CHAPTER 3

THEORETICAL FRAMEWORK

Environmental value can be considered in terms of either the non-use or the use value. Use value is defined as the value derived from the actual use of a good or service, such as hunting, fishing, bird-watching, or hiking. A large part of environmental economics has been devoted to valuing "use" services. Non-use values also referred to as "passive use" values, are values that are not associated with actual use, or even the option to use a good or service. Existence value is a type of non-use value and is the value that people place on simply knowing that something exists, even if they will never see it or use it (Wierencia, 2003).The existence of a beautiful environment is an example of non-use value, and the effects of undesirable sites to daily living are that of use value.

As such, valuation of environment may be implemented using one of the two main methods (Guy and Garrod, 1996). One is the "stated preference method" which asks respondents directly how much they value a specific characteristic of environment. This is suitable for measuring both non-use and use values. For example of use value, those who live nearby the incinerator can be asked to reveal their willingness to pay in order to avoid risk of being cancer caused by the incinerator. Another is the "reference preference method" in which the respondents show their preference indirectly through the market. Nonetheless, this method is applied for use value only. For example, the effects of the incinerator depress the nearby property because people value the effects through houses located near sites.

As the objective of this study is to estimate the risk perception and disamenity, which are regarded as the use value of the environment, both the stated and reference methods can be carried out. However, the stated method is subject to a certain degree of bias. First, the respondent tends to make the too high WTP as they believe that this WTP would be translated into an establishment of compensation scheme. This is a so-called strategic bias. Second, it is the non-trivial task of respondents to state the risk perception due to the fact that they are not familiar with the hypothesis market formulated by researchers. Last, inconsistent results between researchers having done the survey in different periods may exist. Following concerns of strategic bias, non-trivial task of forming CVM in risk perception, and possible inconsistent results as described above, we shall use the market technique to fulfill the objectives. Specifically, in order to assess the effects of risk perception and disamenity associated with the Phuket MSW incinerator on environment, this study employs the standard Rosen's Hedonic Price Model (HPM).

At the outset we shall begin the discussion of theoretical framework by outlining the HPM.

3.1 Estimating the Implicit Prices

Hedonic price function (HPF) is a reduced-form equation of a market with an interaction of demand and supply functions, whereby the partial derivative of HPF with respect to a particular attribute represents market-clearing marginal implicit price or premium of the attribute (Rosen, 1974). Goods in the model is treated as a single composite commodity consisting of the amounts of the various attributes from which consumers can derive utility, and producers incur the costs that are also dependent upon the variety of goods which they provide.

The model assumes the following:

1. the price of a product is a function of its characteristics;
2. the range of product choices is continuous; and
3. the amount of particular characteristics can be varied independently.

By assuming further that consumer's and producer's decision are rational in such a way of maximize utility and maximize profit respectively, we can obtain the implicit price function as follows.

Consumer's decision

Each household consumes one unit of goods with characteristics (Z) and other ordinary goods (X). The consumer wants to maximize their utility function, which is assumed to be strictly concave, within the budget constraint. That is

$$\text{Max } U(Z, X; \alpha) \qquad (3.1)$$

s.t. Y = X + P(Z). (3.2)

where Z = $(Z_1,\ldots,Z_n)$ is the vector of structural, community, environmental, and locational characteristics of goods Z; X is the composite of other ordinary goods consumed whose price is assumed to equal one; Y is the household income; α is a parameter vector of the consumers; and P(Z) is the nonlinear hedonic implicit price for goods (see prove of nonlinearity in Appendix C). Since P(Z) is nonlinear, the budget constraint is nonlinear. P(Z) is an increasing function; that is the more Z available, the higher price it will be.

In order to constitute the conditions for maximizing utility, the Lagrangian function can be derived as:

$$L = U(Z, X; \alpha) + \mu(Y - X - P(Z)) \quad (3.3)$$

Maximization of utility subject to the budget constraint requires consumers to choose X and Z to satisfy the budget constraint. The first-order condition is:

$$\frac{\partial L}{\partial Z_i} = \frac{\partial U}{\partial Z_i} - \mu \frac{\partial P}{\partial Z_i} = 0 \quad (3.4)$$

$$\frac{\partial L}{\partial X} = \frac{\partial U}{\partial X} - \mu = 0 \quad (3.5)$$

$$\frac{\partial L}{\partial \mu} = Y - X - P(Z) = 0 \quad (3.6)$$

From (3.3) $\mu = \frac{\partial U}{\partial X}$. Then, substitute this relationship in equation (3.4), we obtain

$$\frac{\partial U}{\partial Z_i} - \frac{\partial U}{\partial X}\frac{\partial P}{\partial Z_i} = 0. \quad (3.7)$$

Rewrite equation (3.7), we get

$$\frac{\partial P(Z)}{\partial Z_i} = \frac{\partial U(Z, X; \alpha)/\partial Z_i}{\partial U(Z, X; \alpha)/\partial X} = P_{Z_i}(Z) \quad (3.8)$$

where P_{Z_i} is an implicit price function for Z_i . Equation (3.8) represents the marginal implicit price function of a given characteristic (Z_i) which shows consumers' willingness to pay for the i^{th} characteristic of commodity Z.

To emphasize the importance of a spatial context of the problem, define a value or bid function

$$\theta = \theta(Z; u, Y, \alpha) \tag{3.9}$$

According to

$$U(Y-\theta, Z_1, \ldots, Z_n) = u \tag{3.10}$$

where $\theta = \theta(Z; u, Y, \alpha)$ is the amount of the expenditure the consumer is willing to pay at a given utility level u for alternative level of Z at income fixed Y. We differentiate equation (3.10) by Z_i and obtain

$$\frac{\partial U}{\partial X}\frac{\partial X}{\partial Z_i} + \frac{\partial U}{\partial Z_i} = 0 \tag{3.11}$$

$$U_X \theta_{Z_i} = U_{Z_i} \tag{3.12}$$

$$\theta_{Z_i} = \frac{U_{Z_i}}{U_X} \tag{3.13}$$

The first derivative of the bid function with respect to Z_i as shown by equation 3.15 is defined as the marginal bid function. Therefore, consumer's utility is maximized under the following conditions:

$$\theta(Z^*; u^*, Y, \alpha) = P(Z^*) \tag{3.14}$$

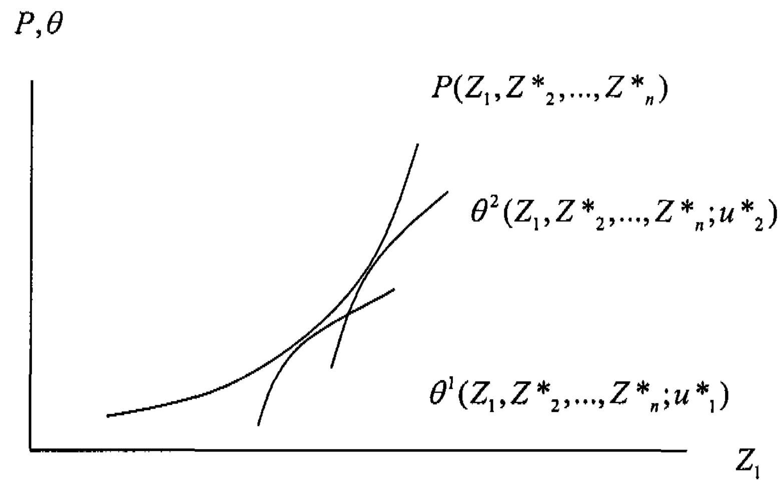
and $\theta_{Z_i}(Z^*; u^*, Y, \alpha) = P_{Z_i}(Z^*)$ for all i^{th} characteristics of Z, (3.15)

The second condition (equation 3.15) is similar to a typical marginal condition (equation 3.8) required for maximizing utility. In equilibrium, a consumer sets his/her marginal willingness to pay (θ_{Z_i}) equal to the implicit price for each characteristic of the goods in order to maximize his/her utility. As seen in Figure 3.1, optimum location on the Z-plane occurs where the two surfaces P(Z) and $\theta = \theta(Z; u, Y, \alpha)$ are tangent to each other.

One dimension of consumer equilibrium is illustrated in figure 3.1, where the surfaces have been projected onto $\theta - Z_1$ plane cut at $(Z^*_2,...,Z^*_n)$. A family of indifference curves, of which only one member, at maximized utility (u^*_1), is defined by $\theta = \theta(Z_1, Z^*_2,...,Z^*_n; u, Y, \alpha)$. Two bid functions of different buyers are shown in the figure 3.1, such that one with value function θ^1 and the other with θ^2. The latter purchases a product offering more units of Z_1.

Figure 3.1

Consumer Equilibrium



Producer's decision

Producer behavior is analogous to consumer behavior. Let the producers provide the number of goods M, with characteristics Z, where Z = ($Z_1,..., Z_n$), at the cost of $C(M,Z;\beta)$, when β is the parameter characterizing the producer, for example technology, factor prices, etc. Assume C(.) is a convex function with C(0,Z)=0 and C_M and C_{Z_i} >0. Thus, the profit of a producer is given by

$$\Pi = P(Z) \cdot M - C(M,Z;\beta). \tag{3.16}$$

The producer wants to maximize profit by choosing M and Z appropriately and the first-order profit maximizing conditions are:

$$P(Z^*) = \frac{\partial C(Z^*, M^*; \beta)}{\partial M} \tag{3.17}$$

$$\frac{\partial P(Z^*)}{\partial Z_i} = \frac{1}{M}\frac{\partial C(Z^*, M^*; \beta)}{\partial Z_i} = G(Z^*, M^*; \beta). \tag{3.18}$$

Equation (3.17) states that at the optimal bundle of characteristics Z*, the quantities will be produced when unit revenue, P(Z), equals marginal cost of the property. Equation (3.18) shows that the marginal revenue from a marginal improvement in characteristic Z_i equals the marginal cost of the property sold. As in the consumer bid function, the offer function can be developed

$$\phi = \phi(Z; II, M, \beta) \tag{3.19}$$

where $\phi = \phi(Z; II, M, \beta)$ is the amount of money to maintain a firm with characteristics β vector at a constant profit level II for change M quantities of goods with characteristic Z. Since each producer produce one units of product only, offer function is found by substituting M = 1 into

$$\Pi = \phi \bullet M - C(M, Z; \beta) \tag{3.20}$$

and

$$C_M(M, Z_1, \ldots, Z_n) = \phi \tag{3.21}$$

then, solving for ϕ, the offer funtion,in terms of Z, Π,and β.

The marginal reservation supply price for the i^{th} attribute at constant profit is ϕ_{Z_i} assumed increasing in Z_i. Since ϕ is the offer price the seller is willing to accept on product Z at profit level Π, and P(Z) is the maximum price obtainable for those models in the market, profit is maximized by an equivalent maximization of the offer price subject to the constraint P=ϕ.

The first derivative of the offer function with respect to Z_i provides the marginal offer function. The conditions for a firm to maximize profit are:

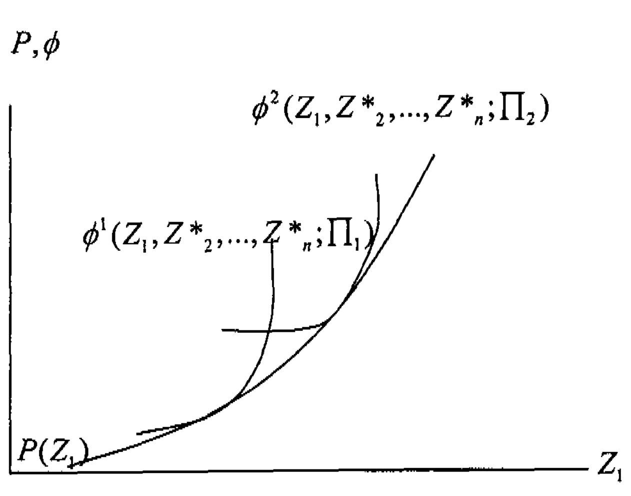
$$\varphi = \varphi(Z; \Pi, M, \beta) = P(Z^*) \qquad (3.22)$$

$$\varphi_{Z_i}(Z; \Pi, M, \beta) = P_{Z_i}(Z^*) \text{ for all } i^{th} \text{ characteristics of Z.} \qquad (3.23)$$

Producer equilibrium is characterized by tangency between a profit-characteristics and implicit price surface. One dimension of the solution is depicted in figure 3.2, where $\phi = \phi(Z_1, Z^*_2, \ldots, Z^*_n; \Pi, \beta)$ defines a family of curves on the $Z_1 - \phi$ plane cut through the indifference surface at the optimum values of the other attributes. Only two producers are shown in the figure, the curve labeled ϕ^1 refers to a production unit possessing production and cost condition making it well suited to produce lesser amounts of Z_1, while the one labeled ϕ^2 refers to a firm with a comparative advantage at producing higher values of Z_1. That is, the two plants have distinct values of the parameter β. More generally, there is a distribution of β across all potential sellers. Let $G(\beta)$ represent that distribution. Then producer equilibrium is characterized by a family of offer functions that envelop the market hedonic price function.

Figure 3.2

Producer Equilibrium



In a competitive equilibrium, the following conditions hold

$$\theta(Z^*;u,Y,\alpha) = P(Z^*) = \phi(Z^*;\Pi,M,\beta) \qquad (3.24)$$

Therefore, the hedonic price function P(Z*) can be described as the envelope of bid and offer functions in equilibrium. The HPF on Z_i plane will be shown as figure 3.3.

By differentiating HPF (equation 3.24) with Z_i, we will get the marginal implicit price function (equation 3.25) as shown in Figure 3.4. The marginal implicit price function has a negative slope because it is the first differential of a strictly concave utility function, as shown in equation 3.8. This means that the more units of Z_i the people consume, the lower the marginal utility of Z_i. It is a so-called the law of diminishing marginal utility.

$$\theta_{Z_i}(Z^*;u,Y,\alpha) = P_{Z_i}(Z^*) = \phi_{Z_i}(Z^*;\Pi,M,\beta) \text{ for all i.} \qquad (3.25)$$

Equation (3.24) and (3.25) imply that for any given characteristic combination (Z), a consumer with the highest WTP for a combination of characteristics will purchase from a firm that is the lowest cost producer of that combination.

Figure 3.3

General Equilibrium of Hedonic Price Function in an Implicit Market of *Z*

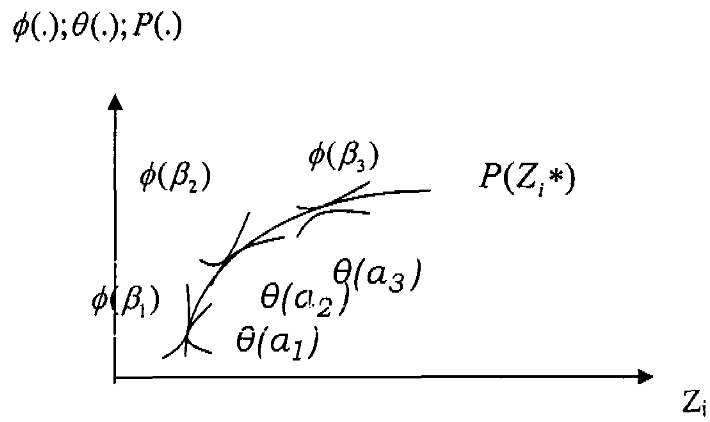
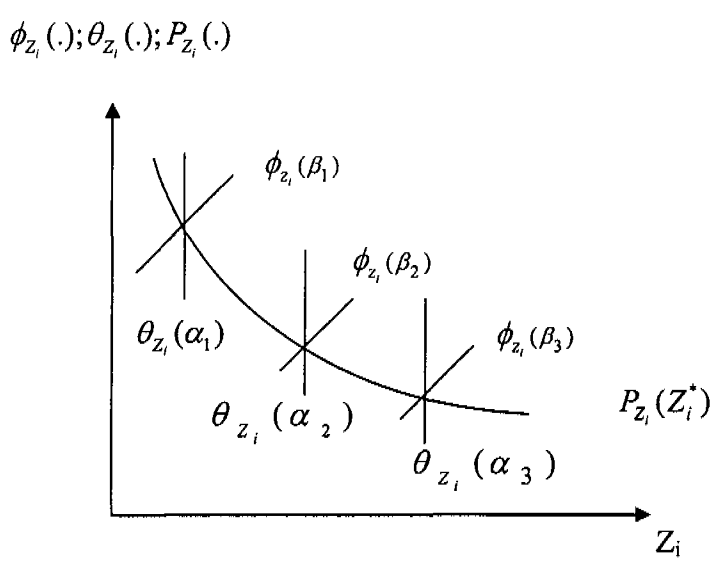


Figure 3.4

General Equilibrium of Marginal Implicit Price Function for the i^th attribute



From Rosen's Approach, to estimate the marginal implicit price, first, it requires the estimation of the demand and supply functions simultaneously in order to obtain the hedonic price function, P(Z).

where $P_{Z_i}(Z) = \theta_{Z_i}(Z;\alpha)$ demand function (3.26)

and $P_{Z_i}(Z) = \phi_{Z_i}(Z;\beta)$ supply function. (3.27)

The reduced-form price function, P(Z), can be estimated, regardless of α and β, by regressing observed property prices, P, on all of their characteristics Z using the best functional form. Second, by denoting the estimated function P(Z) by P($\hat{Z}$), a set of marginal implicit price, P_{Z_i}, evaluated for the characteristic Z_i can be computed by differentially P($\hat{Z}$) by the attribute of interest (Z_i).

3.2 Application of the Implicit Price

The way to estimate the environmental cost due to risk perception and disamenity associated with Phuket incinerator is to estimate a compensated demand function for the environmental attribute (DIST) by regressing the implicit price function of environmental attribute on the level of environmental attribute, household income, and other household characteristics. After that, we take an integral of the area under the compensated demand function between two levels of environmental quality in order to derive the environmental cost (Yang, 1996).

Yang (1996) also indicated that, as shown in Figure 3.4, the implicit price function is formulated from a series of locus points between many marginal bid functions or willingness to pay functions ($\theta_{Z_i}(\alpha)$) and offer functions ($\phi_{Z_i}(\beta)$), so the implicit price function is not a demand function. However, if all consumers have identical utility function and incomes, every point in implicit price function come from one bid function. Thus, the implicit price function can be indicated as demand function under strong assumptions.

As a result, the study adopts the implicit price function as the uncompensated demand function to estimate the environmental cost.