Household's Valuation of Domestic Water in Indonesia: Revisiting the Supply Driven Approach

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1. Introduction

The Demand Driven Approach (DDA) has been one important aspect of the new paradigm of water provision as opposed to the old paradigm of the Supply Driven Approach (SDA). Proponents of the DDA approach argue that water is an economic good and its efficient provision has to be directed to those who are willing to pay for it. Many case studies using the Contingent Valuation Method (CVM) suggest that people in poor rural areas of developing countries are willing to pay a significant portion of their income for water (see for example, Merret, 2002b). This evidence rejects the so-called 3-5% rule (which defines the percentage of income that poor people can afford to pay for water provision), a result that has provided significant support for the DDA approach and the new paradigm of water management.

We apply the hedonic analysis on a nation-wide microeconomic dataset of Indonesia.[2] Our results indicate that in urban areas, people value having improved domestic water sources

[1] This paper was written while the first author was visiting the Department of Economics/CSERGE, University College London. Both authors wish to thank Jerome Adda for helpful comments and discussions. The usual disclaimer applies.

[2] Although the application of the hedonic technique in developing countries has been somewhat controversial due to the non-existence of fully-developed and competitive housing markets, relevant valuation results are comparable to those derived from the application of other valuation techniques. For example, results from the application of the contingent valuation method (CVM) in developing countries, a technique whose validity does not rest on the competitiveness of any underlying market,

(piped and pump water), while this is not true for households in rural areas. Moreover, households in both urban and rural areas do not seem to value communal water sources, probably reflecting the effects of the free-rider problem, when services have characteristics of public goods. On the whole, our results show that households in rural Indonesia are not willing to pay for improved domestic water sources, which pinpoints a major challenge to the DDA approach. Assuming universal rights for provision of safe and improved water quantities that cover basic needs, subsidization of water provision is still called for.

2. Brief Historical Background

Today, more than one billion people are still vulnerable to deadly health hazard, due to inadequate access to safe drinking water (United Nations, 2003). As a response to this situation, in November 2002, United Nations declared that access to adequate amounts of clean water for personal and domestic uses is a fundamental human right of all people. This declaration implies that all people, rich or poor, living in cities or villages, are entitled to sufficient, affordable, physically accessible, safe and acceptable water. The relevant UN Millennium Development Goal is to halve the proportion of people without access to safe drinking water by the year 2015.

In January 1992, the proceedings of the International Conference on Water and the Environment in Dublin, Ireland, declared: “water has an economic value in all its competing uses and should be recognized as an economic good”. This statement is known as the ‘Dublin principle’, which implies that water under scarcity is not a free good, neither in quantity nor in quality terms, hence its use implies not only benefits to the users, but also costs that they need to incur in order to acquire the relevant quantity. That is, people have to pay for water provision, and thus water should be provided to those who effectively demand it. This principle, however, is contradicted by the principle underlining the supply driven approach to water provision, which emphasizes that water is a basic human right for all people and that it should be treated as a ‘social’ or ‘merit’ good, because it is essential to human life. The direct policy implication from this approach is that all people should have access to safe water.

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are on average comparable with those derived from hedonic analyses. See for example, Jiwanji (2000) who provides a critical comparison of fifteen CVM studies that derive WTP for water related characteristics.

These two lines of thought have sustained a continuing debate, which has been documented in, and has influenced, the evolution of international water and sanitation policies. This debate is usually summarized in the phrase ‘demand driven vs. supply driven approaches to water provision’ (see, Seppälä, 2002, for the review of the past experience of international water policies).

3. Supply Driven vs. Demand Driven Approach

During the 1980s, which is usually referred to as the International Drinking Water Supply and Sanitation Decade (IDWSSD), a total of US$ 133.9 billion had been invested in water supply and sanitation, of which US$ 75 billion (55 percent) was spent on providing water supply (WRI, 1998). The Supply Driven Approach (SDA) was one of the distinct features that characterized the relationship between donor agencies and developing countries during this decade (Seppälä, 2002). The adoption of this approach was documented in the attempt to provide, not only well-off households, but also poor households, with access to improved safe water, with an emphasis on public health aspects of water supply and sanitation. The latter was attempted through the introduction of low-cost affordable technologies, which existed at the time. As a result, SDA was driven by a technology-oriented approach that aimed in increasing water supply. Technologies that were considered suitable to serve people with low income were among others, hand pumps or community taps. Providing in-house tap water connection was not considered an affordable option.

Another important feature of SDA is the so-called “affordability rule of thumb”. This refers to the widely used assumption, that people are willing to pay three to five per cent of their income on water and thus the design specification of a water system should not require households to pay more than 5% of their income. As Merret (2002b) indicates, this 5% rule that is ascribed to van Damme and White (1984 in Merret 2002b) has been documented since the 1975 (World Bank, 1975 in Merret, 2002b). In short, the basic premise of the SDA is that poor people cannot afford safe drinking water if its provision amounts to more than 3-5% of their income.

The modest achievements of the policies that have been adopted during the ‘Water Decade’ let to disappointment. In their review of relevant evaluation studies, DFID (1999) suggested that it was observed that water and sanitation systems had problems of under-use, poor maintenance and poor cost recovery. Mu, Whittington, & Briscoe (1990, in Merret, 2002b) mention that there are simply too many leaking taps, abandoned water systems, and defunct village water committees for anyone to be sanguine about the current rate of progress. These and many other relevant studies provide evidence that many developing countries had failed in their program on water provision. Among the various possible causes of this failure, the lack of demand-driven policies and the failure to integrate the economic nature of water in policy-making, are considered to be the most important ones. As Whittington et al (1990) put it: ‘‘designs for new systems are generally made and projects constructed with little understanding in household water demand behavior’’ (Whittington, Lauria, & Mu, 1991, p. 179 in Merret, 2002b).

The need for a shift from the engineering/supply driven approach to the economic/demand driven approach is becoming obvious. Consumers, including households in rural area, may be willing to pay (WTP) substantially more, for higher levels (in terms of accessibility, quality and quantity) of water services. Simply relying on the 3-5% rule of thumb could be shown to be erroneous (DFID, 1999). The need for the adoption of the DDA has been formally introduced in 1992 with the Dublin Principle. The DDA and the Demand Responsive Approach (DRA) are central concepts to the post Water Decade period (Seppälä, 2002), which constitutes one of the most important paradigmatic changes in water and sanitation policymaking.

The demand driven approach (DDA) attracted widespread support as well as opposition. There have been growing concerns that the DDA could lead to inequitable provision of water. For example, the application of the full-cost recovery principle (one of the main implication of DDA) has been heavily criticized because it let to the poor being prevented from access. In addition, setting an appropriate price of water is also problematic in practice, because not only water is an economic good, but also a basic need, a merit good, as well as a social and environmental resource. Moreover, privatization of water provision services, which is supported by the DDA, has also been a disputable solution to the inefficiency inherent in the public provision of water services. Proposals to privatize water provision in developing countries have been strongly resisted especially by local and international NGOs. In Indonesia, recently, international donor agencies such as the World Bank have been forcefully accused to ignore issues of social equity in favor of increased efficiency, because they supported privatization in the water sector.

4. The Role of Valuation Methods in DDA

The bulk of evidence in favor of the argument that households are willing to pay more than just 5% of their income for improved water services, derives from willingness to pay studies, most of which use the contingent valuation method (CVM). These studies constitute the backbone of the DDA (See Merret, 2002b for the review of these studies).

CVM, however, is only one of many method of economic valuation to infer people's preferences. There are basically two broad approaches to valuation, namely the direct and indirect approaches. Direct approaches attempt to elicit preferences directly by the use of survey and experimental techniques in which people are asked directly to state or reveal their willingness to pay for a proposed change under a hypothetical situation. The indirect approaches, seek to elicit preferences from actual observed people's behavior in markets. Preferences over goods and services are revealed indirectly, when individuals purchase marketed goods, which are related to the good or service in question. The hedonic method is one of the indirect approaches. One main advantage of the hedonic method is that inference on valuation derives from observed behavior in real markets. As a result, the reliability of related inference on people's valuation is enhanced compared to that derived from hypothetical methods (Arrow et al, 1993). Hence when the required data is available indirect methods are usually preferred.

In this paper, we use the hedonic technique to infer how much people are willing to pay for access to safe and improved domestic water, which is an attribute of a house whose presence or absence might affect the willingness to pay (WTP) for the house as a whole. Hence, the structure of housing rents and prices will reflect these differentials. By using data on rent/prices of different properties we can in principle identify the contribution which water related attributes make to the value of the traded good, the house. This identifies an implicit or shadow price for these attributes, which in turn can be used for calculating total willingness to pay for their provision. The method commonly used to implement this approach is the hedonic technique pioneered by Griliches (1971) and formalized by Rosen (1974).

The objective of the analysis that follows is to examine if and by how much households in urban and rural Indonesia value the existence of various types of domestic water sources, which are situated in, or accessible from their houses. This is attempted by indirectly testing whether the existence of these water sources is associated with the value of their houses. The analysis is performed separately for the urban and rural households in order to investigate possible differences in their preferences. If respective preferences and derived WTP values for improved water sources are similar between these two samples, and if these values constitute more than 3-5% of sample-specific mean incomes, respectively, then results will provide support for the potential of the DDA approach. If the reverse is true, then two scenarios are possible. Low respective values of willingness to pay may be due to either the low quality of provision or to severe income constraints. Such results indicate the need for supply-side management and/or subsidization of water provision.

4. Empirical Analysis

4.1 Case-Study Background

Indonesia is endowed with approximately 6% of the world's total freshwater resources. Although this seems to suggest an abundance of water in the country, seasonal and spatial variability in the distribution of water resources gives rise to periodic regional water shortages, especially in some areas in the island of Java, Bali and Nusa Tenggara. Although the percentage of the population without access to improved water sources was reduced from 31 percent in 1990 to 24 percent in 2000, this translates into more than 50 million people vulnerable to deadly health risks due to unavailability of safe water sources. The problem is more acute in urban regions, where the number of people without access to safe water sources has increased from 5.45 in 1990 to 7.76 million in 2000.

Since 1980, government policies geared towards increasing access to safe water were mainly focused on improving physical access, by bringing in appropriate cost-effective - and in particular, capital cost-reducing - technologies for water supply. During the 1980s (also referred to as the International Decade of Water Supply and Sanitation (IDWSS)) it was considered that hand pumps and community taps were the appropriate technologies for low-income people, while in-house tap water connection was not considered an affordable option. Low access to pipe water in urban areas is also partly a result of the poor performance of publicly owned private water companies (PDAM), which are poorly regulated, financially mismanaged, priced with inefficient tariff structures and understaffed in terms of the quality of their human resources (World Bank, 1997). Moreover, public water infrastructure faces problems of unsustainability, with most systems breaking down much before their planned design lives, in spite of training in operations and maintenance by the Indonesian government and NGOs (Evans et al., 2001). Lessons learned from the IDWSS, point to the lack of demand management (and the existing focus on supply-side management) as the source of the persistent problem of unsustainable use of water related infrastructure in Indonesian, hence the need for demand-driven management policies seems urgent.

4.2 The Dataset

The Indonesia Family Life Survey (IFLS)[3] is a continuing longitudinal socio-economic survey, the first wave of which was conducted in 1993 (IFLS1). The second wave (IFLS2) was conducted in 1997 although an additional supplement for capturing the ongoing economic crisis was conducted in 1998 (IFLS2+). The third wave, which is still in the process of completion, was conducted in 2000. The sampling scheme used was stratified on provinces, and then randomly sampled within provinces. Thirteen of the nation's twenty-six provinces were selected with an aim to capture a representative sample of the cultural and socio-economic diversity of Indonesia. Within each of the thirteen provinces, 321 enumeration areas (EAs) – each area capturing a single village - were randomly selected, over-sampling urban EAs and EAs in smaller provinces to facilitate urban-rural and Javanese-non-Javanese comparisons. Finally, within each selected EA households were randomly selected (Frankenberg and Thomas, 2000).

In the IFLS2 dataset, 339 (representing 6.34% of the whole sample) households rent their houses (and report their monthly rent), and 5,008 households are either self-owned or occupied (and report their imputed monthly rent). We focus our empirical analysis on households that report imputed monthly rent, in an attempt to avoid possible inconsistencies between data on actual and imputed rent. Water-related characteristics of the house are the focus variables in this hedonic analysis. In particular, we are interested in the valuation of piped, pump and well water, together with water sources located outside the house (when these are used for domestic purposes such as drinking and cooking - 'main use' - and for other uses such as bath and laundry - 'other use'). Based on this information, dummy variables for the three types of domestic water sources i.e. piped, pump, and well water were constructed, together with two variables indicating distance to outside water sources, measured in meters.

Variables representing structural characteristics of the house include the size of the house, number of rooms, house level/stories, material for wall, floor, and roof, existence of toilet, quality of the ventilation, and garbage collection system. One of the important neighborhood characteristics is house accessibility to employment. This is captured by the variable indicating distance from village head office to the center of the district, measured in kilometer. Other neighborhood characteristics are captured by a proxy variable indicating the

[3] IFLS was conducted by Rand Institute, USA. For further information please see http://www.rand.org/labor/FLS/IFLS.

median per capita expenditure on food and non-food items, in the neighborhood/community. A dummy variable for each of the 13 provinces is created for capturing location-specific characteristics of a house. For the urban sample, the reference for this dummy variables is Jakarta i.e. province of the capital, whereas for the rural sample the reference is West Java province (the next highest developed region after Jakarta). The reason of not using the same reference is because there is no rural area in the capital. Descriptive statistics of the variables in the dataset are presented in Table 1.

Table 1. Descriptive Statistics of Variables in The Hedonic Equation

	Urban Sample		Rural Sample	
	mean	s.d.	mean	s.d.
Monthly Rent (Rp)	474,529	(5,693,637)	94,347	(709,590)
<u>Structural characteristics</u>				
Size of the house (m-squared)	83.162	(103.987)	71.636	(106.324)
Number of rooms	5.642	(2.212)	4.697	(1.703)
Multi-level house (1,0)	0.185	(0.388)	0.055	(0.229)
Floor material is ceramics/tiles (1,0)	0.486	(0.500)	0.196	(0.397)
Wall material is cements/bricks (1,0)	0.761	(0.427)	0.463	(0.499)
Roof material is concrete (1,0)	0.008	(0.087)	0.001	(0.027)
Presence of toilet (1,0)	0.746	(0.435)	0.494	(0.500)
Garbage is collected (1,0)	0.459	(0.498)	0.009	(0.093)
Ventilation is adequate (1,0)	0.782	(0.413)	0.735	(0.441)
<u>Water characteristics</u>				
Presence of piped water (1,0)	0.204	(0.403)	0.041	(0.198)
Presence of pump water (1,0)	0.247	(0.431)	0.061	(0.239)
Presence of well water (1,0)	0.121	(0.326)	0.070	(0.255)
Distance to water/main use (meters)	16.494	(149.995)	97.844	(371.731)
Distance to water/other use (meters)	4.789	(34.811)	27.334	(123.200)
<u>Neighbourhood characteristics</u>				
Distance to district center (km)	8.279	(10.536)	31.642	(32.926)
Median percapita expenditure (Rp 000)	80.773	(40.081)	42.618	(14.577)
<u>Dummy provinces</u>				
North Sumatera (1,0)	0.087	(0.281)	0.037	(0.188)
West Sumatera (1,0)	0.030	(0.170)	0.049	(0.217)
South Sumatera (1,0)	0.034	(0.181)	0.046	(0.210)
Lampung (1,0)	0.017	(0.129)	0.070	(0.255)
Jakarta (1,0)	0.183	(0.387)	-	-
West Java (1,0)	0.169	(0.375)	0.145	(0.352)
Central Java (1,0)	0.123	(0.329)	0.173	(0.378)
Yogyakarta (1,0)	0.071	(0.256)	0.037	(0.188)
East Java (1,0)	0.133	(0.340)	0.154	(0.361)
Bali (1,0)	0.038	(0.191)	0.064	(0.245)
West Nusa Tenggara (1,0)	0.038	(0.191)	0.111	(0.314)
South Kalimantan (1,0)	0.033	(0.178)	0.057	(0.232)
South Sulawesi (1,0)	0.045	(0.207)	0.057	(0.231)
Number of observations	2113		2739	

4.3 Estimation Model and Empirical Results

Unfortunately, the theoretical underpinnings of hedonic analysis do not suggest a specific functional form. Therefore, choosing the best functional form is merely an empirical question. To this end we employ a flexible functional form using the box-cox transformation method. The Hedonic equation to be estimated is

$$y^{(\lambda)} = \alpha + \sum_i \beta_i x_{1i}^{(\lambda)} + \sum_j \gamma_j x_{2j} + \varepsilon \qquad (1)$$

where

$$y^{(\lambda)} = \frac{y^{\lambda} - 1}{\lambda}; \; x_{1i}^{(\lambda)} = \frac{x_{1i}^{\lambda} - 1}{\lambda}$$

with α, β, and γ representing vectors of coefficients to be estimated, y the monthly rent of the house, x_{1i} vector of variables to be transformed (i.e., size of the house, number of rooms, and median expenditure of the neighborhood), x_{2j} the vector of other non-transformed variables (dummy variables and variables that are not strictly positive and thus could not be transformed), and λ is the parameter of the transformation (the functional form is linear when $\lambda = 1$ and log-linear when $\lambda = 0$)

We use maximum likelihood to estimate equation (1) together with the λ coefficients for each of the two data samples. Estimated results suggest rejection of linearity and log-linearity of the hedonic function for both the urban and rural samples, with a value of λ equal to -0.164 and -0.092, respectively. The results of the OLS estimation of the non-linear hedonic equation (after variables transformation has been imposed) are shown in table 2. ML estimation results of the non-linear hedonic function are reported in Appendix 1.

Table 2. Result of the Hedonic Equation Estimation

	Urban		Rural	
Variables	Coef.	s.e.	Coef.	s.e.
Structural characteristics				
*Size of the house (m-squared)^*	0.06204	0.012 ***	0.14567	0.023 ***
*Number of rooms^*	0.09169	0.014 ***	0.12221	0.030 ***
Multi-level house (1,0)	0.02468	0.009 ***	0.00370	0.034
Floor material is ceramics/tiles (1,0)	0.03466	0.008 ***	0.02243	0.023
Wall material is cements/bricks (1,0)	0.04826	0.009 ***	0.06988	0.020 ***
Roof material is concrete (1,0)	0.07990	0.038 **	-0.23104	0.287
Presence of toilet (1,0)	0.03670	0.009 ***	0.05141	0.017 ***
Garbage is collected (1,0)	0.04932	0.009 ***	0.18936	0.084 **
Ventilation is adequate (1,0)	0.01503	0.009 *	0.05427	0.019 ***
Water characteristics				
Presence of piped water (1,0)	0.03321	0.010 ***	0.05462	0.042
Presence of pump water (1,0)	0.02197	0.009 **	0.04403	0.035
Presence of well water (1,0)	-0.00289	0.011	0.05334	0.031 *
Distance to water/main use (meters)	0.00000	0.000	0.00002	0.000
Distance to water/other use (meters)	0.00004	0.000	0.00006	0.000
Neighbourhood characteristics				
Distance to district center (km)	-0.00081	0.000 **	0.00061	0.000 **
*Median percapita expenditure (Rp 000)^*	0.18868	0.021 ***	0.15965	0.035 ***
Dummy provinces				
North Sumatera (1,0)	-0.15295	0.016 ***	-0.32628	0.046 ***
West Sumatera (1,0)	-0.08419	0.022 ***	-0.16052	0.042 ***
South Sumatera (1,0)	-0.13383	0.020 ***	-0.14975	0.044 ***
Lampung (1,0)	-0.07120	0.027 ***	-0.20551	0.039 ***
West Java (1,0)	-0.07233	0.012 ***		
Central Java (1,0)	-0.16417	0.014 ***	-0.25402	0.030 ***
Yogyakarta (1,0)	-0.05549	0.016 ***	0.02103	0.047
East Java (1,0)	-0.14701	0.014 ***	-0.20792	0.030 ***
Bali (1,0)	-0.07564	0.020 ***	-0.02619	0.040
West Nusa Tenggara (1,0)	-0.10088	0.021 ***	-0.14004	0.034 ***
South Kalimantan (1,0)	-0.09104	0.022 ***	-0.28496	0.041 ***
South Sulawesi (1,0)	-0.06832	0.021 ***	-0.13832	0.044 ***
Constant	4.13952	0.068 ***	5.42375	0.133 ***
Lambda	-0.164149	0.010 ***	-0.091864	0.007 ***
Adj-R2	0.4918		0.1819	
Mean VIF	1.53		1.45	
White Statistics	276.0753		164.7198	
Observation	2113		2739	

Note: ^) box-cox transformed variable; ***) significant at 1% level; **) significant at 5% level; *) significant at 10% level.

All structural characteristics significantly influence the rental price of urban houses. In rural areas, however, whether the house is multilevel and the house's roof material, are not significantly associated with the rental value of the house. Other qualities of housing structure such as the house's size, number of rooms, floor and wall material, presence of toilet, garbage collection and adequate ventilation, have a significant effect on respective rental prices.

As expected, the proxy used to indicate the quality of the neighborhood's environment (i.e. average median per capita expenditure of neighborhood) strongly affects the rental value of houses in both rural and urban areas. Distance to district center captures, among other things, the degree of a house's proximity to the location of the employment of its tenants. Most people living in rural areas work outside city centers because of their strong dependence on agriculture. However, people in rural areas seem to value proximity to the city center, possibly because it allows them to trade their agricultural products in cities, at lower transportation costs. Most people living in urban areas work close to or in city centers. The unexpected negative sign of the coefficient of this variable (although not significant) could indicate a preference for living outside cities, where the provision and quality of environmental amenities is higher. In addition, the provision of improved transportation to and from district centers decreases the costs associated with choosing to live in out-of-city areas.

Geographical variation by provinces also has a strong effect on the rental value of a house. In the urban hedonic equation, all provincial dummies are significant at less than 1% level of significance. The rental value of houses is highest in the capital of the country, which explains the negative sign in the coefficients of provincial dummy variables. Provincial dummy variables also capture location-specific variation in the cost of living and other regional differentials, for which data does not exist.

Households in urban areas do value domestic water sources as reflected in the significant coefficient indicating the presence of pumped and piped water in the house. As implicitly revealed by the estimated hedonic price function, the presence of well water – which is usually of lower quality (due to contamination) and situated in less convenient locations than piped water – does not significantly affect the price of occupying a house. For rural households, however, only well water is significant (at marginal, 10%, level of significance) in explaining variation in rental prices and the house characteristics that represent the availability of improved domestic water source i.e. piped and pump water are not significant.

These empirical results, allow us to make inference on the preferences of urban and rural households about the different types of domestic water sources. Households in urban areas value the existence of piped and pump water, but not well water. Households in rural areas value only well water. Piped water is generally considered the most reliable water sources and with the best water quality among the three sources. It is mostly provided by the publicly owned water company (PDAM), which delivers clean, treated, water supply to households. Well water is not usually treated before use, although significantly contaminated in some regions (from chemicals and/or seawater intrusion). As far as convenience of use is concerned, well water is considered the least convenient.

Moreover, the results have interesting policy implications as they suggest that preferences and resulting willingness to pay for improved water sources is not as universal as some of proponents of DDA argue. Households in rural areas with much lower income (the income of urban households is on average twice as high as that of rural households, see table 1) are not willing to pay for improved domestic water sources. This result might highlight two possible scenarios: (a) the bad quality of service provided by the PDAM with regards to piped water or (b) the existence of severe income constraints in the rural areas. Scenario (a) indicates the failures of the Supply Driven Approach (SDA) when it functions under institutions that are lacking incentive structures. Scenario (b) indicates the low potential of the Demand Driven Approach (DDA) for solving water allocation problems, as heavy subsidization is still called for.

Moreover, households' valuation of proximity to outside water sources is not significant in explaining rental prices in neither of the two samples. This could be explained by the fact that outside water sources are communal or public goods and as a result people free ride on their use. This is the usual free-rider problem in the provision of public goods, which does not arise in the case of domestic water sources as these fall in the category of publicly provided private goods. The insignificance of distance to outside water sources confirms the findings of an earlier hedonic study in the Philippines, by North and Griffith (1993).

Finally, we calculate the value of the willingness to pay for having piped and pump water for urban sample in rupiahs (see appendix 2, for relevant details). Our calculations suggest that in the urban area, monthly WTP for having piped water is Rp 13,785[4] (3.6% of median expenditure) and for having pump water is Rp 8,830 (2.3% of median expenditure). This suggests that on average, people's willingness to pay for having improved domestic water sources, even in urban areas, falls below 5% of income. Interestingly, North and Griffith (1993) in their study in the Philippines, also using the hedonic approach, find that WTP for in-house piped water amounts to 2.4% of income, which is comparable to our estimates.

5. Conclusion and Policy Implication

[4] The exchange rate in 1997 (the year when the IFLS was conducted) was Rp 2,900 / US$.

Water is an economic good, but also a necessity to life, hence a fundamental right of all people. If the premise of the DDA approach is implemented, while overlooking that right, it will result in a large number of poor people being prevented from accessing a good/service, which is essential for their survival. It is, however, also true that the efficient provision of water should pay due attention to the premises of the DAA approach, as these enable optimal allocation of resources over people and time. However, once resources have been allocated, equity considerations should enter the picture. The challenge faced by the policy-reorientation in providing water supply in developing countries is to redistribute the increased social welfare achieved through a more optimal allocation of resources in such a way that equity considerations are addressed.

In Indonesia, the prevalent instrument that is suggested for supporting the implementation of the DDA approach is privatization of water provision, together with a substantial subsidy reduction in the investment of the water sector. Recently, the issue of privatization in the water sector has been one of the main topics of public dispute. The government is proposing a new water resource bill that will create more opportunities for the private sector to participate in water provision. However, the promotion of privatization of water provision in developing countries already faces strong resistance. Thus, if privatization could enhance the efficiency of water provision (this is still disputed in the relevant literature[5]), it has to be planned and implemented after carefully study of its distributional impacts on all income groups of the respective populations. Moreover, subsidy reductions should also be considered both in terms of their efficiency but also in terms of their impacts on equity.

[5] See Bauer (1997) and Trawick (2003).

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Appendix 1:

Result of the Hedonic Equation Estimation (Maximum likelihood)

	Urban sample		Rural Sample	
	Coef.	chi2(df)	Coef.	chi2(df)
Structural characteristics				
*Size of the house (m-squared)^*	0.06204	29.04 ***	0.14567	38.87 ***
*Number of rooms^*	0.09169	44.12 ***	0.12221	16.74 ***
Multi-level house (1,0)	0.02468	6.95 ***	0.00370	0.01
Floor material is ceramics/tiles (1,0)	0.03466	17.88 ***	0.02243	0.97
Wall material is cements/bricks (1,0)	0.04826	26.88 ***	0.06988	12.67 ***
Roof material is concrete (1,0)	0.07990	4.42 **	-0.23104	0.66
Presence of toilet (1,0)	0.03670	17.39 ***	0.05141	9.22 ***
Garbage is collected (1,0)	0.04932	33.57 ***	0.18936	5.14 **
Ventilation is adequate (1,0)	0.01503	2.98 *	0.05427	8.20 ***
Water characteristics				
Presence of piped water (1,0)	0.03321	11.38 ***	0.05462	1.68
Presence of pump water (1,0)	0.02197	5.97 **	0.04403	1.61
Presence of well water (1,0)	-0.00289	0.07	0.05334	2.99 *
Distance to water/main use (meters)	0.00000	0.01	0.00002	0.68
Distance to water/other use (meters)	0.00004	0.17	0.00006	0.97
Neighbourhood characteristics				
Distance to district center (km)	-0.00081	5.82 **	0.00061	5.64 **
*Median percapita expenditure (Rp 000)^*	0.18868	80.64 ***	0.15965	20.56 ***
Dummy provinces				
North Sumatera (1,0)	-0.15295	94.90 ***	-0.32628	49.87 ***
West Sumatera (1,0)	-0.08419	14.99 ***	-0.16052	14.52 ***
South Sumatera (1,0)	-0.13383	43.07 ***	-0.14975	11.46 ***
Lampung (1,0)	-0.07120	6.97 ***	-0.20551	28.29 ***
West Java (1,0)	-0.07233	36.05 ***		
Central Java (1,0)	-0.16417	133.62 ***	-0.25402	72.06 ***
Yogyakarta (1,0)	-0.05549	12.44 ***	0.02103	0.20
East Java (1,0)	-0.14701	102.81 ***	-0.20792	48.79 ***
Bali (1,0)	-0.07564	14.49 ***	-0.02619	0.42
West Nusa Tenggara (1,0)	-0.10088	23.92 ***	-0.14004	17.20 ***
South Kalimantan (1,0)	-0.09104	17.04 ***	-0.28496	48.69 ***
South Sulawesi (1,0)	-0.06832	10.69 ***	-0.13832	9.88 ***
Constant	4.13952		5.42375	
Log likelihood	-26063.9		-31546.2	
LR chi2(28)	1458.47		577.02	
Observation	2113		2739	

Appendix 2: Willingness to Pay Calculation

We rewrite the hedonic equation in box-cox form,

$$\frac{y^{\lambda}-1}{\lambda}=\alpha+\sum_{i}\beta_{i}\left(\frac{x_{1i}{}^{\lambda}-1}{\lambda}\right)+\sum_{j}\gamma_{j}x_{2j}+\theta w \qquad \text{(A1)}$$

where the water characteristic in question is excluded from x_{2j} and written as w, and θ is its relevant coefficient. w is a dummy variable that has value of 1 if the water source in question is available in the house, and 0 otherwise. Solving equation A1 for y gives,

$$y(x_{1i},x_{2i},w)=\left[1+\lambda\alpha+\sum_{i}\beta_{i}(x_{1i}{}^{\lambda}-1)+\lambda\sum_{j}\gamma_{j}x_{2j}+\lambda\theta w\right]^{1/\lambda} \qquad \text{(A2)}$$

We define willingness to pay for water source (w) as the difference between the rent (predicted by equation A2) of a house with water source w available (w = 1) and the rent if the water source is unavailable (w = 0). Thus to calculate the willingness to pay for the water source in question we use:

$$wtp=y(\overline{x}_{1i},\overline{x}_{2i},1)-y(\overline{x}_{1i},\overline{x}_{2i},0) \qquad \text{(A3)}$$

where bar over variables x indicate its mean value in the relevant sample.