Chapter 3
Methodology

3.1 Conceptual Framework

Hedonic pricing method (utility valuation method) has been applied into various kinds of market to measure the utility of the goods for a long history. Court was considered as the first person who made a formal contribution to hedonic price theory in 1941, even though a few other informal studies had already appeared. From the meaning of words, the term "hedonics" is derived from the Greek word *hedonikos* which simply means pleasure. In economics, the hedonic refers to the utility consumers can get from the goods and services.

The foundation of hedonic pricing method is assumed that a commodity is considered as an aggregation of individual components or attributes, the price of a marketed good derived from its related characteristics, or services it provides. In other words, the price of a commodity is determined by a combination of its attributes that directly effect on its market price. Therefore, the value of a commodity can be evaluated by the implicit value of individual characteristics relate to such commodity by looking at how the consumers are willing to pay for its changes when the characteristics change. The hedonic pricing method is most often used to value environmental amenities that affect the price of residential properties. It is most commonly applied in the housing market to estimate the implicit price of individual characteristic that related to the housing unit.

The hedonic pricing model refers to the property values, involves a two stage

estimation process. The first stage relies on the relationship between property value and the characteristics of properties. The second stage estimates the demand functions by utilizing the marginal price obtained from the first stage hedonic price function. The partial derivative of the above hedonic function with respect to any attribute is the implicit marginal attribute price, ceteris paribus. The parameters correspond to the implicit price of characteristics, respectively.

The applications of the hedonic pricing model in the real market are generally based on the following assumptions:

1. The products are heterogeneous goods which combined with the bundles of the different characteristics.

2. The market operates under a perfect competitive market and there are numerous buyers and sellers. The impact from individuals can be ignored.

3. Buyers and sellers have perfect information on the goods.

4. Market is at equilibrium. There are no interrelationships between each implicit price of attributes.

Even though these assumptions of the hedonic pricing model is difficult to completely satisfied in the real housing market, the hedonic pricing model is still the most widely used in housing market worldwide.

The hedonic function related to the housing attributes, typically, the housing attributes are classified into locational attribute (L), structural attribute (S), and neighborhood attribute (N). Each attribute encompass the related characteristics of the property, which measured both in quantitative and qualitative method (Chin Tung Leong 2003).

The function of the market prices (P) of the property, therefore, can be

expressed as:

$$P = f(L_i, S_j, N_k)$$

Where,

P is the market price of the housing

L_i is the locational attributes i of the housing

S_j is the structural attributes j of the housing

N_k is the neighborhood attributes k of the housing

The partial derivative of the above hedonic function with respect to each attribute is the implicit marginal attribute price, ceteris paribus (Rosen, 1974). The marginal price of these characteristics can be denoted:

$$P^L_i = \partial P / \partial L_i$$

$$P^S_j = \partial P / \partial S_j$$

$$P^N_k = \partial P / \partial N_k$$

According to the hedonic model, the basic function form can be written as:

$$P = \sum_{i=1}^{l} P^L_i L_i + \sum_{j=1}^{n} P^S_j S_j + \sum_{k=1}^{m} P^N_k N_k$$

The market price of the housing unit is considered as the dependent variable which depends on a bundle of housing characteristics that relate to the locational, structural, and neighborhood attributes of the housing.

3.2 The functional form of hedonic pricing model

The application of the hedonic pricing model refers to the selection of the functional form. Generally, there are three kinds of functional form which can be applied into the hedonic model.

1. Linear functional form:

$$P = \alpha_0 + \sum \alpha_i C_i + \varepsilon$$

Where,

P is the market price of the housing

C_i is the characteristics of the housing

a_0 is the constant coefficient

a_i is the coefficient of the variables

ε is the error term

The linear functional form is the most simple and direct one, which represent that one unit change of the characteristic will cause the change of the housing price by such characteristic.

2. Log-log / double log functional form:

$$lnP = \alpha_0 + \sum \alpha_i lnC_i + \varepsilon$$

The double-log form is one of the common functional forms. All the variables are the log form in the function. The regression coefficient correspond to the elasticity of the characteristic price, ceteris paribus, one percent change in one characteristic will cause the percentage change of the housing price by this characteristic.

3. Semi-log functional form:

$$lnP = \alpha_0 + \sum \alpha_i C_i + \varepsilon$$

The semi-log functional form is a variant of the double-log equation in which some but not all of the variables (dependent and independent) are expressed in terms of their natural log. The application of the semi-log form is quite frequent in economics and business. The right side of the equation (independent of the variables) is the linear form, and left side (dependent variable) is the log form, the regression coefficient corresponds to the increasing rate change of the characteristic price by per

unit change of the characteristic.

3.3 Selection of the variables

3.3.1 General housing characteristics

From the previous studies, there were many housing characteristics selected by the researchers, however, the preferences on housing characteristics in the housing market are distinguished in different places due to the various natural and social economic features. Accordingly, the general housing characteristics in former studies combined with the household preference in Kunming by questionare A (Appendeix) lists as follows:

Table 3.1 The housing attributes in former study and their preference in Kunming

	Attribute	Attribute preference
Locational	Accessibility to CBD	Yes
	View	No
	Traffic condition	Yes
Structural	Number of rooms, bedrooms, bathrooms	Yes
	Floor area	Yes
	Floor level	Yes
	Garage	Not applicable
	Water/ Air heating system/Fireplaces	Not applicable
	Cooling systems/Central air conditioning	Not applicable
	Structural quality (e.g., design, materials, fixtures)	Yes
	Age of the building	Yes
	Orientation	Yes
Neighborhood	Socio-economic status of residents	No
	Education (e.g. proximity to school)	Yes
	Environment quality around the communities (e.g. Crime rate, noise and pollution)	Yes
	Inner environmental quality of the communities (e.g. landscape, cleanliness)	Yes
	Life establishments (e.g. Shopping center, restaurant, hospital)	Yes
	Entertainment facilities (e.g. park, cinema, sports hall gymnasium, museum)	Yes
	Places of worship (e.g. mosques, churches, temples)	No

Source: Chin and Chau(2003), Hai-zhen Wen , Sheng-hua Jia , Xiao-yu Guo (2005)

3.3.1 Locational attribute

Location is always considered as a pivotal housing attribute which direct determine the accessibility to the CBD and traffic condition of the housing unit. The view of the housing unit is not concerned by the households according to the survey in Kunming.

The accessibility to Centre Business District (CBD) is always considered as an essential characteristic to estimate the value of a housing unit. More precisely, CBD is the core of a city and is the concentration of a city's economic, technological and cultural forces by concentration of the retail and high commercial buildings. CBD normally has the functions of finance, trade, services, exhibitions, consulting and so forth, which combine together perfectly under the conditions of the municipal transportations and communications. Thus, the housing units which are located at the shorter distance to CBD experience more convenience.

Few households concern the view of housing units as homogeneity of the condominiums. A few studies found that views are classified by the three types, water view, and mountain view, and the valley view (Benson, 1998). In another way, views also can be considered as the positive view and negative view. A positive view can make households feel comfortable, relaxed and happy by being surrounded by scenery such as sea, mountains, and green space, whereas, a negative view makes people feel depressed, disgusted, dispirited, by being surrounded by scenery such as cemeteries, crematoriums and funeral parlors.

Traffic conditions frequently associated with the commuting cost both on time and money to the destinations such as workplaces, educational facilities, life establishments, and entertainment facilities. The public transportation services such as subways and public buses have a great impact on households' preference on housing. Some consumers are willing to pay more to reduce the cost of traveling time. The public bus transportation system is very convenient in Kunming, local bus route services cover the whole urban area of Kunming with nearly 200 bus routes at a economical price. The public buses have become a key traffic tool in people's daily

life in Kunming. Therefore, the number of bus routes nearby is considered as an indicator of traffic convenience of a housing unit. The closer to the bus station and more choice of the bus routes, the more valuable of the housing.

3.3.2 Structural attribute

The structural attributes refer to characteristics of floor area, the number of bedrooms and bathrooms, garage, water or air heating system/fireplaces, cooling systems/ central air conditioning, structural quality, age of the building and housing orientation. Of which, the garage, water or air heating system/fireplaces, cooling systems/central air conditioning are not applicable in city of Kunming.

Floor area (m^2) of the housing units is directly determined the living space for the households and also has an influence on the number of rooms in a housing unit.

The floor of the housing units was differs in consideration depending on households' preference. Households normally dislike the lowest and topmost floor due to the darkness on lowest one and heat in summer on the topmost floor by survey. But some households thought that the higher the level of housing floor, the more substantial the amount of natural light and the better view quality there is. Additionally, some households choose the housing floor by lucky numbers, for example, six and eight are considered as the lucky for some households. In contrast, households avoid culturally unlucky number such as four which has a similar pronunciation in Chinese as the word of death, and thirteen is thought to be a taboo in some western cultures.

Garage is not applicable for the condominiums. Normally, there is a certain ratio of parking space in the communities for the households, the price of which not include in the selling price of the housing.

Structural quality of the housing units usually is evaluated by the combination of three factors: design, materials, and fixture. The design relates to the artistic and *fengshui* of the housing unit. People prefer the beautiful and fashionable housing design. The construction materials effect on the security and lifetime usage of the housing unit. Better materials used correspond to the sturdiness of the housing constructions. Fixtures are considered as the necessary equipment in a housing unit, which is associated with the convenience for the households.

Orientation has an effect on the amount of nature lighting of the housing unit. Households normally have a greater preference on south-facing orientation of the housing unit, geographically due to the housing units of southern orientation are warmer in winter compared with the housing units with other directional orientation. Culturally, this preference is influenced by the historical arrangements that the seating and living rooms of most Chinese emperors being of southern orientation in ancient China.

Age of the housing units has a direct influence on the tenure of housing unit, determines the future length of usage. The older of the housing units would incur some extra costs on maintenance and reparation due to the ageing of water and electrical systems, which negatively reflect on the value of housing unit.

3.3.3 Neighborhood attribute

The neighborhood attributes of housing units relate to the socio-economic status of neighbors, the environment quality around and inside the communities, the proximity to the educational services, life establishments, entertainment facilities and places of worship.

The socio-economic status of real neighbors, due to it is unpredictability, which is not substantial concerned by most households in Kunming.

The externality of environmental quality around communities refers to crime rate, noise, and pollution. The crime rate is judged by the frequency of theft, robbery, violent issues and murder cases occurred around the communities and greatly affects households security of life and property. Noise comes from the traffic and airports which disturb the households' quality of sleeping. Pollutants of smoke and dust in the air are harmful to the households' health.

The inner environmental quality of the communities evaluate by the combination of public green space, security and cleanliness. Green flora in the communities can improve the air quality. Public security is an essential factor of consideration for households' life and property, the public cleanliness effects on living conditions of the households within a community. In short, households prefer a clean, peaceful and quite environment in the community.

Proximity to life establishments (e.g. the supermarket, restaurant, bank, post office) has a direct influence on households' daily life. Housing units is proximate to life establishments has greater convenience. The supermarket is an indispensable facility in households' daily life which has a great impact on households' preference. Restaurants can save the time households spending on cook meals. A bank is integral to offer various kinds of financial services households require. A post office is an amenity that is convenient for households to send letters or require mailboxes.

Education is considered as a crucial part in one's life. Thus, proximity to the schools is of concern to households, especially households with children.

Entertainment is an indispensible part of household's life. The accessibility to

entertainment destinations (e.g. park, cinema, gymnasium, and museum) is concerned by the households. Parks are the main public places of leisure which often providing the source of natural and beautiful landscapes. They are the good choice for households to spend their holidays or free time to go for a walk after dinner. A cinema is a popular entertainment facility for households to enjoy the newest films, especially for avid film-fans. A museum is a public institution which has collected enormous exhibitions of artifacts with historical value that can broaden the households' outlook. Gymnasiums offer different facilities for households to do the exercise during leisure time to keep healthy.

The places of worship refer to mosques, churches, temples for religious activities. With the development of science and technology, and modern social trends, religious activity is less frequently encouraged by households in many modern cities.

3.3.2 Selection of the characteristics

This study selects 12 housing characteristics as the independent variables measured in quantitative and qualitative methods. The measurement of characteristics and the expected relationship between the housing price and these characteristics are list in table 3.2.

Table 3.2 The measurement of housing characteristics and the expected sign related to housing price

	Characteristics Variable	Measurement	Sign
Locational attributes	Distance to CBD ($Z1$)	The linear distance to the Central Business District (CBD) is approximately scaled by each 500 meters in Kunming	−
	Traffic condition($Z2$)	The total number of bus routes within 500 meters around the communities	+
Structure attributes	Floor area ($Z3$)	Total floor area of the housings units (square meter)	+
	Housing age ($Z4$)	The age of the housing units counted from the year built	−
	Orientation ($Z5$)	Most windows facing direction	+
	Floor ($Z6$)	Floor level of the housing unit	?
	Structural quality ($Z7$)	The structural quality is evaluated by the combination of design, materials, and the fixtures of the housings, which is measured by the satisfaction of owners according to the 5-points Likert scale	+
Neighborhood attributes	Environment quality around the communities ($Z8$)	The environmental quality level around the communities are evaluated by the combination of the crime rate, traffic noise and the air pollution, which is measured by the satisfaction of owners according to the 5-points Likert scale	+
	Inner environment of the communities ($Z9$)	The inner environmental quality of the communities are evaluated by combination of the green area, management, and cleanliness, which is measured by the satisfaction of owners according to the 5-points Likert scale	+
	Total distance to the nearest life establishments ($Z10$)	The total distance to the community to the nearest supermarket, restaurant, bank, post office, hospital from the community	−
	Total distance to the nearest educational services ($Z11$)	The total distance from to community to the nearest kindergarten, elementary school, middle school, college/university from the community	−
	Total distance to the nearest entertainment facility ($Z12$)	The total distance to the community to the nearest park, cinema, museum/library, gymnasium	−

Source: create by author

3.4 Model and Hypotheses

3.4.1 Model

The model can be constructed according to the selective variables by three function form as follows:

Model 1: linear functional form

$$P = \beta_0 + \sum_{i=1}^{n=12} \beta_i Z_i + \varepsilon$$

Model 2: log-log form/ double log functional form

$$lnP = \beta_0 + \sum_{i=1}^{n=12} In\beta_i z_i + \varepsilon$$

Model 3: Semi-log functional form

$$lnP = \beta_0 + \sum_{i=1}^{n=12} \beta_i Z_i + \varepsilon$$

3.4.2 Hypotheses

The housing characteristics can be classified into locational attributes (L), structural attributes (S) and neighborhood attributes (N). The price of housing units are considered as a dependent variable which is a function of the locational attributes, structural attributes, and the neighborhood attributes.

The locational attributes are defined as the distance to the Central Business District (CBD) and traffic condition. The distance to CBD is expected to have a negative relationship with the housing price, and the traffic condition, which is measured by the selective number of bus routes within 500 meters, is expected to have a positive relationship with the housing price.

The structural attributes are defined as the floor area, the age of the housings, the housing orientation, floor level and structural quality. The floor area, housing orientation and the structural quality are expected to have a positive relationship with

the housing price, on the other hand, the housing age is expected to have a negative relationship with the housing price.

The neighborhood attributes are measured by the environmental quality surrounding the communities and the inner of the communities, the total distance to the nearest life establishments, educational services and the entertainment facilities. The environmental quality around or inner of the communities are expected to have a positive relationship with housing price and the total distance to the nearest life establishments, educational services and entertainment facilities are expected to have a negative relationship with housing price.

3.6 Data Collection

According to the assumptions of the hedonic model, the housing units are heterogeneous products, which combine of different characteristics. Secondly, the market operates under the perfect competitive market, in which there are many buyers seeking housing units, and numerous sellers supplying the housing units. These buyers and sellers are both freely to enter and leave the market and well informed on the housing characteristics in the housing market.

The housing market in Kunming is generally fit for the assumptions of the hedonic model. The housing transactions were relatively active in 2009 and the transacted price relative stable as well. According to the Statistics Bureau of the Housing Agency in Kunming, the multiple transaction quantity of real estate during 2009 was 78,201 units. According to Taro Yamane's formula (Yamane, 1973), the following calculation was made,

$$n = N/(1+Ne^2)$$

Where,

n is sample size

N is the population size

e is the error of sampling

The sample size has been calculated out as follows:

$$n=78,201/\{1+78,201\ (0.07)^2\} =204,$$

With N=78,201, e=7% (at 93% confidence level), the scope of study focuses on the housing units which were transacted during 2009 in urban area of Kunming, the housing type of condominium was isolated to ensure the homogeneity of the samples. The research chose 204 housing samples which were transacted during 2009 in the housing market of Kunming to establish the index.

The data collection consists of two stages. The first stage is to interview the authority departments of housing administration and the professional real estate agencies in Kunming to get the housing samples which fit for the research scope. The second stage is field surveys which include questionnaire surveys of the sample households along with the measurement, scaling, and evaluation of the characteristics of sample housing units by arriving to these communities.

3.7 Data analysis

This research used Multiple Regression by Ordinary Least Square (OLS) method which runs into the SPSS 16.0. The OLS is the most widely used method utilized to estimate the fitness of the model, which has been considered as a standard of quality compared with the other techniques. Specifically, the multiple regression coefficients indicate the changes in the dependent variable associated with a one-unit

change in an independent variable by holding the other independent variables as the constant.

Descriptive statistics, which is a data analysis technique that describes the minimum, maximum, mean, the standard deviation, and the variance statistics of the sample data. It is used to analysis the minimum, maximum, mean and the standard deviation of variables in this study.

Cross tabulation, the statistical technique that establishes the relationship between the two variables. In this study, cross tabulation is used to compare the relationship between each housing characteristic and housing price.