Working Paper
in Economics and
Development Studies

Department of Economics
Padjadjaran University

No. 200712

Analysis Of Willingness to Pay and Determinant of Drinking Water and Sanitation Availability in Indonesia Using Hedonic Price Model Approach and Logistic Model

Bilang Nauli Harapap
Djoni Hartono

(Faculty of Economics, University of Indonesia)

November, 2007

Center for Economics and Development Studies,
Department of Economics, Padjadjaran University
Jalan Cimandiri no. 6, Bandung, Indonesia.
Phone/Fax: +62-22-4204510
http://www.lp3e-unpad.org

For more titles on this series, visit:
http://econpapers.repec.org/paper/unpwpaper/

ANALYSIS OF WILLINGNESS TO PAY AND DETERMINANT OF DRINKING WATER AND SANITATION AVAILABILITY IN INDONESIA

Using Hedonic Price Model Approach and Logistic Model

BILANG NAULI HARAHAP

AND

DJONI HARTONO

ABSTRACT

This background of this study is our concern on the low quality of drinking water access and sanitation in Indonesia, both in urban and rural areas. The achievement of *Millenium Development Goals* (*MDGs)* in drinking water and sanitation in Indonesia both in rural and urban areas as a part of Asia Pacific region is considered as declining or remain low, especially when linked to the fulfilment of MDGs target in 20015. The keyword in the supply of drinking water and sanitation is sustainability, and for this reason water should be considered as economic goods and it has economic value. One of the problems dealing with drinking water supply and sanitation is the low return of invesment /cost recovery so that we need more accurate information on the amount of people's willingness to pay in order to attract investment on drinking water supply and sanitation. Besides, we also need to know the determinant of drinking water supply facilities and proper sanitation.

There are some goals that this study seek to meet : (i) identifying the effects of drinking water supply and home sanitation on the rent price of a house, (ii) calculating the value of *marginal implicit price (marginal willingness to pay)* for drinking water and sanitation, and (iii) examining factors influencing drinking water supply and sanitation.

Using the *hedonic price model*, we can conclude that: (i) the availability of water piped facilities or pump water influences rent price of houses in urban areas, while the availability of toilet facilitated with septic tank influences rent price of houses both in urban and rural areas; (ii) garbage handlings through collection by authorized agency influences rent price of houses both in urban and rural areas, (iii) the amount of willingness to pay for piped facilities or pumped water in urban area is Rp. 6,850 per month, while the amount of willingness to pay for toilet facilitated with septic tank is Rp. 15,800, and the amount of willingness to pay for garbage collection is Rp. 11,950 per month.

The *logistic model* approach revealed that households' economic and social conditions such as age, number of family members, breadwinner's education, and expenditure per capita influence the availability of drinking water facilities in the form of piped water or pumped water, sanitation facilities in the form of toilet with septic tank, and garbage handling facilities. Human capital or the level of education is very crucial in the possibilities of ownership of drinking water and sanitation facilities.

JEL Classification : Q51, D12, C21, C25

Keywords : 1. Access to drinking water and sanitation 3.*Hedonic Price* Model
2. *Willingness to Pay* 4. Logistic Model

1. Introduction

In recent years, the quality of drinking water and sanitation in Indonesia deteriorates. Approximately there are 49 millions (22.31 percent) people that can not get access to drinking water with proper quality, where 72 percent of them live in the countryside. The sanitation condition is even worse, as almost 97 millions people (44 percent) do not have access to good sanitation, and 70 percent of them live in the countryside. (*The Millennium Development Goals: Progress in Asia and the Pacific 2006).* Compared to the targets stated in the MDG, the development of access to drinking water in urban area slows down, while rural area remains underdeveloped. Meanwhile, both urban and rural areas are still underperformed in meeting the MDG targets in sanitation sector.

Consumption of poor drinking water and bad sanitation lead to the spread of various endemics (e.g. as diarrhea, cholera, and dengue hemorrhage fever). At least there are 2 millions people killed by diarrhea every year, and most of them are children below five years (WHO and UNICEF, 2000). On the contrary, consumption of clean drinking water and good sanitation create both direct and indirect economic impacts and health benefits. The direct economic impact is the decreasing health expenditure, while the indirect impact is the decreasing possibility to become sick (that forces people to absent from work or school, loses work time due to children's sickness, and reduces productivity).

The direct health benefits related to the better access to clean drinking water and good sanitation are: (1) more efficient water resources management, (2) more saved time from easier access to drinking water and sanitation, (3) more leisure time, and (4) increased property value. A study by WHO in 2004 revealed that a US$ 1 investment for drinking water and sanitation yields as much as US$ 5 to US$ 8. This profit comes from the economies of time due to the better access to proper drinking water and good sanitation.

The keyword in the supply of drinking water and sanitation problem is sustainability. It is very important to recall the Dublin-Rio Principle, which is widely used in the development of drinking water service and sanitation (Bappenas, 2003). The principle states that water has economic value, so that it should be considered as economic commodity.

There are some potential gains from the development of drinking water, sanitation and environment hygiene facilities. Recent findings prove that people's appreciation towards drinking water supply service has increased, as shown by the fact that poor people pay more

for drinking water supply service than the rich people. Consequently, if people think that the water supply and sanitation services are bad, they do not want to use the facilities and will not pay for the service either.

Generally, there are some factors that hinder the supply services of drinking water and sanitation from meeting people's expectation, i.e.: under-usage, low maintenance, and low return on investment/cost recovery. In brief, investment is needed to improve drinking water and sanitation supply service. To improve return on investment, it is very important to find out information about people's ability to pay for drinking water supply and sanitation. We also must pay attention to other determinant, such as the social and economic factor of households. By knowing the nature of this determinant, intervention to improve drinking water supply and sanitation can be conducted.

Related to the provision of drinking water and sanitation issue, there are some questions that this study seeks to answer:

(i) What is the impact of drinking water supply and home sanitation on the rent price of a house?

(ii) What is the effect of other factors availability on the rent price of a house?

(iii) How much is people willingness to pay for drinking water supply and sanitation?

(iv) What are the effects of household social and economic factors on drinking water supply and home sanitation?

Meanwhile, there are several objectives to meet by this study:

(i) to identify the effects of drinking water supply and home sanitation on the rent price of a house

(ii) to calculate the value of *marginal implicit price (marginal willingness to pay)* for drinking water and sanitation, and

(iii) (iii) to study the factors influencing drinking water supply and sanitation.

This study uses *hedonic price model* to recognize effects of drinking water supply, sanitation, and the amount of willingness to pay on drinking water and sanitation, where logistic model is used to study factors influencing drinking water supply and sanitation.

2. Literature Review

In general, 'economic value' is defined as maximum units of goods or services that a person is willing to sacrifice in order to get other goods or services. This concept is formally known as the *willingness to pay* of a person towards goods and services he desired. By using this concept, ecological value of an ecosystem can be translated into economic terms through measuring the monetary value of goods and services. Willingness to pay can also be measured in the form of income increase that makes someone *indifferent* to the *exogenous* changes. The exogenous changes exist because of price changes (due to the resources scarcity, for instance) or because of changes in resources quality. Consequently, the WTP concept is strongly related to the concepts of *Compensating Variation* and *Equivalent Variation* in the theory of demand. In other words, WTP can be interpreted as the maximum amount that a person is willing to pay to prevent the deterioration of 'something'.

Economic value can also be measured through the *Willingness to Accept (WTA)* concept, which is defined as minimum income that a person needs to have in order to accept the deterioration of 'something'. In practice, the WTP is used more often than the WTA because the WTA is not an incentive-based measure. Hence WTA is less precise than the WTP for human behavior study *(behavioral model).*

Garrod and Willis (1999), as well as Hanley and Splash (1993), stated that even though the WTA and WTP seem to be similar, there are always differences in terms of results. The differences are caused by the following factors: (i) imperfection of questionnaire design and interview techniques, (ii) endowment effect in measuring WTA, where there is possibility that respondents refuse to value the resources they have. Respondents can say that the resources they have is irreplaceable so that it has very high *selling* price. This phenomenon is often called *loss aversion,* where someone tends to overvalue the losses; (iii) respondents overcautiously answer the WTA questionnaire by considering their incomes and preferences.

In fact, the WTP is related to the measurements of CV and EV, hence can be measured more precisely by basing it on the Hicks curve (Compensated Demand Curve), as price under the Hicksian Demand Curve is used for compensation measurement. Thus, if there is a price change from P_0 to $\bar{P}$ as a result of environmental change, the WTP is defined as follow:

$$WTP = \int_{P_0}^{\bar{P}} X^h(P,u)dP \qquad (1)$$

$$= M(\bar{P},u) - M(P_0,u)$$

$M(\bar{P},u)$ is income after changes with constant utility and $M(P_0,u)$ is the initial income. The equation above conveys that WTP is an area under Hicksian Demand Curve, limited by price on base line condition, P_0, and price as a result of changes, $\bar{P}$. Neoclassical economic theory states that it is equal to income differences *(M)* needed by a person to stay in the utility after the changes.

In measuring WTP, Haab dan McConnel (2002) in Fauzi (2004) suggested that reasonable measurement of WTP should fulfill these requirements: (i) WTP does not have negative lower limit, (ii) upper limit may not exceed income, and (iii) there is always consistency between forecasting randomness and calculation randomness.

According to Fauzi (2004), there are two groups of economic valuation techniques for non marketable resources. The first group is valuation technique which relies on implicit price that can reveal WTP through developed model, known as *Revealed WTP* techniques. Some techniques included in this group are *travel cost method, hedonic pricing*, the new technique *random utility model.* The latter is valuation technique based on surveys where WTP is obtained directly from respondent through written or oral interviews. Some popular techniques included in this group are *Contingent Valuation Method (CVM*) and *Discrete Choice Model.*

Figure 1 below depicts the scheme of Non Market Valuation techniques classification.

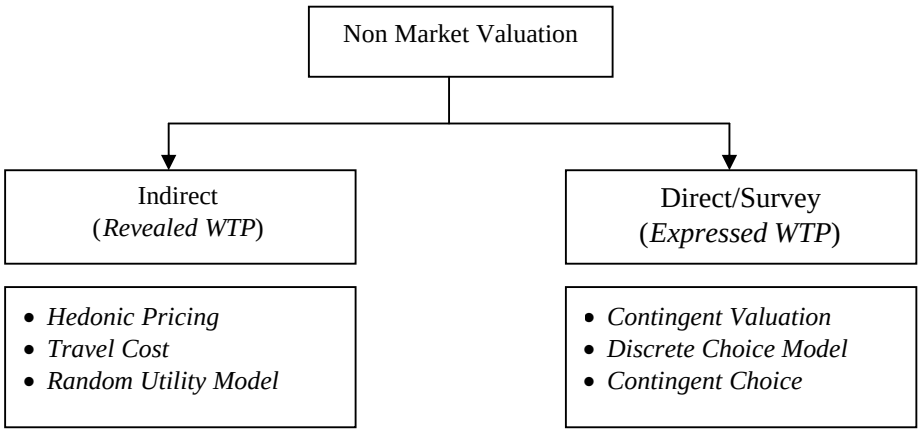


Figure 1. Non Market Valuation
Source: Fauzi (2004)

Travel Cost Method

Travel Cost Method (TCM) is derived from a concept developed by Hotteling in 1931 which is formally introduced by Wood and Trice (1958) and Clawson and Knetsch (1966). This method is mostly used for analyzing the demand of outdoor recreation, such as fishing, hunting, and hiking. Basically, it studies cost that an individual has to spend to visit the recreation areas. For instance, a person who like to fish at the beach will spend time and money to come to the fishing area on the beach. We can predict the value that the consumer gives to the natural resources and environment by identifying consumer's expenditure pattern. Basic assumption underlying the TVM approach is that each consumer's utility towards recreation activities is separable, so that the demand function of recreation activities is not affected by the demand of other activities such as watching movies, shopping, etc.

Contingent Valuation Method

Contingent Valuation Method (CVM) approach was first introduced by Davis (1963) in a survey on hunting behavior in Miami. This approach became popular in the mid seventies when the US government adopted it to study its natural resources. It is called *contingent* (depends on something) because information gathered really depends on the developed hypothesis. There are two ways in using the CVM method, namely experimental techniques through simulation and game, and survey techniques.

The CVM is firstly aimed to identify people's willingness to pay, for example the WTP for the betterment of environment quality (such as water, air, land, etc.) Secondly, the CVM is aimed to identify people's willingness to accept for environmental deterioration. Relevant measurement for respondent who does not have ownership on goods and services produced from the resources is the 'Maximum Willingness to Pay'. On the contrary, if respondent has ownership on goods and services produced from the resources, then the relevant measurement is the 'Minimum Willingness to Accept' or the minimum amount that he will accept as compensation on the deterioration of resources he has.

Although the CVM is perceived as a good method to measure WTP, it has some practical weaknesses. First, the value obtained by this method can be systematically *overstated* or *understated* from the real value. This bias may come from the implementation of incorrect strategy. For instance, if the questionnaire mentions that the respondent will be charge for the

environment betterment, then the respondent tends to understate the environment value. On the contrary, if the respondent is told that the interview is for hypothesis-testing only he/she tends to overstate from the real value. There is also possibility of *compliance bias*[1] where the respondent tries to please the interviewer by giving 'yes' answer although he/she does not mean to agree to pay for something.

Hedonic Price Model

Hedonic lexically means 'dealing with utility'. It also means something that deals with pleasure. Econometric Hedonic Model is a model where independent variable is linked to quality, such as quality of a product to buy. Hedonic Price Model is often applied to the environmental economics because it concerns with goods having implicit price, while the price itself is attached to the goods (for example: effects of air pollution on property price and effects of clean environment on the property price).

To estimate price of a house, the *hedonic price* method measures household's expenditure for housing, where expenditure itself is differentiated further into measured price and quantity. Through this method, rent price for different houses or similar houses in different location can be predicted and compared. Meanwhile, the *hedonic equation* is simply a regression of 'house characteristic' expenditure (rent or value). Independent variable represents house individual characteristic and coefficient of regression can be used as implicit price estimator for those characteristics (Malpezzi, 2002). The *hedonic price* method is very useful to explain the value of real estate through features of the property. The *features* of a property comprise three components: physics, accessibility, and surrounding environment (Fujita, 1989).

The *hedonic price* technique is developed from the Attribute/Characteristic Theory. The most often referred studies on hedonic price are Lancaster's (1996) and Rosen's (1974). Focusing on the demand side, Lancaster established a branch of microeconomics studying utility which is not directly taken from the goods but from characteristics of the goods.

[1] *Compliance bias*, also called *warm glow*, happens more frequent in rural areas because people in rural areas sociologically tends to agree with what the interviewer asks.

Lancaster developed this theory by using the 'activity analysis'. He did not limit the discussion to the housing problems only, but also applied the concept to some topics such as finance, trade off between working and leisure, and money demand. Like Lancaster, Rosen (1974) focused on the characteristics. The difference is that Rosen paid less attention to utility, but put more emphasize on how consumers and suppliers interact in a supply and demand framework of those characteristics. Moreover, Rosen did not discuss the functional form explicitly, but tended to take the non linear hedonic price structure. There are many two-step demand models that adopt Rosen's model as their foundations, although Rosen only gave little explanations on how to estimate those structural parameters.

In Rosen model, $z = (z_1, ..., z_n)$ is defined as characteristic vector of house and $p(z)$ is hedonic price function following market clearing condition where the number of commodity offered by supplier in a location is equal to the number of commodity demanded. Freeman (1993) divided general house characteristic vectors into three parts: (i) environmental facilities vector (*environmental amenities*) in a certain location, called Q; (ii) house structure characteristic vector (such as wide, number of rooms, house age, construction type), called S; and (iii) neighborhood characteristic vector of house location (such as schools quality, accessibility to park, shop and working place, and crime rate), called N. Price of a house is a function of house structure, neighborhood characteristic and environmental characteristic. The function is clearly defined in the following equation.

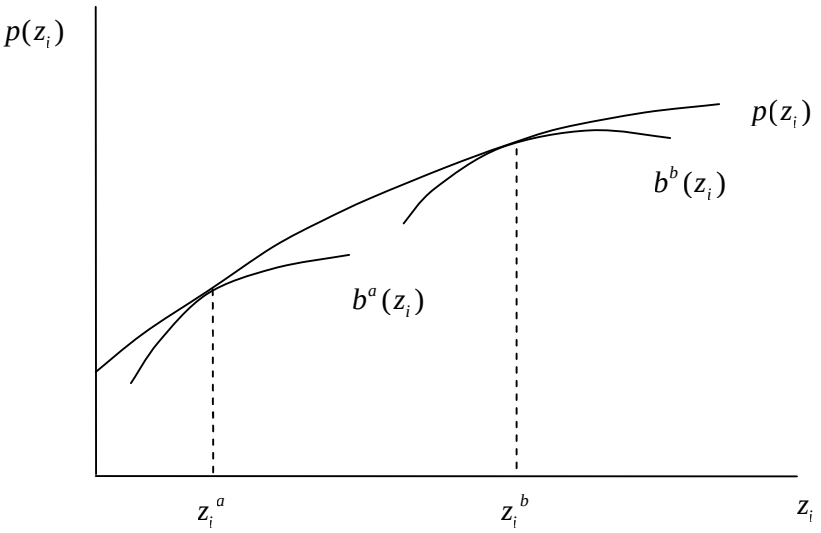
$$Pz_i = Pz(S_i, N_i, Q_i) \qquad (2)$$

Households and firms accept the house price (price is given) at competitive market and in general $p(z)$ is non linear. The non linearity of $p(z)$ is caused by differences in house characteristic. For instance, a house having two rooms with 5 meters ceiling height is not the same with a house having one room with 10 meters ceiling height.

Household maximizes utility $u = u(x, z_1, z_2, ..., z_n)$, where x represents a bundle of commodities with normalized prize, subject to non linear budget constraint $y = p(z) + x$. First order condition of the function is

$$\frac{\partial u / \partial z_i}{\partial u / \partial x_i} = \partial p / \partial z_i , \quad i = 1,...., n \qquad (3)$$

Household will choose all characteristics satisfying conditions above. In other words, *marginal willingness to pay* for z_i has to be equal to the *marginal cost* for buying more z_i, where other things remain constant. By changing the equation with constant i, we will be able to obtain *indifference curve* or *bid curve* which describes the maximum amount individual will pay in line with the characteristics of goods. Bid-rent function is written as $b_i = b_i(z_i, z^*, u^*)$, where u^* is the solution of utility maximization and z^* describes the optimum number of other characteristics. Differences in income and preference cause individuals to have different bid curve. *Bid functions* of two different individuals are shown in figure 2, showing the decrease of WTP (*diminishing willingness to pay)* for z_i there is *diminishing marginal rate of substitution* between z_i and x. Rosen model also talks about *supply side* but it focuses on the characteristic value for the house buyer, therefore supply side model for house market is not needed (Freeman, 1993).



Source: Freeman (1993)

Figure 2
Hedonic Price Function and *Bid-rent Function*

There are two problems of the Hedonic Price model, i.e. theoretical and empirical problems. The theoretical problems concern with some strong assumptions used as basis of

hedonic price model, which are considered as unrealistic. Market clearing conditions should be achieved and market should be in equilibrium. Besides, there should be enough variation of house types so that every household can choose any house in the house market. Household is assumed to get perfect information about all available houses in the housing market without considering the transaction cost. If a household does not get perfect information, it will be indifferent to the relation between price and the property characteristics. In addition, household will not move if the transaction cost is high, and as a result the equilibrium point of house market will not be achieved. The hedonic price model requires all assumptions to be fulfilled, so it is considered less feasible to be applied to the developing countries where the house market is still unimproved.

Empirical problems in the Hedonic Price concern with definition and measurements of dependent variable, explanatory/independent variables, and functional form used in the identification problems. Most empirical problems deal with multicollinearity due to lots of independent variables in the hedonic price equation. Multicollinearity condition is difficult to avoid because environmental characteristics usually collinear. For instance, a property located near a road will be affected by high sound and air pollution. Therefore, it will be difficult to distinguish the effects of air pollution and sound pollution.

This study applies the hedonic price model because the model is able to identify effects of each characteristic of house elements on the house price/rent. The value of each characteristic can be quantified in the form of marginal implicit price, also called marginal willingness to pay.

3. Methodology

The theoretical basis of the *hedonic price* model does not suggest specific functional form. Linear model or logarithmic model can be used as the alternatives. Follain and Malpezzi (1980), conducted a test on linear and logarithmic functional form (*semilog* dan *double log*). Their study revealed that the semilog form had greater advantages than the linear form. First, semilog model considers variation in money value of certain characteristic, so that price of a component depends on other characteristics of a house. Second, coefficients of semilog model have simple intepretation. The coefficients can be intepreted as follow : Percentage of changes in rent price will induce 1 unit change in independent variable. Next, *semilog* model

often reduces general statistical problems known as heteroskedasticity, or changes *error* variance. Last, *semilog* model can be calculated easily.

The estimation model used in this study is specified in logarithmic function, namely the *double-log* (all house characteristic , except *dummy* variable, are put in the log form).

$$\ln(P_i) = b_0 + \sum_{i=1}^{n} b_i \ln Z_i \qquad (4)$$

This functional form is the best choice, as it can show the decreasing marginal price and the relation between house's attributes, while at the same time reduces heteroskedasticity (Arimah, 1995). *Marginal impicit price (implicit willingness to pay)* of continuous variable (except index) for each household will depend on dependent variable (rent price per month) and characteristic level as written below:

$$P_{Z_i} = \partial P_i / \partial Z_i = b_j (P_i / Z_i) \qquad (5)$$

Whereas *marginal implicit price (implicit willingness to pay)* of *dummy* variable and *index*, which depends on dependent variable only, is shown as the following:

$$P_{z_i} = \partial P_i / \partial Z_i = (e^{b_j} - 1) P_i \qquad (6)$$

In this study, the *hedonic price* model is modified to comply with the first and second goals of the study, i.e identifying the effects of drinking water supply and home sanitation on the rent price of a house and calculating the value of *marginal implicit price (marginal willingness to pay)* for drinking water and sanitation. The *hedonic price* model in this study is explicitly written as :

$$r = \beta_0 + \sum_{i=1}^{m} \ln \beta_{1i} St_i + \beta_2 A + \beta_3 \ln N + \beta_4 DW + \sum_{i=1}^{n} \beta_{5i} DSa_i + \sum_{i=1}^{o} \beta_{6i} DP_i + \varepsilon \qquad (7)$$

Where:

r = Rent price of a house per month

St = Structure of a house vector

A = Accessibility variable (index from 0 to 1)

N = Neighborhood condition variable

DW = Drinking Water dummy variable

DSa = Sanitation vector dummy variable

DP = Province dummy variable

ε = *error term*

A study by Yusuf (2005) concluded that rural and urban areas have different characteristics on the housing market and on drinking water supply and sanitation. Therefore, in this study we differentiate the hedonic price model applications for rural and urban areas. Consequently, the separation of rural from urban areas will result in location bias. The Heckman Test procedures (two-stage procedures) are used to eliminate this location bias.

Logit Model

To achieve the third goal of this study, i.e. examining the factors influencing drinking water supply and sanitation, we use the Logit Model. This model is selected because it is mathematically simple and after being compared with probit model, it shows bigger *pseudo* R^2. Some objectives are set to comply with the goal: (i) examining effects of household's socioeconomic characteristics on the availability of piped drinking water and pumped water, (ii) examining effects of household's socioeconomic characteristics on sanitation facility namely the use of toilet with septic tank, and (iii) examining effects of household's socioeconomic characteristics on the garbage processing.

The Logit Model used in this study comprises three dependent variables: (i) the availability of piped water facilities or pumped water (1, 0); (ii) the availability of sanitation facility namely the use of toilet with septic tank (1, 0); and (iii) the garbage processing, taken by garbage authority (1, 0). The model is formulated as follows:

$$L_i = \ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 Um + \beta_2 S + \beta_3 AR + \beta_4 DT + \beta_5 DD + \beta_6 DM + \beta_7 DU + \beta_8 E + \varepsilon \quad (8)$$

Where:

p_i = probability that a household has drinking water facility or sanitation

Um = the breadwinner's age

S = breadwinner's sex (1, 0)

AR = number of people in a household

DT = *dummy* for residence: urban area (1, 0)

DD = *dummy* for breadwinner's education: primary school (1, 0)

DM = *dummy* for breadwinner's education: high school (1, 0)

DU = *dummy* for breadwinner's education: academy/university (1, 0)

E = income per capita per month

4. Data Sources

The data used in this study come from the *Indonesia Family Life Survey* (IFLS) in 2000[2]. Samples in this survey includes 83 percent of Indonesian living in 13 provinces. The respondents are individuals, relatives of those individuals, households, neighborhood community where household lives, and health and education facilities used by the community.

The IFLS in 2000[3] listed 10,574 households selected as survey samples. From this number, 7,928 of them are IFLS targets since they were interviewed in the previous IFLS (1993 and 1997). Among these targets, 6,800 households were interviewed for the IFLS in 1993 (or almost 90 percent of all households interviewed by ILFS in 1993). The survey is divided into *household survey* (HH) and *community facility survey* (CFS).

5. Result and Analysis

Analysis is conducted after running statistical test on the OLS model. The statistical test is needed to ensure that the coefficient of estimation is unbiased. There are three tests to be done, namely multicollinearity, heteroskedasticity, and sample selection bias (Heckman test) because the survey differs rural areas from urban areas.

Multicollinearity is a common problem in the hedonic price model due to the presence of many independent variables in explaining the variation of house rent price. For that reason, the tolerance test (TOL) and variance inflation factor (VIF) are conducted. Gujarati (2003) mentioned that *rule of thumb* for indicating multicollinearity is that the VIF value of the variable is bigger than 10. Then, if TOL value is approaching zero, the possibility of multicollinearity is bigger, whereas TOL value approaching 1 means no multicollinearity. In this study, the test of the combined samples results in a VIF value of 3.60 at most, and the mean value of VIF is 1.92. The test also obtain that the highest TOL value is 0.98 and the

[2] IFLS data can be downloaded at www.rand.org/FLS/IFLS

[3] IFLS 2000 is the third survey while the first was in 1993, then the second was in 1997.

lowest is 0.28. The highest VIF value for urban area is 2.21, while 2.05 for rural area. Those VIF value is far below 10, therefore we can conclude that there is no high multicollinearity between variables.

One assumption used in the OLS regression is that variance of error must be the same with $\text{var}(u_i) = \sigma^2$ (constant), which is called homoskedasticity. Homoskedasticity in the OLS creates bigger variance in the estimates, which affects the hypothesis testing (the t test and the F test). As a result, both hypothesis testing results become less accurate (Nachrowi and Usman, 2005). For this treason we apply Breusch-Pagan / Cook-Weisberg test to the regression, and the result shows that Ho (here Ho: variance is constant) is rejected, meaning that there is heteroskedasticity. *Robust regression* in STATA program is used to deal with that problem.

The sample test is conducted to eliminate the effects of non-randomness sample selection. The most commonly used methods to prevent these effects are the two-step Heckman and the Maximum Likelihood Heckman. The two-step Heckman can be done through constructing probit model which shows possibility that the household is in urban or rural area. This is known as first step. In this case, the area where household located is predicted based on the socioeconomics character.

Estimation of a probit model produces *probability density function (PDF)* and *cumulative distribution function (CDF)*. When the PDF is divided by the CDF, we will get the *inverse mills ratio (IMR)*. To find out whether there is bias in sampling process, the *inverse mills ratio* is treated as an independent variable in the regression. This is known as the 'second step'. If the *inverse mills ratio* is significant, then there is bias in sampling process. One result from our regression analysis tells that the *inverse mills ratio* for urban sampling is significant while the *inverse mills ratio* for rural sampling is insignificant. For this reason, regression of the hedonic price for urban area **includes** the *inverse mills ratio*, while the regression for rural area excludes it.

5.1 Analysis of the Hedonic Price Model.

As depicted by Table 2, piped water or pumped water in urban area have a significance level of 95% and have positive relation, meaning that the improvement of drinking water in a house will increase its rent price. Nevertheless, the availability of piped water and pumped water in rural area influences rent price insignificantly. Generally, the household's

consciousness toward proper drinking water supply exists only in urban area, reflected by the increase of the rent price. In urban area, availability of piped water or pumped water will increase rent price as much as 9.1 percent. Meanwhile, the availability of toilet equipped with septic tank has a significance level of 99 percent in urban area, rural area and combination of both areas. In rural area, the availability of toilet with septic tank will increase the rent price as much as 21 percent while it is insignificant in rural area.

Garbage handling through collection by an authorized agency is considered as decent. Coefficient of garbage handling is significant at the level of 99 percent, except in rural area where the significance level is 95 percent. It might happen due to the lack of access for the authorized agency to the remote area. In 2004, garbage handled by the authorized agency was at 1.5 percent, a slight increase compared to the amount in 2000 (which is only 1 percent). In urban area, the availability of garbage service will increase house rent price by 16 percent.

In general, conditions of a house structure influence the rent price, as shown by the significance in almost all house structure variables (e.g. width of a house, number of rooms, wall, and floor condition), except for roof condition which is insignificant. In rural areas, house with more than one storey is insignificant to the rent price. Perhaps it is caused by the fact that most houses in rural area have one storey only due to cheap price of the land.

The distance between a house and the downtown does not influence rent price in rural areas. It might happen because people in rural areas work around their neighborhood so that the distance to the downtown is not important. On the contrary, people in urban area, who work in non agricultural sector, will look for houses near to their workplaces, usually in CBD (*central business district*). Meanwhile, the condition of people living in neighborhood area is correlated with the rent price. Income increase will indirectly improve the quality of neighborhood where someone lives. A one percent increase in median of income per capita will raise the rent price by 0.64 percent.

There is variation of rent price between the provinces, as shown by the evidence that in almost all province (except Bali and West Nusa Tenggara), significance really influences rent price. Negative sign of province is applied to Jakarta as reference province where rent price in Jakarta is much more expensive than rent price in other areas. The reference for rural area is the West Java province, as there is no area categorized as rural area in Jakarta. The *Dummy* for

Bali and West Nusa Tenggara has positive sign, perhaps because of the high rent price in the two provinces (which is higher than rent price in East Java province).

5.2 Implicit Price (*Marginal WTP)* of Drinking Water and Sanitation.

The formula used to calculate the WTP is $WTP_i = (e^{b_i} - 1)R$, where b_i represents the coefficient of regression estimation, e is the natural logarithmic numeral, and R is the median of house rent price per month. Table 3 shows that the willingness to pay for drinking water availability is still low. In urban area, the amount of willingness to pay for piped water and pumped water is Rp. 6,850 per month, or less than 1 percent of total expenditure. The amount of willingness to pay for toilet equipped with septic tank is Rp. 15,800 per month, while the amount of willingness to pay for garbage service is Rp. 11,950 per month.

The amount of WTP for drinking water in each province is shown by Table 4. The highest WTP for piped or pumped water in Jakarta is Rp. 18,300. This is in line with the prediction that Jakarta is the biggest city in Indonesia, and the average income per capita of Jakarta people is higher than people in other areas. Next, Bali and West Java are both in the second place. Considering the percentage of expenditure, provinces having more than 1 percent of the total expenditure are Bali and West Java. This result complies with a study by Jiwanji (2000), which stated that the WTP for drinking water is around 0.2 percent to 4.5 percent of income. It also agrees with Metalia (2004), who revealed that the WTP for piped water in Bandar Lampung is Rp. 15,000 – Rp. 20,000 per month.

The availability of sanitation device, in the form of toilet with septic tank, is highly valued by the households. Table 5 depicts that the WTP for toilet with septic tank reach the amount of more than Rp. 10,000 per month, even in Jakarta it is more than Rp. 40,000 per month. The percentage of the WTP for toilet with septic tank is around 1.1 to 3 percent, and it shows that people are aware of the importance of sanitation. A study by Crane, et al (1997) stated that marginal implicit price for in house toilet of the renters in Jakarta is US$ 5 per month (or around Rp. 12,500, assuming that $ 1 = Rp.2,500). Compared to this, the WTP for sanitation is increasing.

Garbage handling done by authorized agency is one of important aspects influencing the house value. Table 6 shows that people are willing to pay more for the availability of the facilities, ranging from Rp. 8,000 to Rp. 32,000 per month. This WTP for garbage handling is

greater than what was reported by Slamet (2005) in his study, which stated that the WTP for garbage handling in Pemalang, West Java is Rp. 2,000 per month. This amount of WTP for garbage handling shows people awareness of garbage processing. Furthermore, the WTP amount can be considered in improving service done by authorized agency. If the investment needed to improve service is less than the WTP, then there is possibility that people are willing to pay to get better service.

5.3 Determinant of Drinking Water Supply and Sanitation.

The availability of drinking water sanitation is divided into three parts: (i) the availability of piped or pumped water, (ii) the availability of toilet with septic tank, and (iii) the availability of garbage handling service by authorized agency. The determinant of drinking water supply and sanitation in this research is socioeconomic condition of a household.

Piped Water and Pumped Water

Variables that significantly influence the availability of piped water or pumped water are breadwinner's age, number of family member, breadwinner educational background, and expenditure per capita, whereas breadwinner sex is insignificant as can be seen on table 7. The coefficient of breadwinner's age variable is 0.0081 and the *odds ratio* is 1.0081, meaning that each breadwinner who is one year older tends to possibly have piped or pumped water 1.008 times higher than younger breadwinner. It can be interpreted that older breadwinner tends to have higher possibility to have piped water or pumped water than the younger one.

The coefficient of residence variable is 1.3122 and the *odd ratio* is 3.7144, meaning that the proportion of household having piped or pumped water in urban areas is higher than in rural areas. The possibility that household in urban area having piped or pumped water is 3.7 times higher than the possibility of household in rural area. The higher the education level of breadwinner, the higher possibility to have piped or pumped water facilities will be. The possibility that a university/academy graduated breadwinner to have piped or pumped water is 2.46 times higher than breadwinner who does not finish the primary school. The higher a household's per capita expenditure, the higher the possibility to have piped or pumped water facilities will be. Each household with per capita expenditure of 1 unit higher (Rp. 100,000), will have higher possibility to have piped or pumped water by 1.14 times.

Sanitation: Toilet with Septic Tank

Variables that significantly influence the availability of toilet with septic tank are breadwinner's age, breadwinner's sex, number of family member, breadwinner educational background, and expenditure per capita (as depicted by Table 8). The tendency to have sanitation facilities in households with female breadwinner is higher than those with male breadwinner. With the coefficient of -0,239 and the *odds ratio* of 0.787, we see that possibility of male breadwinner for having decent sanitation is 0.79 times less than what female breadwinner has. This condition comes as a result of female's better awareness of house condition. Next, an increase in the number of family members increases the risk of sanitation availability. With an *odd ratio* of 1.0656, an increase in the number of family member by 1 person increases possibility of having sanitation facilities as much as 1.065 times.

Household residence positively influence sanitation availability where proportion of households having sanitation facilities in urban area is higher than those in rural area. Urban household possibility to have sanitation facilities is 2.6 times higher than the possibility that rural area has. There is a big influence of breadwinner education level to the ownership of toilet with septic tank. Household whose breadwinners education is high (university/academy graduated) will have 8.4 times higher possibility to have decent sanitation than those whose breadwinners do not pass primary school have. The amount of household expenditure increases the possibility of decent sanitation, where each household with 1 unit higher (Rp.100,000) of per capita expenditure will have possibility to have toilet with septic tank as much as 1.216 times.

Garbage Handling by Authorized Agency

Variables that significantly influence the availability of garbage handling by authorized agency are breadwinner's age, breadwinner's sex, number of family member, breadwinner educational background, and expenditure per capita per month as can be seen on table 9. The tendency to have garbage handling facilities in households with female breadwinner is higher than those with male breadwinner. The possibility that male breadwinner having decent sanitation is 0.67 times less than what female breadwinner has. Then, an increase in the number of family member raises the possibility of having garbage handling facilities done by

authorized agency, in which an addition in the number of family member (1 person) will increase possibility of having garbage handling facilities as much as 1.07 times.

Distinct probability comparison is shown by the location of household, where the possibility of households in urban area to get garbage handling facilities done by authorized agency is 54 times higher than the possibility of households in rural area do. It is commensurate with the fact that the percentage of garbage handling done by authorized agency in rural area in 2004 is 1.5 percent. Households with breadwinner having university/academy degree is 6.2 times more possible to get garbage handling facilities done by authorized agency than those with breadwinner not passing the primary school have. The higher the expenditure per capita of a household, the more possibility that it garbage is handled by authorized agency will be. Every household with 1 unit higher (Rp.100,000) of per capita expenditure will have 1.1 times higher possibility to get garbage handling facilities done by authorized agency..

6. Conclusion

There are some conclusions that can be drawn from our analysis. First, the availability of piped or pumped water positively influences house rent price in urban area, where it does not influence the house rent price in rural area and combined area. Piped or pumped water availability increases house rent price in urban area by 9.1 percent. Second, the availability of toilet facilitated with septic tank influences rent price of houses in urban, rural, and combined areas. Availability of toilet equipped with septic tank increase house rent price by 21 percent. Third, in urban area, the amount of willingness to pay for piped or pumped water is Rp. 6,850 per month, while the willingness to pay for availability of toilet with septic tank reaches Rp. 15,800 per month, and the willingness to pay for garbage handling by authorized agency is Rp. 1,950 per month .

The fourth conclusion is about factors influencing availability of piped or pumped water in a household. Those factors are breadwinner's age, breadwinner's sex, number of family member, breadwinner educational background, and expenditure per capita per month. The higher the level of breadwinner education means the higher the possibility that there is piped or pumped water facility in the household. Households with breadwinner having university/academy degree is 2.46 times more possible to have piped or pumped water facilities than those with breadwinner not passing the primary school do. Every household with

1 unit (Rp.100,000) higher of per capita expenditure will have 1.14 times higher possibility to have piped or pumped water facilities than households having less expenditure per capita.

Fifth, factor influencing availability of toilet sanitation with septic tank are breadwinner's age, breadwinner's sex, number of family member, breadwinner educational background, and expenditure per capita. Households with female breadwinner 's tendency to have sanitation facilities is higher than those with male breadwinner. Urban household possibility to have sanitation facilities is 2.6 times higher than the possibility that rural area has. There is a big influence of breadwinner education level to the ownership of toilet with septic tank. Household with educated breadwinners (university/academy graduated) will have 8.4 times higher possibility to have decent sanitation than those whose breadwinners do not pass primary school.

Sixth, factors that significantly influence the availability of garbage handling by authorized agency are breadwinner's age, number of family member, breadwinner educational background, and expenditure per capita. Probability of households in urban area to get garbage handling facilities done by authorized agency is 54 times bigger than the probability of households in rural area do. Households with breadwinner having university/academy degree is 6.2 times more possible to get garbage handling facilities done by authorized agency than those with breadwinner not passing the primary school.

Suggested Policy

The above discussion and conclusions lead us to two suggested policies and a followed up study. The first is that WTP calculation results can be used as a reference in programs to improve water and sanitation quality, especially dealing with cost recovery. Second, households are willing to pay for the facilities although the amount they want to pay is still small. This condition needs government intervention to invest on improvement of those facilities which will be responded by households through bigger willingness to pay, especially in urban areas. Willingness to pay in rural area is still so low so that subsidy from government is needed (e.g. in the form of Specific Allocation Fund for drinking water and sanitation). Third, by looking at factors influencing availability of drinking water and sanitation facilities, we find out that the level of education is very crucial. For this reason, improvement of human capital is strongly needed to indirectly increase the availability of descent drinking water and sanitation facilities in every household. The importance of descent drinking water and

sanitation facilities should be disseminated to increase people knowledge and at the same time improve their awareness.

Bibliography

ADB, UNDP, UNESCAP. (2006). "The Millennium Development Goals: Progress in Asia and the Pacific 2006".

Al-Ghuraiz, usuf and Enshassi, Adnan (2005). "Ability and Willingness to Pay for Water Supply Service in the Gaza Strip", *Building and Environment*, 40 (2005), 1093-1102.

Arimah, B.C. (1992) "Hedonic Price and Demand For Housing Attributes in A Third World City: The Case of Ibadan, Nigeria", *Urban Studies*, 29.

Arimah, B.C. (1995). "Willingness to Pay For Improved Environmental Sanitation in a Nigerian City", *Journal of Environmental Management*, 48, 127-138.

Bappenas (2005). Laporan Perkembangan Pencapaian Tujuan Pembangunan Millenium (*Millenium Development Goals*) Indonesia Tahun 2004 dan 2005.

Bappenas (2003). Kebijakan Nasional Pembangunan Air Minum dan Penyehatan Lingkungan Berbasis Masyarakat Tahun 2003.

Biro Pusat Statistik (2006). "Beberapa Indikator Penting Sosial Ekonomi Indonesia Edisi Juli tahun 2006" BPS Pusat Jakarta.

Biro Pusat Statistik (2005). "Statistik Perumahan dan Permukiman Modul Susenas tahun 2004". BPS Pusat Jakarta.

Biro Pusat Statistik (2005). "Survei Sosial Ekonomi Nasional (Susenas) Kor tahun 2004". BPS Pusat Jakarta.

Biro Pusat Statistik (2001). "Statistik Kesejahteraan Rakyat tahun 2000". BPS Pusat Jakarta.

Brasington, David M. and Hite, Diane. (2005)"Demand for Environmental Quality: A Spatial Hedonic Analysis", *Regional Science and Urban Economics* 35, 57-82.

Can, Ayse. (1992) "Spesification and Estimation of Hedonic Housing Price Models" *Regional and Urban Economics* 22 (1992), 453-474 North Holland

Casey, James F., Kahn, James R., and Rivas, Alexandre (2006). "Willingness to Pay *for* Improve Water Service in Manaus, Amazonas, Brasil", *Ecological Economics* 58, 365-272.

Crane, R., Daniere, A. dan Harwood, S. (1997). "The Contribution of Environmental Amenities To Low–Income Housing: A Comparative Study of Bangkok And Jakarta", *Urban Studies*, 34.

Fauzi, Akhmad (2004). Ekonomi Sumber Daya Alam dan Lingkungan. Jakarta: Penerbit Pustaka Gramedia Utama.

Freeman, MA (1993). The Measurement of Environmental and Resources Values: Theory And Methods, Resources for the Future, Washington, DC.

Fujita, Masahisa (1989). "Urban Economic Theory : Land Use and City Size."Cambridge University Press, Cambridge, New York, USA.

Gujarati, Damodar N. (2003). "Basic Econometric" Fourth Edition. Mc Graw Hill-Irvine New York, USA.

Halvorsen, R. and R. Palmquist (1980), "The Interpretation of Dummy Variables in Semilogarithmic Equations", *The American Economic Revie*w 70: 474–475.

Heckman, J. (1979), "Sample Selection Bias as a Specification Error", *Econometrica* 47: 153–161.

Hutton, Guy and Haller, Laurence (2004). Evaluation of the Cost and Benefit of Water and Sanitation Improvement at the Global Level. World Health Organization, Geneva

Johnston, Jack and DiNardo, John (1997). Econometric Methods, Fourth Edition. Mc.Graw-Hill Companies, New York, USA.

Lancaster, Kelvin (1966). "A New Approach to Consumer Theory" *Journal of Political Economy*, 74, 1966.

Malpezzi, Stephen (2002). " Hedonic Price Models : A Selective and Applied Review." Housing Economics : Essays in Honor of Duncan Maclennan.

Metalia, Mega (2004). Mengestimasi willingness to pay pelanggan rumah tangga untuk pelayanan air bersih dari PDAM : Aplikasi survei *contingent valuation* di Kota Bandar Lampung, Tesis Magister Ilmu Ekonomi Program Pascasarjana Fakultas Ekonomi UI.

Nachrowi, D. Nachrowi, Usman, Hardius. (2005) "Penggunaan Teknik Ekonometri Pendekatan Populer dan Praktis" Edisi Revisi. PT. Raja Grafindo Persada, Jakarta.

Rosen, S. (1974), 'Hedonic prices and implicit markets: product differentiation in pure competition', *Journal of Political Economy* 82: 34–55.

SIWI. 2005. Making Water A Part of Economic Development : the Economic Benefits of Improve Management Water and Services .

Slamet, Nur Aji Mugi Harjono (2005). "Analisis Kesediaan Rumah Tangga Membayar Retribusi Sampah dengan Metode Valuasi Kontingensi Studi Kasus Kabupaten Pemalang" Tesis MPKP Pascasarjana FE UI.

Strauss, John. Beegle, Kathleen. Sikoki, Bondan. Dwiyanto, Agus. Herawati, Yulia dan Witoelar, Firman (2004) *User's Guide for the Indonesia Family Life Survey, Wave 3*. RAND Land and Population Program.

UNICEF (2004). The State of the World Children 2004.

Watercan (2004). "Why Invest in Water and Sanitation in Developing World" Ottawa, Canada.

Yusuf, Arief Anshory (2002). "Household Willingness to Pay for Domestic Water Source in Indonesia : A Hedonic Property Value Analysis" Master Thesis pada Master Course in Environmental and Resource Economics, University College London, tidak dipublikasikan.

Yusuf, Arief Anshory and Phoebe Koundouri (2005). "Willingness to Pay for Water and Location Bias in Hedonic Price Analysis: Evidence from the Indonesian Housing Market" *Environment and Development Economics*, Cambridge University Press.

World Bank (2006). "Making the New Indonesia Work for the Poor" The World Bank Office Jakarta.

World Bank (2000). ”Indonesia Overview of Sanitation and Sewerage Experience and Policy Option” Indonesia Country and Management Unit, East Asia and Pacific Region.

World Health Organization (WHO) and United Nation Children’s Fund (UNICEF). 2000. “Global Water and Sanitation Assessment 2000 Report”

Table 1 Descriptive Statistics for *Hedonic Price* Variable

Variable	Urban Sample	Rural Sample	Total
Dependent Variable			
Rent Price per month (Rp.)	191,596	85,899	133,160
	(628,885)	(523,621)	(575,397)
Drinking water source characteristics			
Using piped water or pumped water (1,0)	0.72	0.35	0.52
Sanitation Characteristics			
Using private toilet without septic tan k (1,0)	0.12	0.23	0.19
Using private toilet with septic tank (1,0)	0.62	0.30	0.44
Disposing to stream water (1,0)	0.66	0.32	0.47
Garbage handled by authorized agency (1,0)	0.48	0.01	0.22
House structure characteristics			
Wide of house (m2)	85.67	72.71	78.50
	(92.12)	(58.14)	(75.53)
Number of rooms	5.79	5.08	5.40
	(2.86)	(2.22)	(2.55)
Multistoried house (1,0)	0.16	0.04	0.09
Wall made of concrete or brick (1,0)	0.77	0.51	0.63
Floor made of ceramics (1,0)	0.52	0.24	0.36
Roof made of concrete roof tile (1,0)	0.01	0.00	0.00
Proper ventilation (1,0)	0.78	0.76	0.77
Accessibility			
Distance to the downtown (km)	9.25	30.28	20.86
	(14.08)	(30.05)	(26.40)
Neighborhood Characteristic			
Median of expenditure per capita in the *community*	184,031	113,531	145,075
	(82,357)	(32,746)	(69,674)
Dummy Provinces			
North Sumatera (1,0)	0.07	0.05	0.06
West Sumatera (1,0)	0.03	0.05	0.05
South Sumatera (1,0)	0.03	0.05	0.04
Lampung (1,0)	0.02	0.07	0.04
Jakarta (1,0)	0.18	-	0.08
West Java (1,0)	0.17	0.15	0.16
Central Java (1,0)	0.11	0.16	0.14
Yogyakarta (1,0)	0.09	0.05	0.07
East Java (1,0)	0.13	0.17	0.16
Bali (1,0)	0.04	0.06	0.05
West Nusa Tenggara (1,0)	0.04	0.10	0.07
South Kalimantan (1,0)	0.03	0.05	0.04
South Sulawesi (1,0)	0.05	0.04	0.05

Notes : Numbers in brackets are deviation standard.

Table 2 Result of *Hedonic Price* Regression
(Dependent variable : Log of rent price per month)

Variable	Urban Sample	Rural Sample	Combined Sample
Drinking water source characteristics			
Using piped water or pumped water (1,0)	0.087 (0.037) **	0.003 (0.033)	0.037 (0.024)
Sanitation Characteristics			
Using private toilet without septic tan k (1,0)	0.144 (0.055) ***	0.033 (0.039)	0.062 (0.031) **
Using private toilet with septic tank (1,0)	0.191 (0.042) ***	0.130 (0.041) ***	0.157 (0.028) ***
Disposing to stream water (1,0)	0.074 (0.037) **	0.107 (0.034) ***	0.077 (0.025) ***
Garbage handled by authorized agency (1,0)	0.148 (0.040) ***	0.238 (0.114) **	0.261 (0.034) ***
House structure characteristics			
Log of house wide (m2)	0.219 (0.031) ***	0.143 (0.030) ***	0.188 (0.022) ***
Log of number of rooms	0.450 (0.057) ***	0.390 (0.056) ***	0.445 (0.040) ***
Multistoried house (1,0)	0.122 (0.048) ***	-0.040 (0.080)	0.094 (0.042) **
Wall made of concrete or brick (1,0)	0.180 (0.047) ***	0.144 (0.039) ***	0.150 (0.030) ***
Floor made of ceramics (1,0)	0.216 (0.039) ***	0.150 (0.043) ***	0.188 (0.029) ***
Roof made of concrete roof tile (1,0)	0.261 (0.297)	0.257 (0.313)	0.261 (0.235)
Proper ventilation (1,0)	0.025 (0.038)	0.096 (0.036) ***	0.064 (0.026) **
Accessibility			
Distance to the downtown from 0 to 1	-0.306 (0.120) ***	-0.019 (0.070)	-0.089 (0.053) *
Neighborhood Characteristics			
Log Median of community expenditure per capita	0.640 (0.053) ***	0.442 (0.062) ***	0.606 0.038 ***
Dummy Province			
North Sumatera (1,0)	-0.491 (0.082) ***	-0.541 (0.075) ***	-0.743 (0.065) ***
West Sumatera (1,0)	-0.698 (0.083) ***	-0.020 (0.088)	-0.567 (0.072) ***
South Sumatera (1,0)	-0.756 (0.101) ***	-0.321 (0.083) ***	-0.729 (0.073) ***
Lampung (1,0)	-0.575 (0.123) ***	-0.189 (0.078) **	-0.609 (0.077) ***
West Java (1,0)	-0.459 (0.058) ***	- -	-0.469 (0.051) ***
Central Java (1,0)	-0.902 (0.079) ***	-0.432 (0.054) ***	-0.916 (0.059) ***
Yogyakarta (1,0)	-0.769 (0.080) ***	-0.663 (0.082) ***	-0.960 (0.067) ***
East Java (1,0)	-0.905 (0.068) ***	-0.331 (0.053) ***	-0.854 (0.055) ***
Bali (1,0)	0.021 (0.091)	0.418 (0.080) ***	-0.090 (0.067)
West Nusa Tenggara (1,0)	0.008 (0.093)	0.284 (0.066) ***	-0.084 (0.065)
South Kalimantan (1,0)	-0.484 (0.091) ***	-0.418 (0.071) ***	-0.742 (0.064) ***
South Sulawesi (1,0)	-0.384 (0.090) ***	-0.005 (0.080)	-0.481 (0.069) ***
Constant	2.100 (0.653) ***	4.156 (0.721) ***	2.465 (0.460) ***
Mills Ratio	-0.285 (0.047) ***	- -	- -
R-squared	0.4834	0.2156	0.4100
F-statistic	100.78	38.51	178.62
Number of Observations	2,954	3,722	6,677

Note : * significance: 10%, ** significance: 5%, *** significance: 1%

Mills Ratio is applied to urban sample only because it is not significant for rural sample.

Numbers in brackets are error standard.

Table 3 Calculation of *Marginal Implicit Price (WTP)* for drinking water and sanitation.

	Urban			ural		
	Coef-ficient	*WTP* (Rp.)	*WTP* towards expenditure	Coef-ficient	*WTP* (Rp.)	*WTP* towards expenditure
Drinking water characteristics						
Using piped water or pumped water	0.0874	6,852	0.79%	0.0033	133	0.02%
Sanitation Characteristics						
Using private toilet without septic tank	0.1442	11,634	1.34%	0.0330	1,340	0.24%
Using private toilet with septic tank	0.1912	15,800	1.82%	0.1296	5,535	0.99%
Disposing to stream water	0.0742	5,781	0.66%	0.1071	4,520	0.81%
Garbage handled by authorized agency	0.1480	11,964	1.38%	0.2379	10,744	1.92%
Median of house rent price per month		75,000			40,000	
Median of expenditure per month		869,931			558,191	

Table 4 Calculation of *Marginal Implicit Price (WTP)* Drinking water in urban area.

Provinces	Median Of rent price	WTP Piped or Pumped water (Rp)	Median of expenditure	Percentage of expenditure
North Sumatera	60,000	5,482	880,700	0.62
West Sumatera	75,000	6,852	1,219,000	0.56
South Sumatera	59,000	5,391	1,109,700	0.49
Lampung	55,000	5,025	991,800	0.51
Jakarta	200,000	18,273	1,398,600	1.31
West Java	100,000	9,136	824,300	1.11
Central Java	50,000	4,568	678,400	0.67
Yogyakarta	60,000	5,482	684,800	0.80
East Java	50,000	4,568	641,400	0.71
Bali	115,000	10,507	940,000	1.12
West Nusa Tenggara	50,000	4,568	525,000	0.87
South Kalimantan	50,000	4,568	816,900	0.56
South Sulawesi	50,000	4,568	711,900	0.64

Table 5 Calculation of *Marginal Implicit Price (WTP)* for Sanitation in each province

Province	Urban			Rural		
	Median of rent price	WTP		Median of Rent price	WTP	
		Toilet without Septic tank	Toilet with Septic tank		Toilet without Septic tank	Toilet with Septic tank
North Sumatera	60,000	9,307	12,640	25,000	838	3,459
West Sumatera	75,000	11,634	15,800	50,000	1,675	6,919
South Sumatera	59,000	9,152	12,429	30,000	1,005	4,151
Lampung	55,000	8,531	11,586	30,000	1,005	4,151
Jakarta	200,000	31,023	42,133	-	-	-
West Java	100,000	15,512	21,066	50,000	1,675	6,919
Central Java	50,000	7,756	10,533	30,000	1,005	4,151
Yogyakarta	60,000	9,307	12,640	25,000	838	3,459
East Java	50,000	7,756	10,533	35,000	1,173	4,843
Bali	115,000	17,838	24,226	100,000	3,350	13,838
West Nusa Tenggara	50,000	7,756	10,533	50,000	1,675	6,919
South Kalimantan	50,000	7,756	10,533	25,000	838	3,459
South Sulawesi	50,000	7,756	10,533	30,000	1,005	4,151

Table 6. Calculation of *Marginal Implicit Price* stream drainage and garbage handling in each province

Province	Urban			Rural		
		WTP (Rp.)			WTP (Rp.)	
	Median of Rent price	Stream drainage	Garbage handled	Median of Rent price	Stream drainage	Garbage handled
North Sumatera	60,000	4,624	9,571	25,000	2,825	6,715
West Sumatera	75,000	5,781	11,964	50,000	5,650	13,430
South Sumatera	59,000	4,547	9,412	30,000	3,390	8,058
Lampung	55,000	4,239	8,774	30,000	3,390	8,058
Jakarta	200,000	15,415	31,904	-	-	-
West Java	100,000	7,707	15,952	50,000	5,650	13,430
Central Java	50,000	3,854	7,976	30,000	3,390	8,058
Yogyakarta	60,000	4,624	9,571	25,000	2,825	6,715
East Java	50,000	3,854	7,976	35,000	3,955	9,401
Bali	115,000	8,863	18,345	100,000	11,299	26,860
West Nusa Tenggara	50,000	3,854	7,976	50,000	5,650	13,430
South Kalimantan	50,000	3,854	7,976	25,000	2,825	6,715
South Sulawesi	50,000	3,854	7,976	30,000	3,390	8,058

Table 7.Results of Regression Estimation of Logit Dependent Variable: Household having piped or pumped water.

Variable	Coefficient	Odds Ratio	Description
Breadwinner's age	0.0081 **	1.0081	
Breadwinner sex (1,0)	-0.0596	0.9421	1 = Male, 0 = Female
Number of family member	0.0304 **	1.0309	
Household's residence (1,0)	1.3122 **	3.7144	1 = Urban, 0 = Rural
Breadwinner education, Primary school (1,0)	0.1582 *	1.1714	1 = Primary school, 0 = others
Breadwinner education: SMP&SMA (1,0)	0.5427 **	1.7207	1 = SMP and SMA, 0 = others
Breadwinner education: University (1,0)	0.9014 **	2.4630	1 = Academy/university, 0 = others
Household expenditure per capita (100rb)	0.1322 **	1.1413	Expenditure per capita per month
Constant	-1.5306 **		
LR χ^2 (8)	1094.29		
Pseudo R^2	0.1182		
Number of Observations	6681		

Note. : * significance: 10% and 5%, ** significance: 1%

Tabel 8 Results of Regression Estimation of Logit Dependent Variable: Households having toilet with septic tank

Variable	Coefficient	Odds Ratio	Description
Breadwinner's age	0.0203 **	1.0205	
Breadwinner sex (1,0)	-0.2391 **	0.7874	1 = Male, 0 = Female
Number of family member	0.0635 **	1.0656	
Household's residence (1,0)	0.9532 **	2.5939	1 = Urban, 0 = Rural
Breadwinner education, Primary school (1,0)	0.5540 **	1.7402	1 = Primary school, 0 = others
Breadwinner education: SMP&SMA (1,0)	1.4313 **	4.1841	1 = SMP and SMA, 0 = others
Breadwinner education: University (1,0)	2.1322 **	8.4335	1 = Academy/university, 0 = others
Household expenditure per capita (100rb)	0.1952 **	1.2155	Expenditure per capita per month
Constant	-2.9712 **		
LR χ^2 (8)	1390.40		
Pseudo R^2	0.1516		
Number of Observations	6681		

Note : * significance: 10% and 5%, ** significance: 1%

Table 9. Results of Regression Estimation of Logit Dependent Variable : Household having garbage handling facilities done by authorize agency.

Variable	Coefficient	*Odds Ratio*	Description
Breadwinner's age	0.0194 **	1.0196	
Breadwinner sex (1,0)	-0.3892 **	0.6776	1 = Male, 0 = Female
Number of family member	0.0649 **	1.0671	
Household's residence (1,0)	3.9865 **	53.8666	1 = Urban, 0 = Rural
Breadwinner education, Primary school (1,0)	0.6909 **	1.9955	1 = Primary school, 0 = others
Breadwinner education: SMP&SMA (1,0)	1.6163 **	5.0345	1 = SMP and SMA, 0 = others
Breadwinner education: University (1,0)	1.8252 **	6.2039	1 = Academy/university, 0 = others
Household expenditure per capita (100rb)	0.0914 **	1.0957	Expenditure per capita per month
Constant	-6.4046 **		
LR χ^2 (8)	2739.88		
Pseudo R^2	0.3911		
Number of Observations	6681		

Note : * significance: 10% and 5%, ** significance: 1%