding in the water sector are: revenue generated by GWCL and the Community Water and Sanitation Agency (CWSA); government funding; donor funding; long-term loans; and user fees (private sector participation). Until 1986, the then GWSC depended on government subsidies for both operational and development expenditure. In 1986 the government subsidies for operations and maintenance ceased, but funding for development programmes continued. Consequently, due to the inadequate funding to carry out maintenance and

rehabilitation, most of the water supply systems seem to have deteriorated.

During a national stakeholders' conference organized by the Water Sector Restructuring Secretariat in 1996, it was agreed that private sector participation is the best way to accelerate water supply coverage. Private sector participation refers to a range of arrangements between a government agency and a non-public institution (Budds and McGranahan, 2003). Variations of these contractual agreements include Build-Own-Operate (BOO), Build-Own-Operate-Train (BOT) and Build-Own-Train-Transfer (BOTT). Under the Private Sector Participation (PSP) programme, the GWCL assumes the main functions of asset ownership. The abstraction, treatment, transmission, storage and distribution of potable water for domestic, commercial and industrial use in urban Ghana was taken over by the private partner AVRL from 2006 to 2011. The private operator is expected to inject technical expertise to improve efficiency in the operation and maintenance of the systems. Although the private operator has taken over the management and operation of water supply, it is not responsible for making capital improvements to this sector under the current terms. Therefore, the only option is cost recovery for the delivery of water through tariff increases (Fuest and Haffner, 2007).

The Government of Ghana seeks to engage the private sector in water provision in urban areas (Amenga-Etego, 2003). Under this arrangement, private organizations would take over the assets of the public provider and produce, distribute and manage water supply in urban areas. This has generated a lot of public debate in which both the proponents and opponents seek the interest of the consumer. The proponents, mainly the government and public agencies, argue that private sector participation (PSP) in water provision will improve the effectiveness and efficiency of water production, leading to an improvement in the quantity and quality of water produced. Specifically, the proponents of the PSP seek to use the efficiency gains of the PSP to promote access. However, the opponents of the PSP in the provision of water, mainly the civil society, and the trade union, argue that PSP would make water very expensive and could price it out of reach of the poor. They argue further that PSP in the provision of water could lead to a loss of jobs (Fuest and Haffner, 2007).

Opponents of PSP in water provision argue that consumers cannot afford the prices that private investors will charge. Meanwhile, credible estimates of WTP and other demand assessment strategies could be used to demonstrate that these consumers are paying much more than the official tariff rate through informal channels and coping strategies, and that they would be willing to pay even more to secure better water supply services (Zerah, 2000; Dutta, 2006). For example, Whittington et al. (2002) found substantial support among both poor and non-poor households for a privatization plan that would improve water supply and require all consumers to pay higher bills in South Asia. It would, therefore, be very helpful to know how much households would be willing to pay for the current level of water service delivery and improved water provision. Recommendations based on the outcome could ensure efficient delivery of treated water in urban areas, while paying attention to the concerns of the vulnerable and the very poor.

3. Theoretical and econometric models

Private sector participation (PSP) has been promoted in water provision with the assumption that it will improve both water quality and quantity, thereby provide a more affordable and efficient service than the public sector. Thus, private sector participation in water provision has welfare implications for the consumer. The theoretical strategy of the paper was to consider the demand for water for a representative household. Our theoretical model follows that of Casey et al. (2006) for improved water service in Brazil. With a given level of utility, the household seeks to minimize the expenditure to achieve a certain level of utility. The problem of the consumer is then:

$$\min E(W,Y) \tag{1}$$

$$\text{subject to } U=U(W,Y) \tag{2}$$

where W denotes water and Y is a composite good. The consumer will minimize the following expenditure function:

$$E^* = E(P_W, P_Y, U) \tag{3}$$

However, universal water supply is a restricted demand since water is provided to the consumer on a take it or leave it basis. Therefore, the consumer is rather offered W, which the consumer can choose to pay for or not. As a result, we can replace P_W with W in the above equation. We can then state the expenditure function as:

$$E^* = E(W, P_Y, U) \tag{4}$$

For the restricted demand case, the WTP for an improved water service is the difference between the two expenditure functions with $W_1 > W_0$. The compensating surplus is given as:

$$WTP=E(W_0, P_Y, U_0) - E(W_1, P_Y, U_1) \quad (5)$$

The *WTP* is the willingness to pay for universal improvement in water supply. This is the amount that a household is willing to trade for the improvement in water supply, i.e., to give up and still remain on the previous utility level. However, the demographic variables could also affect this welfare measure. Denoting these demographic variables as *d*, we can specify the compensating surplus for a representative household as:

$$WTP_i =E(W_0, P_Y, U_0 ;d_i) - E(W_1, P_Y, U_1 ; d_i) \quad (6)$$

The responses to the scenario allow us to identify the characteristics of respondents who offer zero bids and positive bids. In this case, we can specify the PROBIT model as:

$$Pr (R = 1) = X_1\beta_1 + \varepsilon_1 \quad (7)$$

where $R = 1$ denotes that the respondent indicated a positive bid, X_1 is the vector of variables and β_1 is a vector of parameters. We assume that ε_1 is normally distributed. Thus, the PROBIT model can be estimated by maximizing the log-likelihood function:

$$Pr(R = 1| X_1) = \Phi(\beta_1 X_1) \quad (8)$$

where Φ is the standard normal cumulative distribution function.

Also, the bid curve can be presented as:

$$WTP_i = X_2\beta + \varepsilon_2 \quad (9)$$

where β_2 is a vector of unknown parameters, X_2 is a vector of explanatory variables, and ε_2 is the stochastic disturbance term; it is assumed to be independently, identically distributed.

Although there are studies which adopt this specification for the estimation of the bid curve, e.g., Casey et al. (2006), there are two potential problems with the above formulation. Firstly, in most CVM studies, respondents report "zero bids" which might be attributed to genuine "zero bid" and "protest bid" responses. Secondly, some of the explanatory variables may suffer from significant missing information due to the sensitive nature of those variables. The first issue generates *self-selection* problems. The second problem results in the estimation of bid curves with an unrepresentative sample from the population, another source of

sample selection bias. The overall effects of the sample selection bias are that the stochastic disturbance term will be non-random; consequently, the estimated parameters will be biased.

Heckman (1979) suggests an econometric procedure for solving the sample selection problem. The procedure involves the identification of a latent variable z^* that captures whether or not an individual gives a valid WTP response. The latent variable is revealed by an indicator variable z_i that takes on the value of 1 if $p_i \geq 0$ and the value of 0 otherwise.

This means that

$z_i^* > 0$ if $z_i = 1$ and p is observed.

Alternatively, $z_i^* = 0$ if $z_i = 0$ and p is not observed.

This latent variable may be determined by a set of explanatory variables. We specify this latent variable as:

$$z_i^* = \alpha' Z + u \quad (10)$$

where Z denotes the vector of explanatory variables of the latent variable. The Inverse Mills Ratio (IMR) is derived from the latent variable regression, and is given as:

$$\lambda_j = \varphi(-\alpha' Zj) / [1 - \Phi(\alpha' Z_j)] \quad (11)$$

where φ is the standard normal density function and $\Phi(.)$ is the standard normal cumulative density function. The IMR is then added as an additional explanatory variable in the structural equation, which is modified to:

$$WTP_j = \beta' X + \gamma\lambda + \varepsilon^* \quad (12)$$

where γ is the covariance between the two stochastic disturbance terms. Fonta et al. (2010) uses the Heckman sample selection model on stochastic payment card design proposed by Wang (1997) to estimate willingness to pay for the control of malaria using larvivorous-eating fish species in Cameroon. The stochastic payment card considers a case where there are uncertainties in the commodities being valued. Fonta et al. (2010) observe the presence of sample selection bias.

4. Literature review

The challenge of public policy is achieving efficiency *vis-à-vis* maximum social welfare. A practical approach to welfare analysis in the water sector must consider the cost of water delivery, and the price charged by water companies. Typically, the infrastructure policy must also consider how to recover the infrastructural cost (Ayogu, 2007). These are closely intertwined with the ownership structure, operational efficiency and financial viability. Cost conditions are based on an efficient industry configuration (that is, the number and size distribution of firms that minimize the total cost of supplying the entire market). These issues are mirrored in the current political economy of public service delivery (Besley and Ghatak, 2007), where persuasive evidence for the costs and benefits are necessary for sound public debate.

The idea that private enterprises are more efficient than public firms is based on the public choice model, which seizes on non-transferability of ownership and attenuation of property rights in public firms to account for the differences between privately and publicly-owned firms (Alchian, 1965). A study conducted by Bhattacharyya et al. (1994) found that there is no basis for such a claim of an effect of ownership on the relative efficiency of public and private water utilities in the United States. Typically, Bhattacharyya et al. (1994) found that public water utilities are more efficient than private ones, and therefore the public ownership of water utilities does not reduce incentives to monitor managerial conduct, which is inconsistent with theoretical literature as propounded by Alchian (1965). Similar conclusions were arrived at by Atkinson and Halvorsen (1984), Feigenbaum and Teeples (1983) and Lambert et al. (1993).

The contingent valuation method of estimating WTP for non-marketed goods and services (Mitchell and Carson, 1989) was used for this study. The CVM is a popular method for assessing value of water quality improvement among respondents. Several studies have been carried out in low-income countries to determine the affordability and WTP for water and sanitation services (Whittington et al., 1990; Whittington and Lauria, 1991; Whittington et al., 1992; McPhail, 1993; Altaf et al., 1993; Briscoe, 1993; Griffin et al., 1995; Whittington et al., 2002; Ntengwe, 2004; Dutta, 2006; Ahmad et al., 2005). These studies implemented CVM studies to assess WTP for improved water supply conditions and intended improved government policies on water supply. The studies have revealed that despite the high levels of poverty in the low-income countries, many households are able and willing to pay for water and sanitation services if the public water utilities are run along commercial lines. They also show that demand-

side information about household preferences and priorities can provide valuable inputs into planning in water management. Hence the decision to use the CVM to find out whether Ghanaians were willing to pay for PSP in the provision of quality water supply both in terms of quantity and quality. Merrett (2002) provides a detailed critique of the literature that has applied CVM studies to estimate the WTP for water services in low-income countries, whilst Whittington (2004) draws attention to ethical issues in using CVM studies in developing countries.

5. Methodology

Sample and sampling techniques

The target population for this study was all the people living in Ghana who would in one way or another use the potable water delivery system. The study purposively identified three cities (Accra, Cape Coast and Sunyani) as case studies due to the nature of the water supply situation in the three cities. These cities have varying systems of water supply, which would help the respondents correctly react to the use of private sector participation in improving water supply. A total of 302 heads of household with at least 100 households from each city sampled from randomly selected suburbs of the three cities, formed the sample for the study.

Mode of collection

Structured questionnaires were administered to 302 heads of households to obtain data for analysis. These heads of households were seen as potential users of improved water provision who also generally make decisions about the use of household income and influence the household's drinking water-seeking behaviour. Therefore, their WTP bids would help determine the value of improved quality water provision. The main reason for the use of personal interviews to collect data rather than postal questionnaires or telephone interviews is that interviews would improve response rates and provide opportunities to check the subjects' understanding of the questions.

Three graduates were recruited and trained as research assistants to help with conducting the interviews. They were selected based on their understanding of the local dialects so that they could translate the questionnaire into the local dialects for the respondents. Using local people to conduct the interviews helped avoid compliance bias, since the respondents would not know the sponsor of the study and respondents are likely to be more at ease and feel free to talk to people they can easily communicate with instead of strangers. The researchers organized two days of training for the interviewers. The first day of training was to explain the objectives of the study and the survey instrument to them and offered them the chance to attempt translations into the local dialect to find out if they could translate appropriately to elicit the required response. They were also taught how

to establish an enabling environment for frank conversation.

After the first day of training, each interviewer was given a copy of the survey instrument to take home for further study in order to raise any questions or concerns they might have on the second day of training. They were not told what was going to happen on the second day in order not to prejudice them. The second day of training was divided into short sessions where each interviewer interviewed the other two in turn, before finally interviewing the principal investigator. The principal investigator tried to play the devil's advocate by being as difficult an interviewee as possible. This was to offer us the opportunity to observe how they (the interviewers) would conduct the interviews in the field. Finally, the interviewers were asked to write a report of how they conducted the interviews, emphasizing any problems that they encountered. This was to offer the researchers the opportunity to understand the problems they might face in the field. After the training, the questionnaire was piloted by the research assistant resident in Accra, the result of which informed the review of the questionnaire. The data were collected between September and October 2008.

Survey instrument

The survey instrument, the questionnaire, was designed so that it could be used to collect both qualitative and quantitative data from the respondents for analysis. The qualitative data were to be used to aid interpretation of the quantitative estimates that would be obtained from the statistical analyses. The questionnaire used for the data collection contained the following:

- A series of questions seeking information on the socioeconomic and demographic characteristics of respondents such as income, sex, education level, occupation, marital status, and how they ranked improvement in water provision as a national goal. These data were to be used to relate the answers given by respondents (to the WTP questions) to the other characteristics of the respondent in order to test the internal validity of the study.
- A description of the commodity for which the respondents were requested to state how much they were willing to pay, namely improved quality provision of potable water. Also, the respondents were asked to rank improvement in water provision as a national goal among six other national goals.
- Questions that would determine how much the respondents were willing to pay for improved quality provision of potable water in the cities.

WTP elicitation

An open-ended question was asked to determine the maximum amount that respondents were willing to pay as a monthly water bill for improved quality and reliable water provision. Closed-ended questions are recommended in CVM

studies, however, in close-knit communities closed-ended questions could affect the quality of response (Whittington, 1998). The monthly water bill was adopted as the payment vehicle since the respondents are familiar with this method of paying for water and electricity bills and there is no opposition to this payment vehicle.

6. Results

Description of sociodemographic data

Some economists argue that the influence of sociodemographic factors such as gender, marital status, social class and other psychological reasons of demand behaviour cannot be ruled out in the theory of demand (see Kennedy, 1992; Lipsey and Harbury, 1992). The following sections present the sociodemographic data obtained from the field survey, after which they are used to determine how they influence the ranking of water improvement programmes as a national goal, willingness to vote for PSP in water provision, the monthly water bill, and willingness to pay under PSP in water provision. Table 6.1 shows a description of the variables used in the study, whereas Table 6.2 shows the summary descriptive statistics of the demographic data. The variable LNAWTP is constructed as $(WTP_i + 1)$ in order to be able to compute the natural logarithm of zero bids.

Table 6.1: Description of variables used in the study

Variable	Description	N
ACCRA	Variable for location of respondent. It takes the value 1 if location is Accra and 0 if otherwise	302
CAPE_COAST	Variable for location of respondent. It takes the value 1 if location is Cape Coast and 0 if otherwise	302
PUBLIC_PIPE	Variable for current source of water supply. It takes the value of 1 if current source is public stand pipe and 0 if otherwise	302
PRIVATE_PIPE	Variable for current source of water supply. It takes the value of 1 if current source is private stand pipe and 0 if otherwise	302
TANKER	Variable for current source of water supply. It takes the value of 1 if current source is water tanker and 0 if otherwise	302
W_DISEASE	Variable for the existence of water-borne diseases in the area. It takes the value of 1 if household member has experienced water-borne disease in the past and 0 if otherwise	302

continued next page

Table 6.1 continued

W_POTABLE	Household assessment of the quality of present water supply. It takes the value of 1 if household deems water to be potable and 0 if otherwise	301
WATER_BILL	Average monthly water bill (in GHC)	286
GENDER	Gender of the head of the household. It takes the value of 1 if respondent is male and 0 if female	300
MARRIED	Marital status of the head of household. It takes the value of 1 if married and 0 if unmarried	292
HOUSE_SIZE	Size of the household	280
INCOME	Median of monthly income class of the household	293
PRI_EDUC	Education level variable. It takes the value of 1 if head of household completed primary education and 0 if otherwise	302
SEC_EDUC	Education level variable. It takes the value of 1 if head of household completed secondary education and 0 if otherwise	302
TER_EDUC	Education level variable. It takes the value of 1 if head of household completed tertiary education and 0 if otherwise	301
LNAWTP	Natural logarithm of the amount the respondents are willing to pay, including genuine zero bids.	297
LNAMT	Natural logarithm of respondents' willingness to pay amounts excluding zero bids	171
PSP_ CONNECT	Dummy variable to stay connected after implementation of PSP	298
PSP_IMPROVE	Dummy variable to denote PSP will improve water supply	301
RANKW_HIGH	Dummy variable for ranking water improvement among top three national priorities	302

The heads of 302 households were interviewed for the study. Of this number, 161 were male (53%) and 141 (47%) were female. The gender structure of this sample was slightly male biased as compared to the general population in Ghana. According to the 2000 Population and Housing Census (GSS, 2000), 51% of Ghana's population are female and 49% are male. However, for a variety of reasons, including cultural beliefs, the head of a household in Ghana tends to be a man (GSS, 1999). Hence, since the survey was focused on heads of households, and heads of households in Ghana tend to be male, the sample could be representative of heads of households in Ghana. This could explain why the sample is skewed in favour of males.

The gender variable is particularly important for access to quality water because traditionally, in most households in the developing world, women take care of

household activities, subsistence farming to produce food crops, reproduction and mothering. On the other hand, men tend to grow cash crops and have greater access to better-paid, non-farm employment because they tend to be highly educated. Being the breadwinner gives men much control over family income and major decisions such as who fetches water, when and where water is fetched. Gender was thus used as a variable to assess how it influenced the respondents' ranking of improvement in water provision as a national goal, respondents' willingness to pay for PSP in water improvement, and the amount they were willing to pay for a monthly water bill under PSP. The effect of the respondents' gender as a factor was to be captured in the multivariate analysis by introducing a dummy variable so that 0 represented a female respondent and 1 represented a male respondent.

An analysis of the education background of the respondents indicated that 10 (3.3%) of the respondents had no formal education and 96.7% had completed at least primary education (Table 4.2). This was a highly unrepresentative distribution of educational level attained in Ghana. Our sample under-represents those with no formal education and over-represents those with formal education. GSS (1999: 11) have found that in Ghana, "one in three females and one in five males has no education". To make it convenient to find the effect of formal education on people's WTP for PSP in water provision, and also the amount they are prepared to pay for WTP as monthly water bill under PSP in water provision, the education variable was re-categorized into those who had had no formal education and those who had had some form of education. A dummy variable was, therefore, introduced to capture primary education, secondary education and tertiary education. The base category is thus the respondents with no formal education.

Table 6.2: Descriptive statistics of respondents' sociodemographic characteristics

Variable	Summary statistics
Gender (n, %) Male Female	161, 53.3% 141, 46.7%
Educationa (n, %) No formal education Basic education Secondary education Tertiary education	 10, 3.3% 69, 23% 84, 28% 139, 46%
Marital status (n, %) Married Unmarried	 199, 65.9% 103, 34.1%
Household size Mean Range	 5.08 1-18

continued next page

Table 6.2 continued

Average monthly water bill Mean Range	 GH¢10.82 GH¢0-GH¢170.00
Mean monthly income	GH¢222.22
a Basic education here refers to what is normally referred to as elementary education in Ghana, which is formal education to the age of 15 years. b The exchange rate at the time of the survey was GH¢1.00 to US$1	

Of the 302 respondents, 199 (65.9%) were married and 103 (34.1%) were not married. Marital status was represented by a dummy variable where the base category is those who are not married and 1 representing those who are married.

The occupation of individuals usually influences where they live within a country. For instance, farmers in Ghana mostly live in the remote rural areas, which lack most social and economic infrastructural facilities. It was therefore anticipated that the type of occupation respondents were engaged in may influence respondents' willingness to pay to vote for the use of PSP in water provision, as well as the amount they would be willing to pay for a monthly water bill for improved water supply through PSP. It was also thought that occupation could be used to act as a proxy for income in case the data on income were not forthcoming, or unreliable. The occupational distribution of respondents indicates that 69, constituting 22.8% of the sample, are civil servants, 68, or about 22.5%, are public servants, 145, constituting 48% of the sample, are self-employed and 20, 6.6% of the sample, are unemployed.

Inequalities in incomes, whether at individual, national, or international level, lead to inequalities in the ability to satisfy basic needs – quality food, water and, of course, medical care (IFPMA, 2000)[1]. As a general rule, we would expect that, as income increases, consumption of quality water and sanitation services also increases. Evidence from literature shows that income positively influences people's WTP for goods and services. It was therefore expected that people with higher incomes would be prepared to pay higher amounts for improved water supply than people with relatively lower incomes in Ghana if water is considered a normal good.

It is known that economists prefer the use of money metric utility – income or consumption expenditure – as indicator of poverty and living standards (Samuelson, 1954). Income is generally the measure of choice in developed countries and the preferred metric in developing countries is an aggregate of a household's expenditures. The choice of expenditures over income is dictated by a variety of difficulties involved in measuring income in developing countries, among which the seasonal variability in such earnings and the fact that a large proportion of income in developing countries come from self-employment both in and outside agriculture. It has been argued, however, that the expenditure approach potentially defines the poor group too narrowly (Sahn and Stifel, 2001). This has led some authors to suggest the use of an asset index as proxy for measuring economic status. However, the reliance on an asset index to measure socioeconomic status is unconventional in research about economic disparities, which tends to define

economic status in terms of income and, to some extent, consumption (Sahn and Stifel, 2001). An asset index is usually used in studies that do not provide data on income and consumption (for example, the Demographic and Health Surveys and Living Standards Surveys) and an asset index approach is the only way to examine the distributional aspects of the data from an economic perspective. Whilst acknowledging that there could be some difficulties in measuring income levels in developing countries such as Ghana, leading to a suggestion that an asset index or expenditure approach be used instead, it must be noted that both these have their own problems in terms of data required and how these are measured and valued. Also, it is difficult to understand how the expenditure or asset index approach can explain an individual's ability to pay for their health care.

Table 6.3: Monthly income range of respondents

	Frequency	Per cent	Valid%	Cumulative%
Vali 1 -	9	32.	32.	32
101 -	6	22,	22.	55.
201 -	5	16.	16.	71.
301 -	3	10.	10.	82.
401 -	2	8.	8.	91.
501 -	7	2.	2.	93.
601 -	7	2.	2.	95.
701 -	3	1.	1.	96.
801 -	3	1.	1.	97.
901 -	2	.	.	98.
>100	5	1.	1.	100.
Total	30	100.	100	

Income in this study is defined as the average monthly income of the head of the household (i.e., the respondent). As individuals usually do not like disclosing their actual incomes, income ranges were given for respondents to indicate into which range their monthly income fell. Table 6.3 shows the monthly incomes of the respondents.

The income ranges presented to the respondents in the survey compared very favourably (and was almost identical) to that used by other authors in studies on Ghana. The average monthly income of the respondents was GH¢222.22. By and large, the researchers had no reason to doubt the income data obtained from the field survey, because although some respondents were helped by the interviewers to recall their productive activities in order to estimate their income levels, they reflected the general income levels in the country at the time of the survey. The income variable was later transformed into a continuous variable by using the midpoints of the ranges. There could have been a measurement error in the income variable after the transformation into a continuous variable, hence we adopted econometric methods to check and correct for the endogeneity problem. We predicted the income of the household to depend on gender, educational level of the head of the household, the occupation of the head of the household, and other factors.

A household in this study was defined as "the number of people who depend on the same budget or the number of people who eat from the same pot" (Asenso-Boadi, 2004). Larger households are more likely to use large volumes of water compared to smaller households and it is worth empirically exploring whether the size of Ghanaian households influences the willingness to pay for PSP in improved water provision, and the amount people are willing to pay for a monthly water bill as part of such a project. By the year 2000, the population census indicated that the average household size in Ghana was 5.1 (GSS, 2000). The total number of people in the households surveyed ranged from 1 to 18. The average household had 5.08 members, which reflected the average household size obtained from the census.

Respondents were asked to state whether any member of their household had become ill from water-borne disease in the previous two years and whether they knew of anyone in the locality who had had water-borne disease in the previous two years. It was anticipated that if members of a household required medical attention due to water-borne diseases, then the head of household would be willing to vote, and also willing to pay, for an improvement in water provision even through a PSP. From the field survey, only 15 respondents (5%) had a household member who had suffered from water-borne disease in the last two years and this did not significantly differentiate between the amounts people were willing to pay for PSP in water provision.

Table 6.4 shows the main sources of water supply as stated by the respondents.

Table 6.4: Source of domestic water supply

Sources of water supply	Number	Percentage
Private stand pipe at home	149	49.34
Public stand pipe	82	27.15
Private borehole	38	12.58
Public borehole	19	6.29
Water tankers	8	2.65
Other sources of water	6	1.99
Total	**302**	**100.00**

As can be seen from Table 6.4, 149 of the respondents (representing 49%) get their main water supply through a private stand pipe connected to their homes while approximately 9% rely on water tankers and public boreholes for their water supply. In terms of quality of water supply, 217 of the respondents (representing nearly 72%) indicated that their current water supply was of good quality and 218 respondents (representing 72.2%) indicated that their water supply was potable in the sense that they could drink it straight from the tap. The average amount spent on water per month ranged from GH¢0 to GH¢170 with a mean of GH¢10.82. In the three months preceding the survey, the highest amount respondents spent on water ranged from GH¢0 to GH¢200 with a mean of GH¢16.52; and the lowest amount paid for water ranged from GH¢0 to GH¢120 with a mean of GH¢9.60.

It is believed that how individuals rank improvement in water provision as a

national goal could influence their choice whether to have PSP and their willingness to pay for PSP in the provision of improved water supply. To find out how much respondents value their water supply, they were asked to rank water improvement as a national goal among six others, namely, education; old-age assistance; sanitation; recreational facilities; road construction; and provision of housing. The list of national goals was adapted from the work of Asenso-Boadi (2004) who sought to estimate people's willingness to pay for health care. This material was used for further analysis to determine how ranking of water improvement as a national goal influences the willingness to pay to vote for PSP in water provision, and the amount individuals would be willing to pay for their monthly water bill under a PSP regime if the government asked them to do so. Thus it is believed that respondents' ranking of water improvement would help to reflect on how much they were willing to pay for an improved water supply system and whether they would vote for PSP in water supply.

Table 6.5 shows the distribution of the responses given by the respondents in their ranking of water improvement as a national goal. Out of the total respondents, 62 (20.5%) ranked water improvement first; 74 (24.5%) ranked it second; 92 (30.5%) ranked it third; 38 (12.6%) ranked it fourth; 24 (7.9%) ranked it fifth; and 6 (2%) ranked it sixth and seventh. That is, 75.5% of the respondents ranked water improvement among the top three national priorities as a national goal and only 24.5% ranked it below third. From this, we can conclude that there is significant demand for water quality improvement.

Table 6.5: Ranking of water improvement as a national goal

Rankings	Frequency	Percentage
Ranked first	62	20.5
Ranked second	74	24.5
Ranked third	92	30.5
Ranked fourth	38	12.6
Ranked fifth	24	7.9
Ranked sixth	6	2.0
Ranked seventh	6	2.0
Total	**302**	**100.0**

To help find out how respondents' ranking of water improvement influences their willingness to pay for PSP in improved water provision, and the amount they would be willing to pay for a monthly water bill, the ranking of water improvement variable was recategorized into those who ranked it high and those who ranked it low. Here, "ranked high" refers to those who ranked water improvement among the top three national priorities;[2] and "ranked low" refers to those who ranked water improvement lower than in the top third of national goals.

When respondents were asked their views about a water improvement programme that was described in the questionnaire as "if a water provision system is put in place such that water flows 24 hours a day, quality of water is good

(you can drink direct from the tap), and there is accurate and easily accessible billing…" (see question 16a of the questionnaire, Appendix 3), the majority (52.3%) stated that ownership of such an improvement did matter in terms of performance. Table 6.6 shows respondents' preferences for ownership of a water improvement programme.

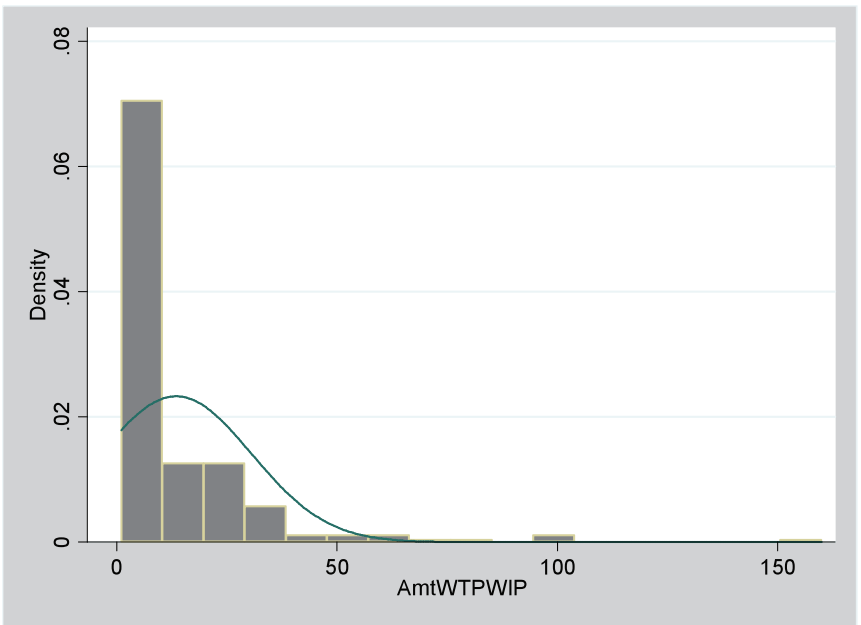
Table 6.6: Preferred mode of operation of water improvement programme

Preferred ownership structure	Frequency	Percentage
Government	80	26.49
Private	40	13.25
Government – private in competition	79	26.16
Government – private in partnership	103	34.11
Total	**302**	**100.00**

As can be seen from Table 6.6, the majority of respondents (about 74%) would want private sector participation in water provision either on its own or in competition and/or in partnership with government. When asked whether they were aware of any attempt by the government to involve the private sector in the provision of water, the majority (64.2%) said they were aware of it. A majority of the respondents, 231, representing 76.5%, held the view that private sector participation in the water sector would improve water provision. We conclude that there is no significant aversion to engaging the private sector in ensuring access to water. This could be a direct response to the huge demand for a water improvement programme we found earlier. Asked whether they would vote for PSP in Water Improvement Programme (WIP) in their area, 246 respondents, representing 81.5%, responded in the affirmative. Asked what they would do if the implementation of the WIP came with higher monthly water bills, the majority of respondents (about 61%) indicated they would stay connected to the system whilst 11.6% did not know what they would do in such a situation.

The amount that respondents were willing to pay for private sector participation in water improvement ranged from GH¢1.00 to GH¢160.00 per month, with a mean of GH¢13.42. This means that WTP is higher than the monthly water expenditure reported for different studies. Firstly, the mean WTP is greater than the mean household monthly water bill of GH¢10.82 found in our study. According to Engel et al. (2005), the average monthly per capita expenditure for domestic water is between GH¢3–GH¢4. Thus, given an average household size of 4 to 5, the total household monthly water expenditure is between GH¢1.50 and GH¢2.00. Compare this with the actual expenditure on water. The distribution of these amounts is shown in the histogram below (Figure 6.1).

Figure 6.1: Histogram of amount water users are willing to pay in level form



Regression results

The multivariate analysis starts with the PROBIT model to identify the factors that influence the willingness to pay for the WIP, which may accompany the private sector participation in water provision. However, as indicated earlier, there is the potential problem of sample selection that could result in biased estimates (Heckman, 1979). As a result, we first estimated a Heckman two-stage sample selection model. The results of this estimation are presented in Table A1 in Appendix 1. The results indicated that there is no sample selection problem. Thus we estimated the PROBIT and ordinary least square equations separately. This can be inferred from the statistical insignificance of the Inverse Mills Ratio. The Z score is -0.54 with the p-value of 0.588.

First, we presented the PROBIT model concerning the willingness to pay for private sector participation in the provision of water. This would permit us to identify the characteristics of those who provided zero bids and those who indicated positive bids. Since we anticipated measurement problems with regards to the income variable, we estimated two models: an ordinary PROBIT model and an instrumental variable PROBIT model. The results are presented in Table 6.7. The dependent variable is the willingness to pay higher water bills when PSP is implemented. The dependent variable is a dummy variable which assumes the value of 1 when the respondent is willing to pay higher water bills, and 0 otherwise.

Models 1 and 2 in Table 6.7 are the ordinary PROBIT estimations and models 3 and 4 are the instrumental variable PROBIT estimations. Models 1 and 3 are estimated according to the assumption that education affects only income. Models 2 and 4 are the counterparts of models 1 and 3 when we relax the assumption that educational background (captured by education dummies) affects willingness to pay for water quality improvement both directly and indirectly through the income variable. The instruments for income in models 2 and 4 comprise gender of the respondent, dummy variables for self-employment, employment in civil and public service, and dummy variables for education and household size.

Table 6.7: Results of the PROBIT and instrumental variable PROBIT models

Independent variables	[1]	[2]	[3]	[4]
ACCRA	-0.09273890	-0.0364798	-0.0145838	0.0050149
	(0.2545334)	(0.2563054)	0.2564585	(0.2624142)
CAPE_COAST	-0.29801910	-0.2310068	-0.1960835	-0.1983514
	(0.2579897)	(0.2597016)	(0.2563933)	(0.2593226)
PSP_CONNECT	0.7918857***	0.7677385***	0.6611671***	0.6971435***
	(0.1830575)	(0.1869837)	(0.2081684)	(0.2495463)
WATER_PUBLIC	-0.2070105	-0.2058185	-0.1297022	-0.1330138
	(0.2916594)	(0.2912168)	(0.2910706)	(0.3274217)
WATER_PRIVATE	0.1184014	0.0805421	-0.0783113	-0.049519
	(0.2599324)	(0.2679687)	(0.2974382)	(0.3588354)
WATER_TANKER	0.292201	0.2115379	0.1565906	0.0919300
	(0.5149722)	(0.495279)	(0.524392)	(0.5522107)
HOUSESIZE	-0.0632101*	-0.0735493**	-0.0649117**	-.0717433**
	(0.032585)	(0.0330298)	(0.0317743)	(0.0337202)
GENDER	0.0703306	0.0597141	-0.0169444	0.0080913
	(0.1833225)	(0.1888869)	(0.1864321)	(0.2030044)
PSP_IMPROVE	0.7090277***	0.7082003***	0.6037265***	.6371733**
	(0.2106438)	(0.2171771)	(0.228767)	(0.2743298)
INCOME	0.0691400	0.0409328	0.2012085*	0.1858041
	(0.0627330)	(0.0654236)	(0.1053927)	(0.2537969)
RANKW_HIGH	0.1965700	0.1636432	0.0996018	0.0995892
	(0.2117340)	(0.2145814)	(0.2272303)	(0.2500447)
PRI_EDUCATION		-0.8431205		-0.8724601
		(0.5917912)		(0.5891381)
SEC_EDUCATION		-0.50550230		-0.5150419
		(0.5129121)		(0.5106429)

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Table 6.7 continued

TER_EDUCATION		-0.2159101		-0.4962261
		(0.5531658)		(0.7199632)
CONSTANT	0.0233608	0.517335	-0.1134535	0.3750970
	(0.4666546)	(0.6477977)	(0.4654131)	(0.7021074)
OBSERVATIONS	264	264	264	264
WALD CHI SQUARE	47.35***	48.81***	51.23***	50.45***
PSEUDO R SQUARE	0.1552		0.1686	

The robust standard errors are in parentheses. *Significant at 10%, ** Significant at 5%, *** Significant at 1%. The dependent variable for all four models is willingness to pay higher water bills.

We performed parametric and semi-parametric tests for both estimation procedures. For the parametric test, we fail to reject the null hypothesis that our initial PROBIT model is correctly specified at a 5% significance level for the instrumental variable PROBIT, and at all conventional levels for the PROBIT estimation procedure. The diagrams for the semi-parametric tests are provided in Figures A2.1 and A2.2 in Appendix 2. Three variables remain statistically significant, irrespective of the model. These variables are the dummy variable for the belief that PSP will improve water quality (PSP_IMPROVE), the size of the household (HOUSESIZE), and the dummy variable for the persistence of water connection after the PSP is implemented (PSP_CONNECT). The income variable is only statistically significant under the instrumental variable PROBIT estimation. None of the location dummies are statistically significant at the conventional levels. Thus we can conclude that the willingness to pay for the PSP in water provision is mainly driven by the extent to which the household believes that PSP will improve water quality and whether the household will remain connected after the implementation of the PSP. The only socioeconomic variable that is statistically significant is the household size, and this result indicates that bigger households would be less willing to pay for the PSP in water provision.

We have a good specification of the instrumental variable PROBIT. The test statistic for the Wald test is 50.17 at 11 degrees of freedom. Thus the model is significant at all conventional levels. The Wald test of exogeneity was also performed on the income variable that we anticipated would be fraught with measurement errors (see Wooldridge, 2002). The null hypothesis is that the income variable is exogenous. The test statistic is 2.17 and we fail to reject the null hypothesis at all conventional levels.

We also estimated four different models to identify the factors that could determine the bids or the amount the households were willing to pay for water quality improvement. These models are presented in Table 6.8. Model 1 is the semi-natural logarithmic model of the full sample; model 2 is the instrumental variable (IV) specification of model 1; model 3 is the semi-natural logarithmic specification of positive bids only; and model 4 is the instrumental variable specification of model 3. In the full sample, we have both positive bids and zero bids, however, in the positive bids we only considered the households with only positive bids for water quality improvement. The C tests for endogeneity were reported for the two

IV estimations, i.e., 2 and 4 in Table 6.8. The test statistics reported are 0.099 and 0.113, respectively. Based on these test statistics, we reject the endogeneity of the income variable. However, following the recommendations of Shea (1997) based on the partial R-square, we reject the null hypothesis at all conventional levels meaning that kth canonical correlation is zero. This means that 2SLS will perform well. We also found ample evidence in support of our earlier conclusion drawn from the PROBIT models that there is no sample selection problem. Models 1 and 3 remain almost similar apart from the small changes in the estimated coefficients with the same sign. First, the specification of the two regressions are a good fit, both are significant at less than 1%. The adjusted R-squares of the two regressions are almost the same. Also, the two regression results produce similar results in terms of the variables that are statistically significant.

Public policies are universal as they affect both those who support and those who do not support the policy. For example, when a water improvement programme is implemented, it will affect the respondents who supported the water improvement programme and those who did not support the policy. Therefore, the preferences of both those who support and those who do not support the public policy need to be included in models that seek to evaluate these public policies. Thus we can include their values in the estimation of our regressions. However, for comparison purposes, we also presented the results in the case of those who made positive bids only. Although the household size is statistically significant in the PROBIT estimation, it is not significant in the bid function. Moreover, rankings for water quality improvement and gender of the head of the household are not significant in the bids quoted by the households. Also, the respondents from Accra quote bids that are statistically different from the base category, i.e. Sunyani. The dependent variable for models 1 and 2 is LNWTP. The dependent variable for models 3 and 4 is LNAMT.

Table 6.8: Results of the semi-logarithmic specification of bid function

Independent variables	[1]	[2]	[3]	[4]
ACCRA	0.2738342***	0.2871157***	0.2076553*	0.215886**
	(0.1039308)	(0.1058901)	(0.1226637)	(0.1214607)
CAPE_COAST	0.07654330	0.0817678	-0.1401462	-0.1376778
	(0.0988231)	(0.0990859)	(0.1138365)	(0.1133958)
WATER BILL	0.0899061***	0.0878019***	0.0821137***	0.0811355***
	(0.0084816)	(0.0086613)	(0.0101906)	(0.010319)
WATER BILL SQUARE	-0.0006051***	-0.0005843***	-0.0005243***	-0.0005148***
	(0.0001286)	(0.0001305)	(0.0001291)	(0.0001315)
GENDER	0.02402600	0.0106389	0.0488194	0.0436142
	(0.0743177)	(0.0799658)	(0.0916400)	(0.0950123)

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Table 6.8 continued

MARRIED	-0.1576431*	-0.1645117*	-0.2172285**	-0.2218098**
	(0.0840584)	(0.0839587)	(0.1002104)	(0.0998721)
HOUSE SIZE	0.0161477	0.0167926	0.0286773*	0.0285049*
	(0.0146255)	(0.0141053)	(0.0155809)	(0.0158519)
INCOME	0.0575441***	0.0775265**	0.0506594**	0.0599596
	(0.0194041)	(0.0391444)	(0.0213705)	(0.0431511)
RANKW HIGH	0.10480600	0.0972919	0.1444311	0.1392676
	(0.0897265)	(0.0914544)	(0.1047462)	(0.1133235)
WATER QUALITY	0.2663656***	0.2610603***	0.2112742**	0.2106307**
	(0.08376900)	(0.0846374)	(0.0983544)	(0.0986977)
CONSTANT	0.7478895***	0.7175757***	0.9804069***	0.966361***
	(0.1646003)	(0.1645465)	(0.1800975)	(0.1679916)
OBSERVATIONS	240	240	171	171
F STATISTIC	61.29***	55.15***	55.02***	50.72***
R SQUARE (CENTRED)	0.6833	0.6816	0.6870	0.6866

*Significant at 10%, ** Significant at 5%; *** Significant at 1%. Robust standard errors are in parentheses.

The variables that are statistically significant at different levels of significance appear to remain the same over the different model specifications. From the results we can conclude that respondents who are resident in Accra quoted higher bids relative to the base category, Sunyani. This is because the dummy variable for Accra is statistically significant, irrespective of the model. This could be interpreted in several ways. However, one plausible interpretation is that residents in Accra face a more acute water situation. Moreover, the current water bills that the respondents are paying determine the bids quoted for the private sector participation for improvement in water provision. The water bill variable is statistically significant for all four model specifications at less than a 1% significance level. However, the water bill increases with the bids at a decreasing rate. This can be inferred from the fact that the square of water bill (WATERBILL_SQUARE) has a negative coefficient and is statistically significant in all the model specifications at all conventional levels. This finding could be interpreted as the persistence of higher water bills: those already paying higher water bills provide higher bids to support the private sector participation in water provision.

The marital status of the head of the household is also statistically significant in the bid function in all model specifications. It means that households where the heads of the household are married quoted lower bids for private sector participation in water provision. This could be an indication of gender division of labour since heads of households are more likely to be male, and females tend to be responsible for water provision in most households. The income variable is suspected to be endogenous. This is the main reason for the estimation of the two-

stage least squares estimations. The income is assumed to depend on the location of the household, gender of the head of the household, marital status of the head of household, size of the household, education background of the head of household, and dummy variables to represent whether the head of household is working as a civil servant, public servant or in the private sector. Thus, we rely on the location of the household, educational attainment of the head of household and dummy variables for the household head working as a civil servant, public servant or in the private sector to ensure exclusion restrictions. Although these variables could affect the bids directly, we are implicitly assuming here that these variables only affect bids through the income. The income equation yields a good fit. The F statistics for both specifications are significant at 1%. The income variable in the bid function is statistically significant in three of the four model specifications. Thus we conclude that bids are affected by the income level of the household.

We performed tests on the instrument, i.e., tests for weak instruments and under-identification. Various tests can assess the strength of the instruments used in the estimation. For under-identification, both the Kleibergen-Paap *rK* LM statistic and Kleibergen-Paap Wald statistic reject the null hypothesis of weak instruments at all conventional levels. The Kleibergen-Paap *rK* LM statistic and Kleibergen-Paap Wald statistic are 49.35 and 89.02 for models 2 and 4, respectively. Under this test, the null hypothesis is that the matrix of the reduced form coefficients has a rank of *K 1 – 1*. The null hypothesis means that the reduced form equation is under-identified. For weak identification, the Kleibergen-Paap *rk* Wald test was used. The null hypothesis is that the equation is weakly identified. The test statistic is 13.91 and we therefore reject the null hypothesis for weak instruments 10% maximal IV relative bias. Thus, given our specification, our instruments performed quite well. For the weak instrument with robust inference, all three reported tests, the Anderson-Rubin Wald test, Anderson-Rubin Wald test and Stock-Wright LM S statistic, reject the null hypothesis at a 5% significance level. The null hypothesis here is that $\beta_{INCOME} = 0$. This means that the coefficient of income in the structural equation is statistically different from zero. The same conclusions also hold for the positive bid sample.

Thus we can conclude that there is ample evidence that bids quoted by the respondents depend on the income of the households. Households with relatively higher income levels provided higher bids for private sector participation in improving water provision. This can also be inferred from the fact that whether households remain connected to water supply after the implementation of the plan depends on the income level of the households. Households with relatively higher income levels indicated they would remain connected to water supply even after the implementation of the PSP. There is also evidence of persistent high water bills in that households that are paying higher water bills provided higher bids for the water improvement programme as well.

7. Conclusion and policy implications

We have evidence that there is an almost universal preference for water quality improvement among our sample. More than 75% of the sample ranked water quality improvement very high (i.e., among the top three) as a national priority. These respondents also believe private sector engagement would improve the water quality. We can infer from this result that the respondents seek quality water and are likely to pay for this programme.

We established that the income level of the household is a key determinant of the bid quoted in support of the water improvement programme. This finding provides evidence in support of opponents in the water privatization debate in Ghana, that the privatization of water will marginalize the poor in terms of access to basic water supply. However, there is also a preference for water quality improvement. This creates the need for expansion in water delivery, which can be provided either by the public or the private sector. We, can, therefore view these two contrasting evidences as a typical public policy dilemma in which we have both losers and winners in public policies. Given the huge demand for water quality improvement, we tend to argue that the winners can potentially compensate the losers. In the famous theory of public policy, the number of policy instruments should be at least equal to the number of policy objectives. Thus, we found evidence that although private sector engagement in water provision may improve water quality, it may not increase access to water supply among the poor. However, water privatization with a corresponding government programme, especially for poor households, could produce the double dividends of quality and universal access that characterize the public debate in Ghana.

We outlined a plan to undertake a study to establish whether Ghanaians were willing to pay for private sector involvement in the provision of improved and continuous water supply. Our method for carrying out the study was the contingent valuation method, whereby randomly selected heads of households were requested to indicate their willingness to pay, and the maximum amounts that they would be willing to pay for the improved water supply. The study offers data complementary to policy and research on institutions and service delivery. We found that there is a huge demand for improvement in water supply and a general notion is that PSP in water delivery might deliver water quality improvement. The mean willingness to pay for water quality improvement is about GH¢13.42 (US$12) per month. Also, we found that PSP in water delivery that increases water bills could reduce access to water among low income households. Therefore, PSP with a complementary

government programme that increases access to water for low income households could provide better water quality without reducing access to water among low income households.

Notes

[1] International Federation of Pharmaceutical Manufacturers Associations (2000).

[2] 75.5% of the respondents ranked health improvement as the first, second or third most important national goal and only 24.5% ranked it below third.

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Appendix A: Tables

Table A.1: Results of the Heckman two-stage estimation procedure

	Coef.	Std. Err.	z	P>z
wtppspwip				
WATER QUALTIY	.0591972	.3325921	0.18	0.859
WATER_BILL	-.0004726	.0131074	-0.04	0.971
GENDER	.0627799	.2957976	0.21	0.832
MARRIED	-.0039791	.3172032	-0.01	0.990
INCOME	-.0043301	.078565	-0.06	0.956
PRI_EDUC	-.2071315	.9371772	-0.22	0.825
SEC_EDUC (JSS)	-.1327081	.8460182	-0.16	0.875
SEC_EDUC (SSS)	-.0940338	.8368599	-0.11	0.911
TER_EDUC	-.0835187	.9134237	-0.09	0.927
CIVIL_SERVICE	.0040083	.6995533	0.01	0.995
PUBLIC_SERVICE	.0037452	.6196636	0.01	0.995
SELF_EMPLOY	.0648862	.6778119	0.10	0.924
PSP_CONNECT	.2280971	.2967017	0.77	0.442
PUBLIC_PIPE	.0883846	.6763529	0.13	0.896
PRIVATE_PIPE	-.0883246	.6583765	-0.13	0.893
WATER_TANKER	-.1437138	.7079862	-0.20	0.839
HOUSE_SIZE	-.0277738	.0503695	-0.55	0.581
W_POTABLE	-.0408457	.3987287	-0.10	0.918
W_DISEASE	-.0822686	.4017258	-0.20	0.838
PSP_IMPROVE	.2461726	.3349666	0.73	0.462
CONSTANT	.6200188	1.281936	0.48	0.629
lnawtp				
WATER QUALITY	-.4850004	.8376523	-0.58	0.563
ACCRA	7.152648	.	.	.
CAPECOAST	.525221	.86607	0.61	0.544
WATER_BILL	.0811599	.1044422	0.78	0.437
GENDER	-.3240713	.5950723	-0.54	0.586

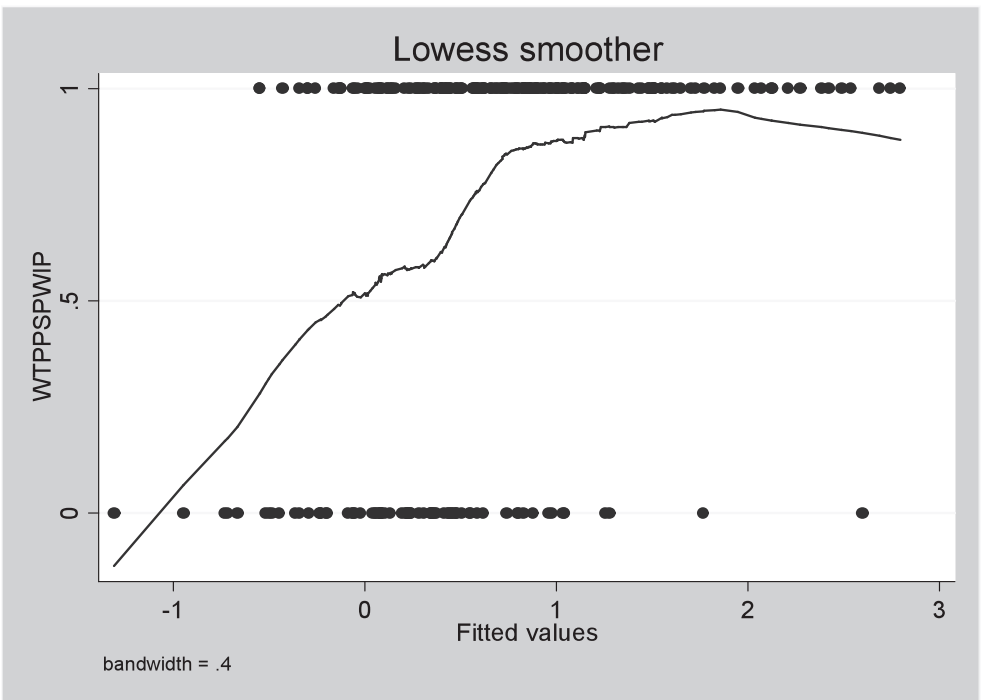
continued next page

Table A.1 continued

MARRIED	-.307877	.5732908	-0.54	0.591
INCOME	.2309739	.255332	0.90	0.366
CONSTANT	1.951802	1.500914	1.30	0.193
mills				
lambda	-2.046098	3.765853	-0.54	0.587

Appendix B: Figures

Figure B.1: Lowess smoothing graph for semi-parametric test for IVPROBIT



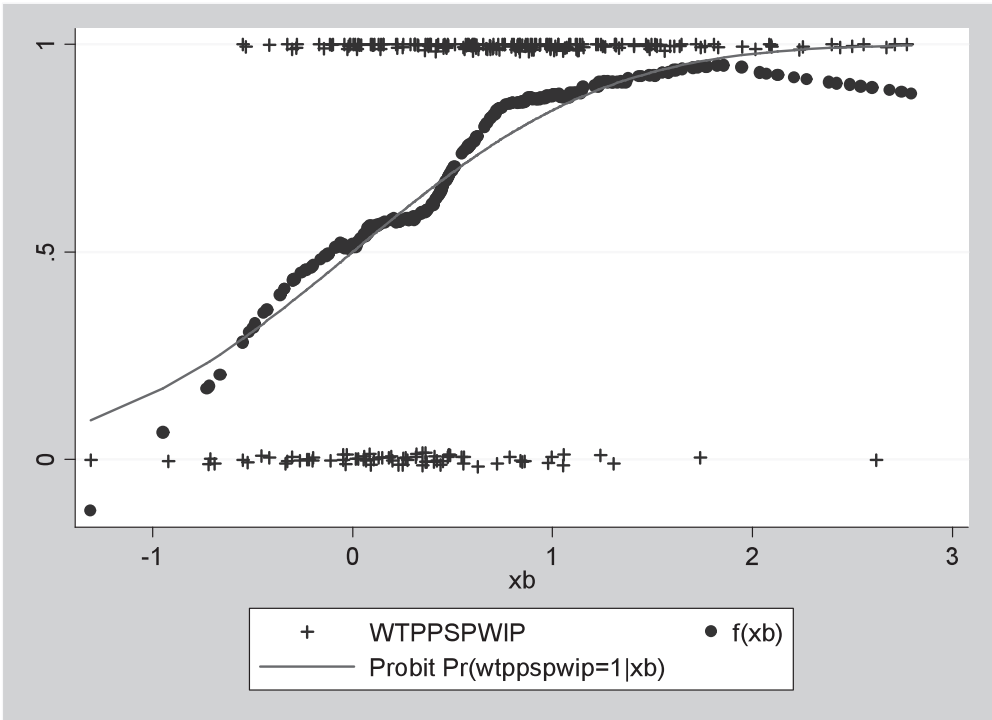
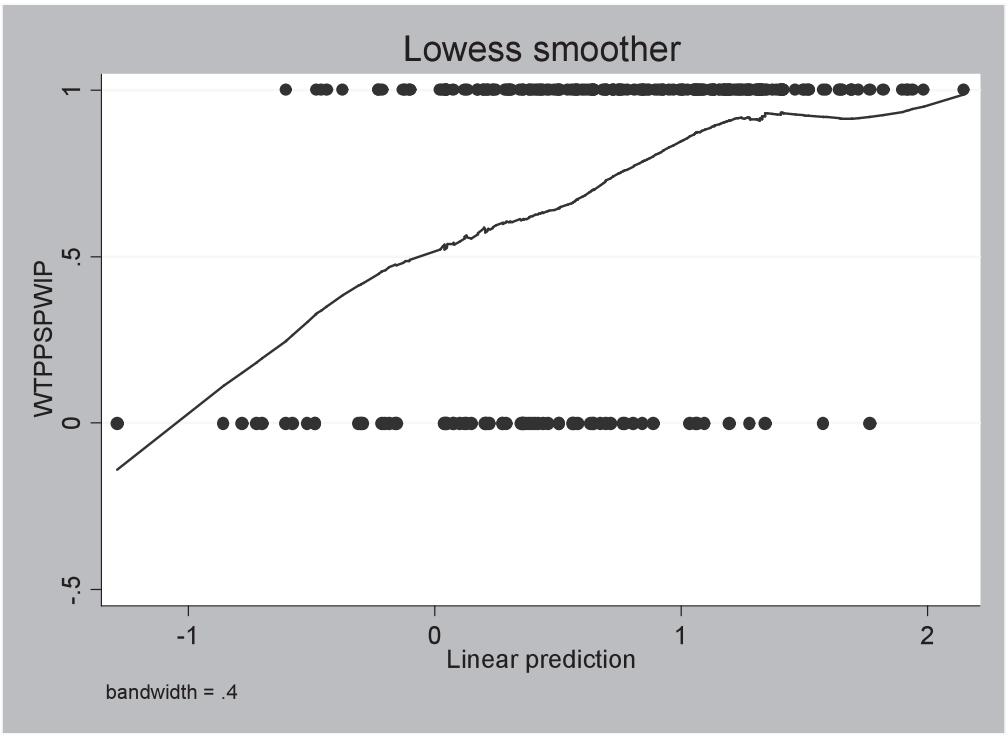

1
.5
0
-1
0
1
2
3
xb
WTPPSPWIP
f(xb)
Probit Pr(wtppspwip=1|xb)

Figure B.2: Lowess smoothing graph for semi-parametric test for PROBIT



Appendix C: Questionnaire

Private sector participation in the provision of quality drinking water in urban areas in Ghana: Are the people willing to pay?

Household Questionnaire

Good morning/afternoon/evening. I am from the Department of Economics, University of Cape Coast. I am here to administer a questionnaire on behalf of a lecturer of this University. You have been randomly selected to participate in an economic decision making experiment. We promise that the responses you give will be treated with strict confidentiality. Your responses will be added to those of other respondents for a general analysis so there will be no way of tracing your response back to you after the analysis is done.

DO YOU AGREE TO PARTICIPATE?

a) Yes [ ]

b) No [ ]

NB: Interviewer should fill in the spaces below & tick where applicable

Name of Interviewer …….

Date of interview ……..

Time of interview …….

Location (City, Town, Village) …….

Questions

1. How would you rank improvement in water supply among other national goals? (Please rank in order of priority from 1 – 7; with 1 being of the highest priority).

   (i) Education Improvement [ ]

   (ii) Old-Age assistance [ ]

   (iii) Health Improvement [ ]

(iv) Water Improvement [ ]

(v) Recreational Facilities [ ]

(vi) Roads Construction [ ]

(vii) Provision of Housing [ ]

2. What is your main source of domestic water?

(a) Private stand pipe at home [ ]

(b) Public standpipe [ ]

(c) Private borehole [ ]

(d) Public borehole [ ]

(e) Water tankers [ ]

(f) Other(s), specify ……

……

3. How often does water flow in your house (If (a) and (b) are your sources of domestic water)?

(a) Daily [ ]

(b) Once a week [ ]

(c) Twice a week [ ]

(d) Other(s) specify ……

4. What is the average duration of water supply if available?

(a) I hour [ ]

(b) 2 hours [ ]

(c) 3 hours [ ]

(d) the whole day [ ]

(e) Other(s) specify …….

5. How much on the average do you spend on water per month?

Amt. in GH cedis …….

6. What was the highest amount you paid for water per month over the past three months?

Amt.in GH cedis …….

7. What was the lowest amount you paid for water per month over the past three months?

Amt.in GH cedis ……..

8. In your opinion, is water supply in your area

   (a) good quality [ ]

   (b) bad quality [ ]

9. Is your water potable?

   (a) Yes [ ]

   (b) No [ ]

10. If yes to q 9, have you or a member of your household become ill from water-borne diseases in the past two years?

    (a) Yes [ ]

    (b) No [ ]

11. If no to q 9, how much do you have to spend in a month to improve water quality for consumption? e.g. expenditure on sachet water, chemicals to improve domestic water usage, etc

    Amt GH cedis …….. per month

12. Do you know of any other person who has become ill from water-borne diseases in the past two years?

    (a) Yes [ ]

    (b) No [ ]

13. Are you aware the Government has engaged the private sector in the provision of water?

    (a) Yes [ ]

    (b) No [ ]

14. Do you think private sector participation will improve the provision of water?

    (a) Yes [ ]

    (b) No [ ]

15. What would be the most preferred model of water supply?

    (a) Government [ ]

    (b) Private [ ]

    (c) Government and private in competition [ ]

    (d) Government and private in partnership [ ]

16 a. If a water provision system is put in place such that water flows **24 hours a day,** quality **of water is good** (which you can **drink direct from the tap)**, and there is **accurate and easily accessible billing**, would it matter who the owner of such system is? i.e. does it matter if it is privately or publicly owned?

(a) Yes [ ]

(b) No [ ]

16 b. If Yes to 16a, kindly state your preference

(a) Private [ ]

(b) Government [ ]

17. Suppose that the Government of Ghana and a private company jointly implement a Water Improvement Programme [WIP] that ensures that water quality description in q 16a is implemented. However, this will lead to an increase in your water bill. Would you be willing to pay the higher water bill?

(a) Yes [ ]

(b) No [ ]

18. I want you to suppose that the improved water service for households in cities (Accra, Cape Coast, Sunyani) with public private sector through GWCL would result in an increase in your total monthly water bill. For this new Water Improvement Programme described in q17 would you vote for the implementation of the Water Improvement Programme?

(a) Yes [ ]

(b) No [ ]

19. Looking at your current disposable income, how much will your household be willing to pay for such an improved water delivery service described in q16a above?

Amt (GHC) ……

20. Now, I want you to suppose that in fact most people did vote for the plan to improve the water supply system. Assume that the typical household's monthly water bill for water increased over and above what your household was willing to pay in q19 above, what do you think your household would do?

i) Stay connected and pay the higher water bill [ ]

ii) Disconnect and find water elsewhere [ ]

iii) Don't know [ ]

21. If you prefer (i) in q20, what is the maximum amount you would like to pay?

Amt (GHC) ……

22. If you prefer (ii) in q20, kindly state what sources of water your household will use?

    (a) ……

    (b) ……...

    (c) ……

23. Which of the options of implementation would you prefer?

    (a) Government [ ]

    (b) Private [ ]

    (c) Government and private in competition [ ]

    (d) Government and private in partnership [ ]

Demographic data

1. Sex of respondent

    (a) Male [ ]

    (b) Female [ ]

2. Marital status

    (a) Unmarried [ ]

    (b) Married [ ]

3. Size of household

    (a) Number of adults …….

    (b) Number of children (below 18 years) ……..

4. Occupation

    (a) Civil Servant [ ] (c) Public Servant [ ]

    (b) Self employed [ ] (d) Unemployed [ ]

    Kindly state your actual employment ……..

    ……
    ……

5. Monthly income level in GHC ***(Interviewer tick the box that is applicable)***

    (a) 0 – 100 [ ] (g) 601 – 700 [ ]

    (b) 101 – 200 [ ] (h) 701 – 800 [ ]

    (c) 201 – 300 [ ] (i) 801 – 900 [ ]

    (d) 301 – 400 [ ] (j) 901 – 1000 [ ]

    (e) 401 – 500 [ ] (k) Above 1000 [ ]

    (f) 501 - 600 [ ]

6. Educational background

(a) No schooling [ ]

(b) Primary [ ]

(c) Junior Secondary [ ]

(d) Senior Secondary [ ]

(e) Tertiary [ ]

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