2014 3rd International Conference on Business, Management and Governance
IPEDR vol.82 (2014) © (2014) IACSIT Press, Singapore
DOI: 10.7763/IPEDR.2014.V82.15

Is Access to Potable Water a Determinant of Urban Rental Values?

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Abstract. This paper uses the urban housing market in Ghana, a developing country in West Africa to determine rental values. We argue that inadequate access to potable water due to rising urban population and other demand and supply constraints affect housing values. To test this hypothesis, this study uses survey data and applies the hedonic pricing method. We compute the marginal willingness-to-pay (Marginal WTP) for access to potable water supply in residences for both localised and non-localised log-log models. The study finds that water supply in urban residences is a major determinant of rental values and that households are prepared to spend sizable proportions of their income to improve their quality of life.

Keywords: West Africa, Ghana, Urban, Access to Water, Hedonic Valuation, Elasticity

1. Introduction

The United Nations (1995) has observed that population in urban areas is made up of about half of the world's population. Choutmert et al. (2014a) have indicated that population in urban areas of developing and emerging countries are growing rapidly. They argue further by citing the United Nations Population Division (2008) as having indicated that the urban population in sub-Saharan Africa will be at least tripled by the year 2050. Giving the poverty levels and water supply constraints in developing countries, population growth has made demand for water outstrip its supply hence creating a huge water deficit in most developing countries. The World Health Organization (WHO et al., 2000) have acknowledged how access to water in developing countries is a problem plaguing millions of people and worsening the plight of the poor.

Institutions responsible for supplying water in Ghana are constrained in supplying water to all especially households in urban Ghana. This is mainly as a result of production and distribution challenges, continued population growth without proper urban planning, and non-revenue water losses (Van-Rooijen et al. 2008). Generally, effective supply of water in Ghana is 280,000 cubic metres per day while the daily demand of 763,300 cubic metres per day is twice effective supply hence creating a supply deficit (Water Aid, 2005). In the case of daily production and demand, GWCL (2004) is reported in Fuest and Haffner (2007) to have revealed that the daily demand in 2003 was estimated to be 1,023,000 cubic metres while the supply was 593,000 cubic metres. Better still, in Accra "Water demands are almost six times higher than the actual capacity of the water supply system in 2007" (Adank et al., 2011, p.12). This explains why there is excess demand over supply of potable water resources in Ghana. This water supply-gap to a developing country like Ghana is quite worrying in the wake of meeting the Millennium Development goals by 2015. Evidence is found in the work of Salaam-Blyther (2012) on progress towards meeting MDG target by 2015 where substantial strides to achieving this target have been made. However, there are recent doubts to its achievement and sustainability due to urban population growth explosions.

Access to potable[1] water supply is one of the urban services alongside access to toilet, access to electricity, access to transport and information technology that needs to be addressed in the light of the gargantuan urban population growth. It is against this background that this study seeks to estimate

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[1] Water of specified quality standard meant for drinking purposes. Also safe water (see Ghana Water Policy, 2007)

household's economic value for access to potable water through the housing market in Ghana. This is important as it seeks to inform policy makers and stakeholders in urban housing resource allocations. Also, Malpezzi (1985) and Choumert et al (2014b) have observed that only a few studies have been done in this respect particularly in Africa. This study contributes to the literature on housing markets and potable or drinking water valuation.

The rest of this study is structured as follows: Section 2 reviews the literature relevant to the study. A description of the data and fieldwork issues are presented in section 3. The analysis and discussions of results are undertaken in section 4. Section 5 presents the conclusion of the paper.

2. Data and Field Work Description

2.1. Study Area and Population

Ghana is a sovereign country located within the western part of Africa, along the Gulf of Guinea. It covers an area of 238,537 sq. km (equivalent to 92,100 sq. miles). The population of Ghana is estimated to be over 25million. The economy of Ghana is currently facing economic challenges yet it still has one of the promising growth rates on the Continent of Africa. Ghana is divided into ten administrative regions with ten cities or urban areas. It is endowed with a broad range of natural resources which include but not limited to oil, gold, water resources, diamond, and timber. This study now zeros in on the Greater Accra Region of Ghana. The Greater Accra Region of Ghana has ten administrative regions with its capital city as Accra. It has the second highest number of population accounting for about 15% of the entire population. It is also regarded as having the highest population density in Ghana. Most people in this region depend on several sources of water supply for drinking and for general use. This mainly include piped, borehole, well, sachet and/or bottled water. According to the 2010 Housing and Population Census as provided by the Ghana Statistical Service (2012), the total population of the Greater Accra Region with ten districts is 4,010,054. The population in households is 3,888,512 with male and female distributions as 1,938,225 and 2,071,829 respectively. The total number of households is 1,036,426 with an urban household population of 766,955 and a rural household population of 269,471. Since this section of the study focuses on the urban household population, the required population used by the study is 766,955 households.

2.2. Sampling Frame

In this study, the sampling frame is mainly housing units. However, there were some few cases of office and shop units within each district. The criteria for district selection was that, it should be one of the ten districts in the GAR of Ghana ensuring sufficient geographical coverage and spatial variation. The unit of analysis were household level respondents mainly household heads who are 18years and above of sound mind, and falls within the three income brackets (High, medium and low). They should have worked within the last five years and are currently employed or unemployed within the last seven days of the month of the interview. They should as of the time of the interview be living in the district and should not be visitors. All potential respondents reserved the right to either accept to participate or decline participation.

2.3. Sampling Technique and Sample Size Computation

Following FAO (2000) recommendations, the study therefore followed the case of India as presented by Hadker et al. (1997). The fieldworkers were to interview a pre-determined number based on the computed sample size of each district to control for sample size bias. Further, their task was to interview urban households distributed around Greater Accra Region at any time between 8am to 6pm (time hired) within the localities of all ten districts. Thus, respondents were first categorised according to their respective districts and randomly selected within the districts. Here, they are observed to have equal probability of being selected in the sample. This study adopts a simplified formula to calculate sample size as developed by Yamane (1967)[2]. The computed sample size yielded the required sample size of 400 households. Thus, the

[2] Sample Size Computation (Yamane 1967)

$n = \frac{N}{1+N(e^2)}$, $n = \frac{1{,}036{,}426}{1+1{,}036{,}426(0.05^2)} \approx 400$

N=population size (Total Number of Households) and e=margin of error 0≤e≤1 minimum representative sample size required to control for sample size bias was 400 households. However, to ensure proper representation and a larger sample size the study used a sample size of 1,650 households. 25 fieldworkers were used to administer the questionnaire from March-May, 2014.

2.4. Hedonic Empirical Model

The development of the empirical model for this study is sourced from the theoretical model as given by Rosen (1974) for hedonic valuation (HVM) estimations in equation 1.

$$V = f(S, N, W) \tag{1}$$

"Where V is the estimated market value of the property (sales price), S denotes a set of structural characteristics, N a set of neighbourhood amenities, and W represents the types of water services available (piped network, other non-piped water sources). The first order derivative of the hedonic price function with respect to one such characteristic yields an indirect estimate of the willingness-to-pay for this particular characteristic"(van den Berg and Nauges, 2012, p.154). This model is modified to include a vector of socioeconomic characteristics of respondents' households.

3. Estimation and Discussion of Survey Result

VARIABLES	Model 1: Lin-Lin	Model 2:Lin-Log	Model 3: Log-Lin	Model 4: Log-Log	Model 5: Lin-Lin
Access to Water Supply in Res.	19.635**	19.669**	0.187***	0.181***	60.434***
	(7.836)	(8.306)	(0.045)	(0.045)	(9.101)
Access to Toilet Fac. in Res.	44.774***	46.328***	0.468***	0.472***	138.232***
	(7.013)	(7.337)	(0.046)	(0.047)	(5.934)
Proximity to School (Km)	-3.454***	-3.272***	-0.015***	-0.015**	
	(0.835)	(0.971)	(0.005)	(0.006)	
Proximity to Highway (Km)	-3.909**	-4.157**	-0.022**	-0.021**	
	(1.544)	(1.827)	(0.008)	(0.009)	
Proximity to 3-5Star Hotel	0.852***	0.792***	0.005***	0.004***	
	(0.146)	(0.155)	(0.001)	(0.001)	
Owner of Residence	25.806***	26.359***	0.141***	0.141***	
	(7.755)	(8.252)	(0.044)	(0.044)	
HH Income	63.025***		0.282***		
	(4.647)		(0.020)		
Log_HH Income		151.151***		0.749***	
		(10.693)		(0.048)	
Constant	-80.620***	-38.556***	3.163***	3.304***	
	(10.435)	(8.681)	(0.051)	(0.046)	
District Dummies	*No*	*No*	*No*	*No*	*No*
Observations	1,604[a]	1,604[a]	1,604[a]	1,604[a]	1,648[a]
R-squared	0.383	0.299	0.329	0.305	0.383

Dependent Variable: Rent per month in Ghana cedis (1 Gh ₵= 0.319 US$ as at 15/10/2014).
[a]Non-responses reduced the number of observations from 1648 to 1604 in cases where this is reported.
Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The descriptive statistics and the description of the variables used in generating the results as presented in Tables 2 and 3 are presented in Table 1. Mainly Four models are estimated namely the lin-lin (Model 1), lin-log (Model 2), log-lin (Model 3) and log-log (Model 4). We acknowledge that property markets are normally characterised with heterogeneous goods which can easily influence rental values. To control for this, Individual dummies were created for all the ten districts and robust standard errors estimated. Furthermore, it is observed that multicollinearity is not severe in the models used for this study. This is because the study used the Variance Inflation Factor (VIF) to test for the severity of multicollinearity. The VIFs provides values ranging 1.01-1.27(both Tables) and a mean VIF value of not more than 1.11 (both Tables) which suggests that the VIFs are not significantly greater than 1. (See Chatterjee and Hadi, 2006; Choumert et al., 2014).

The analysis is based on the log-log model while the others evaluate the robustness of the preferred model. This study first dropped variables which were highly correlated and/or insignificant in the model and focused on only those variables that had the right signs and significant following the conventional statistical levels provided below the tables. The results support the apriori expectation of a positive relationship between structural characteristics (access to water supply and access to toilet facilities both in residence) and rental values. This suggests that houses with access to water supply services and access to toilet facilities are likely to have higher rental values. Thus, access to these water related variables are very relevant in Ghana and probably for other developing countries with similar characteristics. Other recent African context studies which include but not limited to Choumert et al., 2014a, 2014b; and Knight et al. (2004) had similar findings. A relatively lower rental values is therefore expected for estates with either one of them. Neighbourhood characteristics have ambiguous signs yet significant. Noise and dust prone areas such as unwalled schools and highways had negative effects on rental values in Ghana. However; quiet, decent and more secured environments where most of the 3-5 star hotels are located have positive effect on rental values. In the case of household-level characteristics, the income of the household head and status of the respondent as owner of residence have positive effect on rental values. These socioeconomic characteristics at the household level are used as proxies to describe the level of knowledge, awareness and perception of the household (See van den Berg, 2012). Thus, households with higher levels of income or are owners of their residence are assumed to have acquired higher levels of knowledge or perhaps are aware of the rationale behind staying in a residence with access to basic utilities(such as toilet and water), low crime and noise levels etc. have higher values for their residence.

The study further introduces district dummies to assess the extent to which specific district attributes affect other district's rental values. The introduction of district dummies in the model did not significantly change the results. All the variables kept their signs as expected with slight changes in their respective magnitudes or coefficients. The positive trend between rental values with access to water implies that houses with access to water supply will continue to enjoy higher rental values which could take care of initial water installation costs.

3.1. Computation of marginal willingness-to-pay

The study further derived the marginal WTP otherwise called elasticity for access to water supply in their residences. Following van den Berg and Nauges (2012) we adopt the formula without necessarily going through the derivatives. This therefore is given as:

$$Marginal\ WTP = (e^{\beta} - 1) \times 100$$

From the log-log model (without localisation) it yields:

$$Marginal\ WTP = (e^{0.181} - 1) \times 100 = 19.84\% \approx 20\%.$$

In addition, the 95% confidence interval for the estimated parameter ($\overline{\beta}$) is 0.09 and 0.27 or 9% and 27%. Moreover, from the log-log model (with localisation) it yields:

$$Marginal\ WTP = (e^{0.121} - 1) \times 100 = 12.86\% \approx 13\%.$$

Also, the 95% confidence interval for the estimated parameter ($\overline{\beta}$) is 0.04 and 0.22 or 4% and 22%.

In effect, the marginal WTP which represents the elasticity of access to water in urban Ghana shows the degree of responsiveness in rental values as a result of a certain percentage change in access to water supply. Therefore, access to water elasticity is 20% in the case of log-log model (without localisation) and 13% for log-log model ((with localisation). In both cases, access to water elasticity lies between 13% and 20%. This according to Bartik (1988) and Choumert et al. (2014) should be interpreted as upper bound values because the utility dummies may include unobserved attributes and utilities.

4. Conclusion

The paper argues that lack of access to water services negatively affects proper housing values in urban Ghana. To test this hypothesis, the study estimates household's marginal WTP for access to water services using the Hedonic Valuation Method (HVM). The study concludes that access to water services is crucial in determining rental values in Urban Ghana. Thus, households' access to water supply elasticity has given enough evidence of their WTP for higher rental prices for houses with access to potable water supply. In sum, access to water is highly valued because it increases households' utility and quality of life.

It is therefore recommended that although the initial cost of having residential water supply is very high, landlords or homeowners who are able to take the risk now will be able to pay off over a reasonable period of time. Lastly, From the perspective of this study, we recommend a further determination of the real cost of accessing potable water to Ghanaian households so as to evaluate the cost and benefit to inform policy decisions and properly direct resource allocation.

5. Acknowledgement

The author is grateful to Prof. P.G. Moffatt and Dr. Corrado Di Maria for their comments on an earlier draft of this paper. They have recommended a further improvement of this version. The financial support of the School of Economics, University of East Anglia (UK) is very much appreciated.

6. References

[1] Adank, M., Darteh B., Moriarty, P., Osei-Tutu, H., Assan D., van Rooijen, D. (2011): Towards integrated urban Water Management in the Greater Accra Metropolitan Area: Current Status and Strategic Directions for the Future. SWITCH-Ghana.

[2] Bartik, T. J. (1988). "Measuring the Benefits of Amenity Improvements", *Land Economics*, 64(2), pp 172-183.

[3] Chatterjee, S. and Hadi, A.S (2006): Regression Analysis by Example, 4th ed., John Wiley and Sons.

[4] Choumert, J., Kere, E.N., Lare, and A.L (2014a): The impact of Water and Sanitation access on Housing Values: The case of Dapaong, Togo, CERDI Working Paper No. 201403.

[5] Choumert, J., Stage, J. and Uwera, C. (2014b): Access to Water as a determinant of rental values: A housing hedonic analysis in Rwanda, *Journal of Housing Economics*, Vol. 26, pp. 48-54.

[6] FAO [Food and Agriculture Organization of the United Nations, 2000]: Applications of the contingent valuation method in developing countries: A survey, FAO Economic and Social Development Paper 146, Italy.

[7] Fuest, V. and Haffner, S. A. (2007): PPP-Policies, Practices and Problems in Ghana's Urban Water Supply, *Water Policy Journal* Vol.9, pp 169-192, IWA publishing.

[8] Government of Ghana, Ghana Statistical Service (GSS, 2012): 2010 Population and Housing Census, Summary Report of Final Results, Sakoa Press Limited, Ghana.

[9] GWCL [Ghana Water Company Limited, 2004]. Urban Water Supply Coverage – Information provided to the administrator of district assemblies common fund, Accra, Unpublished document.

[10] Hadker, N, Sharma, S., David, A. and Muraleedharan (1997): Willingness-To-Pay for Borivli National Park: Evidence from a Contingent Valuation, Ecological Economic, Vol.21 pp 105-122.

[11] Knight, J.R., Herrin, W.E., Balihuta, A.M., (2004): Housing Prices and Maturing Real Estate Markets: Evidence from Uganda. *Journal of Real Estate Finance and Economics,* Vol.28, pp.5-18.

[12] Malpezzi, S., Mayo, S. K., & Gross, D. J. (1985). *Housing demand in developing countries*. Washington: World Bank.

[13] Rosen, S. (1974): Hedonic prices and implicit markets: Product differentiation in pure competition, Journal of Political Economy.

[14] Salaam-Blyther, T. (2012): "Global Access to Clean Drinking Water and Sanitation: U.S and International Programs", Congressional Research Service Report for Congress, US.

[15] United Nations (1995): World Urbanization prospects: the 1994 revision: estimates and projections of urban and rural populations and of urban agglomerations. United Nations Department for Economic and Social Information and Policy Analysis Population Division, New York

[16] United Nations Population Division (2008): World Urbanization Prospects: the 2007 revision, Department of Economic and Social Affairs, United Nations Population Division, United Nations, New York.

[17] Water Aid (May, 2005): National Water Sector Assessment-Ghana. Accessed on the 16/10/2014 @http://www.wateraid.org/~/media/Publications/national-water- sector-assessment-ghana.pdf.

[18] WHO [World Health Organization, 2000]: Global water supply and sanitation assessment 2000 report. WHO, United Nations Children's Fund, Geneva, Switzerland, New York.

[19] Van Den Berg, C. and Nauges, C. (2012): The willingness to pay for access to piped water: a hedonic analysis of house prices in Southwest Sri Lanka, Lett Spat Resour Sci (2012) 5:151–166, published by Springer.

[20] Van Rooijen, D.J., Spalthoff, D. and Raschid-Sally, L (2008): "Domestic Water Supply in Accra: How Physical and Social Constraints to Planning have greater consequences for the poor. A reviewed paper presented at the 33RD WEDC International Conference, Accra-Ghana on the Theme: Access to Sanitation and Safe Water: Global Partnerships and Local Actions.

[21] Yamane, T. (1967), Statistics, an Introductory Analysis, 2nd Ed., New York: Harper and Row.