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An Estimation of the Impact of Feng-Shui on Housing Prices in Taiwan：A Quantile Regression Application

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Feng-shui is an old and traditional body of knowledge in Chinese society. Feng-shui has a significant influence on many aspects in daily life for most Chinese, including choosing locations for dwelling units, offices, burial sites, and so on. However, there have been few studies on the impact of feng-shui on housing prices. By applying a housing hedonic equation and a data set of 77,624 observations in Taiwan, we have attempted to estimate the impact of feng-shui on housing prices. We find that all six types of bad feng-shui have a significantly negative impact on housing prices. Moreover, by applying a quantile regression, we find that most of the bad feng-shui has a stronger negative impact on expensive dwelling units. Our findings confirm that people who buy expensive housing units care about feng-shui more than those who buy less expensive housing units. .

Keywords:

Feng-shui; Hedonic Equation; Quantile Regression

1. Introduction

Feng-shui is a general term that depicts certain conditions of a local area, including weather, geology, landscaping, environment, and even sometimes, taboos in buildings.[1] Although some Chinese people feel that feng-shui is a mysterious phenomenon, with improvements in technology and social progress, there are still lots of Chinese people who believe that feng-shui continues to be an important factor that affects their daily behavior, such as buying a house, choosing a burial site, and so on. Lu (1999) discusses the reasons why some Chinese people believe that feng-shui is a mysterious phenomenon. Since there are so many sub-streams (namely, feng-shui occultism) and each sub-stream has its own way of explaining this phenomenon, it is difficult for ordinary people to understand what is true and what is not. Therefore, people are inclined to believe that feng-shui is simply a way that a feng-shui master deceives the public.

Yet, in a modern society like Taiwan, why are there still so many of people who believe in feng-shui? Confucius once said: "As time goes by in a year, everything grows up." In ancient Chinese agrarian society, farmers followed the seasons to tend to their crops and reap their harvest. Tung (179-104 B.C.) in the Han dynasty also said: "The environment and people should get around as one group." This means that humans should work with the environment. In other words, feng-shui originates from the daily life of people. For example, people who want easier access to water should live near a river and those who want to avoid strong winds should live near the mountains. In modern society, individuals are so busy that they often face immense stress and are easily frustrated and alienated. Therefore, they are inclined to seek help from feng-shui so that they could find something to save their souls and help them avoid bad luck, or even become rich and famous. As an architect, Han (2006) finds that feng-shui is very popular. When he designs a house, he asks the owner which direction the building should face with respect to feng-shui.

There is some literature that discusses the impact of feng-shui on people's daily lives and especially on housing demand. Lu (2000) finds that even the prime minister of the UK invited a feng-shui master to apply feng-shui techniques for him when he was constructing his new office. Bourassa and Peng (1999) apply a data set taken from a Chinese community in New Zealand and find that home addresses with different numbers could have significant impacts on housing prices.[2] Moreover, Tam, Tso, and Lam (1999) use the definition of facing a river and the back leaning on a mountain as an

[1] For a detailed discussion of the definition of feng-shui, one may refer to Hu (1999).
[2] For example, four is a bad number for Chinese people because the pronunciation of "four" is similar to "death" in Mandarin, so people do not like to have "four" in their home address.

index for feng-shui and find that feng-shui has a significant impact on the housing prices in their data set from Hong Kong.

In the Taiwanese housing market, Lin (2007) finds that bad feng-shui may reduce the housing price by 10% on average. Bai et al. (2004) discuss the types of bad feng-shui that homebuyers care about the most, including lu-chun, double-layer road, and dead-end road, etc.3 In the application of a data set from Taichung city, Chen (2004) confirms that lu-chun has a significant impact on housing price. Huang et al. (2005) find that with bad feng-shui, a home seller may reduce the asking price by 6% to 8%. Chuang and Hwa (2008) find that the impact of feng-shui on home buying decisions is dependent on the age of the buyer, but independent from gender, education, and religion.

Moreover, some undesirable facilities are also taken as bad feng-shui in Taiwan. Lee and Ho (1996) have conducted a survey in Taipei to study attitudes toward some of the undesirable facilities, such as funeral parlors, crematories, and cemeteries. Chen (2002), Yang (2003), and Liao (2005) all discuss how Chinese people try to avoid living near death-related facilities. They all agree that it is bad feng-shui for a dwelling unit to be in close proximity to funeral parlors, crematories, and cemeteries.

Since it is clear that Chinese people care very much about feng-shui when they buy or build a new dwelling unit, it is interesting to determine the impact of feng-shui on the price of a dwelling unit. Moreover, Chu (1999) finds that the richer and more famous care about feng-shui more than their less well off peers. So, we would also like to see if the impact is different for dwelling units with different prices. In this study, we apply a large data set with 77,624 dwelling units in Taiwan to estimate the actual impact of feng-shui on housing prices. In order to investigate the magnitude of the impact for different housing units with different prices, we also employ a quantile regression model to estimate our data set.

The paper is constructed as follows: Section 1 is the introduction and literature review. In Section 2, we introduce the hedonic equation and the quantile regression model. The definitions of variables and basic statistics of the data set applied in this study are shown in Section 3. The empirical results are discussed in Section 4. We conclude this study in Section 5.

[3] Lu-chun means that a dwelling unit is facing the road in a direct way. For example, a dwelling unit located at the end of dead-end road and directly facing the road so that people in the house could see the entire street.

2. A Quantile Regression on Housing Price

Rosen (1974) has written a seminal paper on the hedonic model, in that the total price of a house is determined by its characteristics and underlying shadow price for each characteristic.[4] Following the model produced by Rosen (1974), we set up our regression model as a semi-log form as follows:[5]

$$\begin{aligned} LPRICE_j = {} & \beta_0 + \beta_1 SPACE_j + \beta_2 RWIDE_j + \beta_3 AGE_j + \beta_4 FLOOR1_j \\ & + \beta_5 TOPFLOOR_j + \beta_6 GARAGE_j + \beta_7 RATEPUB_j + \beta_8 STEEL_j \\ & + \beta_9 NIMBY_j + \beta_{10i} FS_{kj} + \beta_{11l} YEAR_{lj} + \beta_{12m} TYPE_{mj} + \beta_{13n} CITY_{nj} + \varepsilon_j \end{aligned} \tag{1}$$

where

$LPRICE_j$: log of total price of a dwelling unit *j*,

$SPACE_j$: floor space,

$RWIDE_j$: width of road,

AGE_j : age of dwelling unit,

$FLOOR1_j$: whether the dwelling unit is located on the first floor,

$TOPFLOOR_j$: whether the dwelling unit is located on the top floor,

$GARAGE_j$: whether the dwelling unit comes with a garage,

$RATEPUB_j$: rate of public space,

$STEEL_j$: whether the dwelling unit *j* is made with steel,

$NIMBY_j$: whether the dwelling unit *j* is near an unwanted public facility,

FS_{kj} : whether the dwelling unit is near bad feng-shui *k*,

$YEAR_{lj}$: the *l*-th year of transaction, including 2002, 2003, 2004, 2005, 2006, and 2007,

$TYPE_{mj}$: *m*-th types of building, including efficiency, apartment, high building, single house, and public housing, and

$CITY_{nj}$: *n*-th county to which the dwelling unit belongs.

According to Chu (1999) and Lu (2000), the marginal effect of feng-shui on housing prices could be different for households with different income levels.

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[4] There is much literature that applies the hedonic model to estimate the total house price, such as Goodman (1978), Goodman and Kawai (1982), Lin (1993), and Kao (2000).

[5] There are several literatures that apply a semi-log function form, such as Follain and Malpezzi (1980), Soderberg (2001), Sirmans, MacPherson, and Zietz (2005), and Chang (2007).

This implies that the marginal effect of feng-shui on housing prices for houses with different prices could be different, too, since affluent households usually buy more expensive houses. In order to capture the different impacts of feng-shui on housing prices, we apply a quantile regression here, since ordinary least squares (OLS) can only show the mean effect of feng-shui on housing price.

The quantile regression was first introduced by Koenker and Bassett (1978). They applied the concept of least absolute deviation (LAD) and provided a more robust estimation model. The object function is a sum of the weighted absolute deviation. For instance, if we try to solve the solution under quantile θ, then the share of the number of observations for data less than and above θ will be θ and 1-θ. Then, the deviations have weights of 1-θ and θ. Suppose the housing price equation is as follows:

$$\ln p_i = x_i'\beta + \varepsilon_i, \qquad i = 1, 2, ..., n \tag{2}$$

The objective function for OLS is

$$\min_{\beta} \sum_{i=1}^{n} (\ln p_i - x_i'\beta)^2 \tag{3}$$

where β is the estimated coefficient under OLS. However, the objective function under the quantile regression is as follows:

$$\min_{\beta} \frac{1}{N} \left[\theta \sum_{\ln p_i \geq x_i'\beta} |\ln p_i - x_i'\beta| + (1-\theta) \sum_{\ln p_i \leq x_i'\beta} |\ln p_i - x_i'\beta| \right] \tag{4}$$

The estimated coefficients of the quantile regression of β_θ can be obtained by solving Equation (4). By solving Equation (4), we obtain the marginal effect of each characteristic on the housing price in different "quantiles".[6]

3. Data Description

The data set applied in this study is from the mortgage data set of one of the largest private banks in Taiwan, between 2002 and 2007. The definitions of

[6] For a detailed discussion of quantile regression, one may refer to Kuan (2007). Lately, the quantile regression has been applied in different fields. For example, Chuang and Kuan (2005) have applied quantile regression to the financial market, Hsu (2003) on money demand, Basset and Koenter (1982), Machado and Mata (2005), and Chen and Kuan (2006), and Chen (2006) to the labor market. Finally, Chang and Liao (2006), Zietz, Zietz, and Sirmans (2007), and Chang (2007) have all applied quantile regressions to the real estate market.

the variables are in Table 1 and the basic statistics are in Table 2. In total, there are 76,264 observations in our data set. The data distributions among years and counties are shown in Table 2. One important point that we have to make here for the data set applied in this study is that most of the data are from the five largest cities in Taiwan, including Taipei City, Taipei County, Taichung City, Tainan City, and Kaoshiung City. Table 2 shows that 72.3% of the data observations are from these five cities. Although the mortgage appears to be heavily concentrated in the five major cities, our intuition is that the lending policy for the bank from which applied data is typical for most large private banks in Taiwan. Since the housing markets in the five major cities are generally more prosperous than those of other rural areas in Taiwan, large private banks are more interested in providing mortgages there. Traditionally, people in rural areas who want to obtain a mortgage will usually go to state-owned banks or some other small or private financial institutions, such as credit unions and credit departments of agriculture associations.[7]

In terms of some of the important basic statistics, one may see that the average housing price is NT$4.77 million in Table 2. The average floor space is 38.11 pins, which is a little larger than the average floor space of the total housing units in Taiwan.[8] The average width of the road where the houses are located is 9.67 meters. The average age of the dwelling units is 11.74 years.[9] The average amount of public space is 15.8%.[10] Moreover, the percentage of housing units with garages is 19.6%, which is much lower than that of the total housing units in Taiwan (51.3%). [11]

[7] Since we do not have the total distribution of the total housing mortgage in Taiwan, we could not run a test to see if the regional distribution of data is similar to that of the population.

[8] One pin is equal to 36 square feet. According to Social Indicators, published by Directorate General of Budget, Accounting and Statistics (DGBAS), Executive Yuan, Taiwan, the average floor space in 2005 of the total housing units in Taiwan is 35.9 pins.

[9] Again, according to Social Indicators, the average age of the total dwelling units is 17.5 years in 2005. It is common to see that the average age of the dwelling units in the market is higher than that as a whole.

[10] Since there is no data in the census, we have no idea about the average figure for the total housing units in Taiwan. Traditionally, the amount of public space for a single unit is zero, 10% for a five-floor apartment, and 30% for an apartment that is in a high building. Since there are more and more high rises constructed in Taiwan, the average of the total amount of public space should be quickly increasing.

[11] Since most observations in our data set are from the five major cities and parking space is much more expensive there, the average rate of having a garage is lower in our data set.

Table 1 Definitions of Variables

Variables	Descriptions of variables	Expected sign
PRICE	Total price in transaction	-
SPACE	Total floor space	+
RWIDE	Width of the road	+
AGE	Age of the dwelling unit	-
FLOOR1	if the house is located on the first floor, then FLOOR=1; otherwise FLOOR =0	+
TOPFLOOR	If the house is located on the top floor, then TOPFLOOR=1; otherwise TOPFLOOR=0	+
GARAGE	If there is a garage, then GARAGE=1; otherwise GARAGE=0	+
RATEPUB	The percentage of public space in a dwelling unit	-
STEEL	If the dwelling unit is made of steel, then STEEL=1; otherwise STEEL=0	+
NIMBY	If the house is located near an unwanted public facility, then NIMBY=1; otherwise NIMBY=0	-
FS1	If the house is on lu-chun, then FS1=1; otherwise FS=0	-
FS2	If the house is located on a dead-end road, then FS2=1; otherwise FS2=0	-
FS3	If the house is near a viaduct, then FS3=1; otherwise FS3=0	-
FS4	If the house is near a cemetery or a funeral parlour, then FS4=1; otherwise FS4=0	-
FS5	If the house is near a shrine or a temple, then FS5=1; otherwise FS5=0	-
FS6	If the house is located on the fourth floor, then FS6=1; otherwise FS6=0	-
YEAR	year dummies, 2007 is the reference group	
	if 2002, then YEAR1=1; otherwise YEAR1=0	
	if 2003, then YEAR2=1; otherwise YEAR2=0	
	if 2004, then YEAR3=1; otherwise YEAR3=0	
	if 2005, then YEAR4=1; otherwise YEAR4=0	
	if 2006, then YEAR5=1; otherwise YEAR5=0	

(Continued…)

(Table 1 continued)

TYPE	type of building, (The reference group is the high building.)				-/+
	Type1=1	EFFICIENCY	Type1=0	otherwise	
	Type2=1	APARTMENT	Type2=0	otherwise	
	Type3=1	SINGLE HOUSE	Type3=0	otherwise	
	Type4=1	VILLA	Type4=0	otherwise	
	Type5=1	PUBLIC HOUSE	Type5=0	otherwise	
CITY	If the dwelling unit belongs to the county, then city=1, otherwise city=0 (the reference group is Taipei County).				
	City1=1	Keelung City	City1=0	otherwise	
	City2=1	Taipei City	City2=0	otherwise	
	City3=1	Taoyuan County	City3=0	otherwise	
	City4=1	Hsinchu City	City4=0	otherwise	
	City5=1	Hsinchu County	City5=0	otherwise	
	City6=1	Miaoli County	City6=0	otherwise	
	City7=1	Taichung City	City7=0	otherwise	
	City8=1	Taichung County	City8=0	otherwise	
	City9=1	Nantou County	City9=0	otherwise	
	City10=1	Changhua County	City10=0	otherwise	
	City11=1	Yunlin County	City11=0	otherwise	
	City12=1	Chiayi City	City12=0	otherwise	
	City13=1	Chiayi County	City13=0	otherwise	
	City14=1	Tainan City	City14=0	otherwise	
	City15=1	Tainan County	City15=0	otherwise	
	City16=1	Kaohsiung City	City16=0	otherwise	
	City17=1	Kaohsiung County	City17=0	otherwise	
	City18=1	Pingtung County	City18=0	otherwise	
	City19=1	Hualien County	City19=0	otherwise	
	City20=1	Yilan County	City20=0	otherwise	

Source: This study.

Table 2 Basic Statistics

Variables	Mean	S. D.	Minimum	Maximum
PRICE (NT$0,000)	477.1	411.9	11.7	19367
SPACE (square pins)	38.1	17.3	5.4	312.4
RWIDE (meters)	9.7	7	1.2	80
AGE (year)	11.7	9.9	0	54.67
FLOOR1 (%)	5.5	22.7	0	100
TOPFLOOR (%)	13	33.7	0	100
GARAGE (%)	19.6	39.7	0	100
RATEPUB (%)	15.8	13.3	0	87.7
STEEL (%)	0.2	4.9	0	100
NIMBY (%)	2.2	14.7	0	100
The house is on lu-chun (FS1) (%)	1	-	0	1
The house is located on a dead-end road (FS2) (%)	1.8	-	0	1
The house is near a viaduct (FS3) (%)	1.4	-	0	1
The house is near a cemetery or a funeral parlor (FS4) (%)	0.4	-	0	1
The house is near a shrine or a temple (FS5) (%)	1.3	-	0	1
The house is located on the fourth floor (FS6) (%)	9.1	-	0	1
EFFICIENCY (%)	2.6	-	0	1
APARTMENT (%)	24.3	-	0	1
HIGH BUILDING (%)	50.4	-	0	1
SINGLE HOUSE (%)	16.8	-	0	1
VILLA (%)	3.2	-	0	1
PUBLIC HOUSE (%)	2.8	-	0	1
Keelung City (%)	1.5	-	0	1
Taipei City (%)	12.3	-	0	1
Taipei County (%)	22.4	-	0	1
Taoyuan County (%)	10.7	-	0	1
Hsinchu City (%)	2.3	-	0	1
Hsinchu County (%)	2.2	-	0	1
Miaoli County (%)	0.9	-	0	1
Taichung City (%)	11.8	-	0	1
Taichung County (%)	3.5	-	0	1
Nantou County (%)	0.2	-	0	1
Changhua County (%)	2.7	-	0	1
Yunlin County (%)	0.5	-	0	1
Chiayi City (%)	1.1	-	0	1
Chiayi County (%)	0.4	-	0	1
Tainan City (%)	5.6	-	0	1
Tainan County (%)	3.7	-	0	1
Kaohsiung City (%)	10.2	-	0	1
Kaohsiung County (%)	3.7	-	0	1
Pingtung County (%)	0.9	-	0	1
Hualien County (%)	1.9	-	0	1
Yilan County (%)	1.3	-	0	1

(Continued…)

(Table 2 continued)

Variables	Mean	S. D.	Minimum	Maximum
2002 (%)	11.5	-	0	1
2003 (%)	11.7	-	0	1
2004 (%)	29	-	0	1
2005 (%)	30.6	-	0	1
2006 (%)	10.1	-	0	1
2007 (%)	7.1	-	0	1

Source: This study.

In terms of type of housing unit, Table 2 shows that about half (50.4%) of the housing units are located in high-rises, while 24.3% of the housing units are located in five-floor apartments. Traditionally, most apartments are located in five-floor buildings in Taiwan.[12] Moreover, 16.8% of the housing units are single houses and most of them are located in central and southern Taiwan.

Since this study is focused on the impact of feng-shui on housing prices, here, we would like to discuss in detail on how feng-shui may affect housing prices.

(1) Lu-chun: according to feng-shui, a household that lives in a dwelling unit with lu-chun may have a higher chance of losing money and may easily become injured. Bai et al. (2002), Huang et al. (2005), and Lin (2007) have conducted surveys and confirm that Chinese people do not like to live in a house with lu-chun. The study by Chen (2004) also finds that lu-chun has a negative impact on housing price. We conclude that, other things being equal, a house with lu-chun should have a lower price.

(2) Dead-end road: in a dead-end road, “chi” cannot freely flow and there might be stagnant ”chi”.[13] Therefore, people who live on a dead-end road will have fewer chances to gain wealth and fame. Since Chinese people do not like to live on a dead-end road, we expect that a dwelling unit located on a dead-end road will have a lower price.

(3) Near a viaduct: if a house is near a viaduct, it appears that the house is cut by the viaduct and so the household inside the house will feel uncomfortable and even may find it difficult to sleep. Therefore, the impact of a viaduct on housing price should be negative too.

[12] According to the Building Technology Regulation, published by the Ministry of Interior Affairs of Taiwan since 1945, an elevator is required for a new building if it is higher than five floors. Since then, most apartment buildings have five floors.

[13] In Daoism, “chi” is a kind of energy which could float around inside the human body or in space.

(4) Near a cemetery or funeral parlor: if a house is near a cemetery or a funeral parlor, it may easy to gather yin-chi.[14] Since most Chinese people do not like yin-chi, we expect that cemeteries and funeral parlors should have a negative impact on housing price.

(5) Near a temple or shrine: if a dwelling unit is near a temple or shrine, it may have to endure more noise pollution and also more air pollution too.[15] Therefore, the housing price near a temple or a shrine should be lower.

(6) Located on the fourth floor: since the pronunciation of "four" is similar to "death" in Mandarin, traditionally, "four" is a bad luck number. Therefore, we expect that the price of a dwelling unit located on the fourth floor should be lower than a dwelling unit located on other floors.

In Table 3, we find that the average prices for houses with lu-chun, located on a dead-end road, near a temple or shrine, or on the fourth floor are lower than those otherwise. However, the average prices for dwelling units near a viaduct or cemetery or funeral parlor have higher average prices than those otherwise. We guess that a possible reason for these scenarios in our data set is because most houses near a viaduct, cemetery, or funeral parlor in our data set are located in downtown and therefore, their average prices are higher.

Table 3 Average Housing Prices with Different Kinds of Feng-shui
Unit: NT$10,000

FENG-SHUI	Sample	Size Mean	SD
The house is on lu-chun	762	454.89	224.56
The house is not on lu-chun	76862	477.29	413.32
The house is located on a dead end road	1402	397.58	270.78
The house is not located on a dead end road	76222	478.54	413.90
The house is near a viaduct	1048	615.97	470.08
The house is not near a viaduct	76576	475.17	410.72
The house is near a cemetery or a funeral parlor	306	511.26	291.52
The house is not near a cemetery or a funeral parlor	77318	476.94	412.30
The house is near a shrine or a temple	1020	438.13	252.43
The house is not near a shrine or a temple	76604	477.59	413.58
The house is located on the fourth floor	7099	410.02	334.58
The house is not located on the fourth floor	70525	483.82	418.29

Source: This study.

[14] Yin-chi is a kind of chi that comes from the death or death related places.
[15] Chinese people like to burn joss paper money to the gods or their ancestors in temples during certain holidays, and this may produce pollution during those days.

4. The Estimation of the Impact of Feng-shui on Housing Price

By applying our data set in Equation (1), the estimated results for both the OLS and quantile regressions are shown in Table 4.[16] The adjusted R-squares in OLS is 0.777, while the pseudo R-squares at different quantiles are between 0.492 and 0.587. Moreover, most estimated coefficients are significant under the 95% significance level. Overall speaking, the estimated results are satisfactory.

FLOOR (0.0187), RWIDE (0.0043), GARAGE (0.1301), FLOOR1 (0.1561), TOPFLOOR (0.0009), and STEEL (0.1618) all have significantly positive coefficients both in OLS and all quantiles as expected. On the other hand, AGE (-0.0055), RATEPUB (-0.0238), and NIMBY (-0.0657) all have significantly negative coefficients both in OLS and all quantiles, which are again consistent with our expectations.

Moreover, it will be interesting to see the changes of the estimated coefficients for some major variables in different quantiles. For floor space, we can see that the coefficient of floor space increases from 0.0189 in the 0.1 quantile to 0.0201 in the 0.9 quantile. This result shows that high-income individuals would like to pay more for larger housing units.[17] The coefficient of road width (RWIDE) also increases from 0.0023 in the 0.1 quantile to 0.0059 in the 0.9 quantile. The result shows that the willingness-to-pay for a wider road increases as the homeowner income increases.[18] The coefficient of AGE decreases from -0.0118 for the 0.1 quantile to -0.0017 for the 0.9 quantile. There are two reasons: first, the depreciation rate for housing units is higher for expensive houses. Secondly, the affluent may pay a higher unit price for newer houses.

The variable of public space shows a negative coefficient (-0.0238) which means that on average, Taiwanese people prefer a house with less public space. However, when we run the quantile regressions, we see quite a different impact that public space has on housing units with different prices. In Table 4, we see that for cheaper houses (quantile 0.1), the coefficient of public space is negative (-0.1393) and then the coefficient gradually becomes positive. In fact, the coefficient of public space becomes 0.0972 with the most expensive houses (0.9 quantile).

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[16] The estimations for the 5 quantiles are shown in Table 4, including the 0.1, 0.25, 0.5, 0.75, and 0.9 quantiles.

[17] In the recent housing market in Taiwan, one can see that there are more and more large housing units sold with higher unit prices. For luxury housing units, the developers intend to build houses with better materials and better design and so on, which also contribute to a higher unit price.

[18] For most cities in Taiwan, a wider road usually means that it is located in downtown or a new town which implies that it is a more expensive area.

Table 4 The Estimation Results of OLS and Quantile Regressions

MODEL	OLS			0.1			0.25			0.5			0.75			0.9		
Variables	Coef.	T-value		Coef.	T-value		Coef.	T-value		Coef.	T-value		Coef.	T-value		Coef.	T-value	
INTERCEPT	5.7624	833.16	***	5.4750	375.71	***	5.6067	636.55	***	5.74	770.54	***	5.8712	627.45	***	5.9702	468.75	***
SPACE	0.0187	243.13	***	0.0189	86.33	***	0.0193	140.81	***	0.02	154.21	***	0.0196	170.50	***	0.0201	124.30	***
RWIDE	0.0043	25.20	***	0.0023	7.96	***	0.0033	17.58	***	0.00	21.81	***	0.0051	20.80	***	0.0059	20.38	***
AGE	-0.0055	-34.29	***	-0.0118	-31.58	***	-0.0089	-37.48	***	-0.01	-37.66	***	-0.0037	-18.23	***	-0.0017	-6.30	***
FLOOR1	0.1561	33.30	***	0.0922	13.29	***	0.1036	20.28	***	0.15	26.98	***	0.1897	26.40	***	0.2321	30.42	***
TOPFLOOR	0.0009	0.27		-0.0271	-4.16	***	-0.0057	-1.32		0.01	2.38	**	0.0192	4.78	***	0.0188	3.96	***
GARAGE	0.1301	42.00	***	0.1188	21.85	***	0.1095	26.52	***	0.11	31.27	***	0.1304	33.18	***	0.1134	29.12	***
RATEPUB	-0.0238	-1.78	*	-0.1393	-6.86	***	-0.0663	-4.10	***	0.01	0.53		0.0725	3.83	***	0.0972	3.55	***
STEEL	0.1618	7.69	***	0.1836	5.45	***	0.1554	6.38	***	0.19	8.78	***	0.1071	5.79	***	0.0595	1.87	*
NIMBY	-0.0657	-9.41	***	-0.0407	-2.68	***	-0.0493	-5.75	***	-0.05	-5.25	***	-0.0737	-7.57	***	-0.0720	-6.61	***
FS1	-0.0102	-0.98		0.0205	1.13		0.0131	0.90		0.00	-0.39		-0.0061	-0.46		-0.0162	-1.19	
FS2	-0.0595	-7.54	***	-0.0238	-0.92		-0.0277	-2.35	**	-0.04	-4.22	***	-0.0505	-4.13	***	-0.0511	-4.13	***
FS3	-0.0427	-4.76	***	0.0016	0.07		0.0026	0.29		-0.02	-2.54	**	-0.0739	-7.07	***	-0.1071	-8.75	***
FS4	-0.0826	-5.06	***	-0.1273	-4.04	***	-0.0688	-2.34	**	-0.08	-3.01	***	-0.0257	-1.04		-0.0228	-1.62	
FS5	-0.0350	-3.86	***	0.0267	1.48		-0.0023	-0.20		-0.03	-4.53	***	-0.0383	-4.04	***	-0.0628	-5.16	***
FS6	-0.0398	-10.77	***	-0.0405	-6.74	***	-0.0331	-8.28	***	-0.04	-9.94	***	-0.0412	-8.41	***	-0.0333	-5.81	***
EFFICIENCY[a]	-0.3925	-57.66	***	-0.4260	-24.79	***	-0.3959	-45.58	***	-0.39	-46.87	***	-0.3503	-32.46	***	-0.2937	-23.50	***
APARTMENT	-0.0543	-15.06	***	-0.0282	-4.19	***	-0.0230	-5.71	***	-0.03	-8.36	***	-0.0529	-12.51	***	-0.0755	-12.53	***
SINGLE HOUSE	0.3986	82.50	***	0.2866	32.30	***	0.3378	52.24	***	0.40	62.10	***	0.4511	65.82	***	0.4663	54.77	***
VILLA	0.3404	46.34	***	0.2414	19.40	***	0.2652	29.94	***	0.32	38.75	***	0.3886	43.66	***	0.4084	31.30	***
PUBLIC HOUSE	-0.1970	-30.26	***	-0.1810	-13.54	***	-0.1828	-24.13	***	-0.21	-22.28	***	-0.2016	-18.53	***	-0.1909	-17.94	***
KEELUNG CITY[b]	-0.6126	-71.68	***	-0.5705	-46.58	***	-0.6189	-78.11	***	-0.63	-70.16	***	-0.6550	-92.38	***	-0.6639	-32.76	***
TAIPEI CITY	0.4877	129.09	***	0.4619	57.33	***	0.4680	93.96	***	0.48	107.59	***	0.5106	97.42	***	0.5402	79.43	***

(Continued…)

(Table 4 continued)

MODEL	OLS			0.1			0.25			0.5			0.75			0.9		
Variables	Coef.	T-value		Coef.	T-value		Coef.	T-value		Coef.	T-value		Coef.	T-value		Coef.	T-value	
TAOYUAN COUNTY	-0.5112	-127.85	***	-0.4320	-68.19	***	-0.4785	-103.54	***	-0.51	-114.24	***	-0.5349	-100.03	***	-0.5399	-88.31	***
HSINCHU CITY	-0.4039	-55.21	***	-0.4016	-22.86	***	-0.3732	-34.93	***	-0.40	-59.16	***	-0.4290	-47.82	***	-0.4332	-32.07	***
HSINCHU COUNTY	-0.5450	-73.37	***	-0.4703	-33.86	***	-0.5108	-62.34	***	-0.55	-63.84	***	-0.5736	-74.42	***	-0.5829	-70.22	***
MIAOLI COUNTY	-0.7407	-65.70	***	-0.6499	-23.36	***	-0.6850	-50.55	***	-0.74	-59.54	***	-0.7964	-52.15	***	-0.7947	-36.94	***
TAICHUNG CITY	-0.5646	-140.15	***	-0.4763	-78.70	***	-0.5229	-116.14	***	-0.57	-141.74	***	-0.6144	-132.58	***	-0.6506	-108.78	***
TAICHUNG COUNTY	-0.7118	-115.35	***	-0.6068	-57.15	***	-0.6619	-98.74	***	-0.73	-106.95	***	-0.7634	-114.68	***	-0.7860	-79.44	***
NANTOU COUNTY	-0.7748	-36.77	***	-0.7111	-22.94	***	-0.7297	-18.03	***	-0.76	-45.97	***	-0.8139	-27.59	***	-0.8267	-23.73	***
CHANGHUA COUNTY	-0.8081	-117.97	***	-0.7121	-65.14	***	-0.7661	-84.53	***	-0.81	-127.17	***	-0.8602	-84.88	***	-0.8662	-81.44	***
YUNLIN COUNTY	-1.0238	-71.56	***	-0.9969	-25.39	***	-1.0236	-48.95	***	-1.01	-55.22	***	-1.0233	-68.88	***	-1.0431	-38.10	***
CHIAYI CITY	-0.8110	-79.88	***	-0.7580	-52.03	***	-0.7603	-66.80	***	-0.81	-120.51	***	-0.8708	-100.07	***	-0.8891	-55.73	***
CHIAYI COUNTY	-1.0783	-66.20	***	-1.0243	-25.12	***	-1.0407	-44.62	***	-1.07	-48.19	***	-1.0756	-40.60	***	-1.1197	-53.84	***
TAINAN CITY	-0.7518	-144.86	***	-0.6692	-68.96	***	-0.7069	-119.61	***	-0.75	-138.45	***	-0.7977	-112.68	***	-0.8083	-80.65	***
TAINAN COUNTY	-0.8943	-148.52	***	-0.7977	-60.14	***	-0.8422	-118.06	***	-0.89	-159.04	***	-0.9439	-132.51	***	-0.9716	-118.26	***
KAOHSIUNG CITY	-0.5581	-129.66	***	-0.5568	-73.17	***	-0.5814	-104.70	***	-0.59	-102.37	***	-0.5194	-59.53	***	-0.4640	-53.39	***
KAOHSIUNG COUNTY	-0.7466	-122.36	***	-0.7356	-75.16	***	-0.7346	-79.91	***	-0.73	-131.24	***	-0.7697	-87.17	***	-0.7766	-69.40	***
PINGTUNG COUNTY	-0.9091	-78.81	***	-0.8330	-37.28	***	-0.8887	-100.59	***	-0.92	-62.11	***	-0.9718	-54.85	***	-0.9715	-54.81	***
HUALIEN COUNTY	-0.8106	-102.24	***	-0.7074	-59.79	***	-0.7511	-92.36	***	-0.81	-106.44	***	-0.8689	-107.82	***	-0.8972	-77.04	***
YILAN COUNTY	-0.6652	-71.13	***	-0.5840	-34.53	***	-0.6165	-49.22	***	-0.66	-60.07	***	-0.6969	-75.01	***	-0.7118	-67.43	***

(Continued…)

(Table 4 continued)

MODEL	OLS			0.1			0.25			0.5			0.75			0.9		
Variables	Coef.	T-value		Coef.	T-value		Coef.	T-value		Coef.	T-value		Coef.	T-value		Coef.	T-value	
2002[c]	-0.3228	-65.09	***	-0.3001	-34.57	***	-0.3182	-48.64	***	-0.32	-50.83	***	-0.3213	-45.48	***	-0.2921	-32.50	***
2003	-0.3047	-61.99	***	-0.2864	-32.39	***	-0.2923	-46.98	***	-0.29	-45.20	***	-0.2913	-42.93	***	-0.2886	-34.96	***
2004	-0.2273	-52.23	***	-0.1795	-27.31	***	-0.2034	-34.95	***	-0.22	-41.12	***	-0.2369	-37.77	***	-0.2308	-30.47	***
2005	-0.1684	-38.73	***	-0.1105	-17.49	***	-0.1413	-25.00	***	-0.16	-32.47	***	-0.1822	-34.64	***	-0.1818	-23.89	***
2006	-0.0966	-19.05	***	-0.0517	-6.50	***	-0.0777	-12.61	***	-0.09	-15.04	***	-0.1026	-15.88	***	-0.1059	-14.74	***
Adj/Pseudo R^2	0.7768			0.4916			0.5215			0.5435			0.5565			0.5870		
Sample size	77,624			77,624			77,624			77,624			77,624			77,624		

Source: This study.

Notes: a. High rises are the reference group for type of building.

b. The reference group for cities is Taipei County.

c. The reference group for year is 2007.

d. The coefficients with ***,**,* are significantly different from zero at the 99%, 95% and 90% significance levels, respectively.

The result shows that the poor may not like to pay much for public space. On the other hand, the rich are willing to pay more for larger public space. In other words, public space is a luxury good for people in Taiwan.

Finally, the impact of not in my backyard (NIMBY) on housing price is similar to that of unwanted feng-shui in that the poor may care less about NIMBY so that the negative impacts of NIMBY on cheaper housing units are fewer. The estimated result shows that the negative coefficient for NIMBY is -0.0407 for cheaper houses (0.1 quantile) and -0.0720 for expensive ones (0.9 quantile).

For those with unwanted feng-shui in this study, we find that FS2 (located on a dead-end road), FS3 (near a viaduct), FS4 (near a cemetery), FS5 (near a temple), and FS6 (located on the fourth floor) all have significantly negative coefficients in the OLS regression results as we expected. While FS1 (lu-chun) also has a negative coefficient (-0.0102), it is not significantly different from zero.

According to Chu (1999), the rich and famous may care about feng-shui more than the others do. Since the rich and famous usually live in more expensive dwelling units then the poor, this means that the negative impacts of bad feng-shui on a dwelling unit with a higher price might be higher than those for dwelling units with lower prices. In order to investigate the potential different impacts, we apply a quantile regression to our data set and the results are shown in Table 4.

In Table 4, one may see that the signs of most of the estimated coefficients are similar to the results by OLS. However, the size of the estimated coefficients is quite different for the different quantiles. In order to show the different scales of the estimated coefficients at different quantiles, we plot the estimate coefficients in different quantiles in Figure 1.[19]

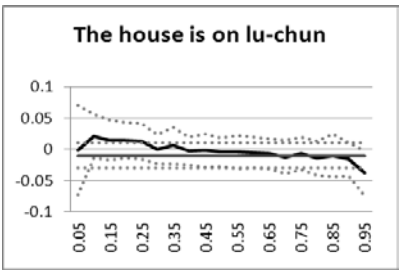
In Figure 1, the solid and straight horizontal line is the estimated coefficient under the OLS (i.e. 50% quantile). The solid line that goes up and down represents the changes of the estimated coefficients at different quantiles. The other two dotted lines are the 95% confidence intervals for the estimated coefficients under the quantile regressions.

It is clear to see that in Figure 1(a) (lu-chun), 1(b) (dead-end road), 1(c) (viaduct), and 1(d) (temple), the slope of the lines of the estimated coefficients in the quantile regressions for the above four variables are all negative. This means that the estimated coefficients are smaller as the

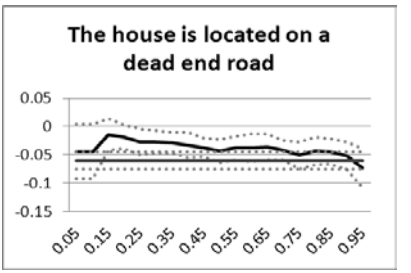
[19] In order to smoothly plot the estimated coefficients in different quantiles, we compute the coefficients in 100 points, instead of only five estimated points in the five quantiles as shown in Table 4.

quantile goes up in those figures, which is consistent with our expectations in that the negative impact of bad feng-shui on housing price is greater for more expensive dwelling units.

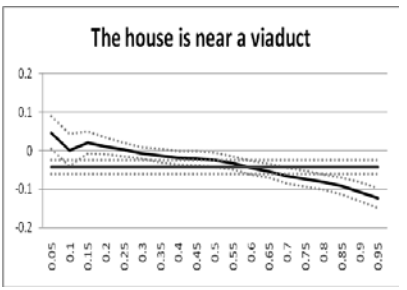
Figure 1 The Estimated Coefficients under OLS and Quantile Regressions with Confidence Intervals



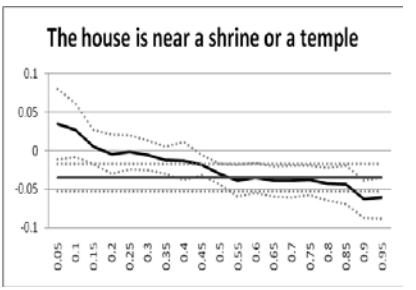
1(a)



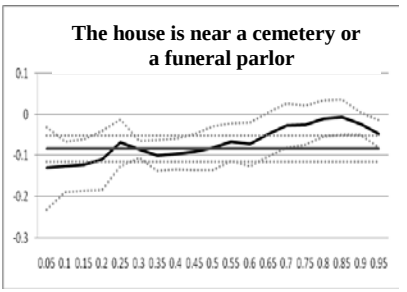
1(b)



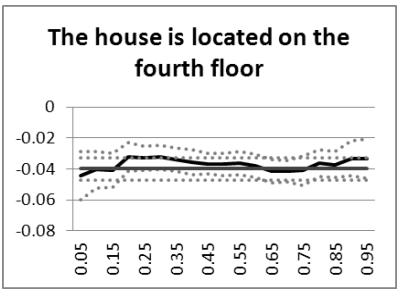
1(c)



1(d)



1(e)



1(f)

Source: This study.

In Figure 1(e), the line for the estimated coefficients in the quantile regression has a slightly positive slope, although the mean impact is negative (-0.0826). The result implies that the negative impact of a dwelling unit located near a cemetery or a funeral parlor is less for more expensive

housing units. This result is different from our expectations. One possible reason is that while most funeral parlors in Taiwan are located downtown, a dwelling unit near a funeral parlor means that it is near downtown, too, and so the affluent might like to buy it just for convenience.

In Figure 1(f), one can see that the line of the estimated coefficients in the quantile regression is close to a straight line (-0.0398). The result shows that the negative impact of a fourth floor on housing price is the same for all kinds of housing units. This simply means that both the rich and the poor do not like their house to be located on the fourth floor.

Finally, we compute the test statistics for the difference of the estimated coefficients among the five quantiles in Table 4. The test results are shown in Table 5. One can see that except for the fourth floor, all of the different types of feng-shui have significantly different impacts on the housing prices for dwelling units with differences in prices.[20] Again, this confirms that feng-shui has various impacts on houses with different prices.

Table 4 Tests of the Price Differences between Quantiles

Quantile	(0.1,0.5)	(0.1,0.9)	(0.25,0.75)	(0.5,0.9)
The house is on lu-chun	2.15	3.08*	1.53	0.52
The house is located on a dead-end road	0.58	0.95	2.86*	0.35
The house is near a viaduct	1.56	21.37***	40.77***	37.00***
The house is near a cemetery or a funeral parlour	1.82	9.70***	1.80	5.03**
The house is near a shrine or a temple	11.22***	18.00***	9.80***	6.94***
The house is located on the fourth floor	0.30	0.96	2.47	0.47

Source: This study.
Note: The statistics with ***, **, and * are significantly different from zero at the 99%, 95%, and 90% significance levels, respectively.

5. Conclusion

Feng-shui is a historical tradition that affects home-buying behavior, even in a modern society like Taiwan. It is clear that bad feng-shui might have a significantly negative impact on a dwelling unit. Moreover, according to

[20] Whenever there is one significant statistic, then we should reject the null hypothesis in that the coefficients are the same for all quantiles.

Chu (1999), the rich and famous might be care more about feng-shui whenever possible.

In order to estimate the size of the above two potential effects, this study has employed a data set from a private bank in Taiwan with 77,624 observations. By using an OLS regression, we find that all bad feng-shui have significantly negative impacts on housing prices, such as location on a dead-end road, or near a viaduct, temple, cemetery, or located on the fourth floor. Lu-chun has a negative impact on a dwelling unit, however, the impact is not significantly different from zero.

To investigate the possible different impacts of feng-shui on different people, we have applied a quantile regression for dwelling units with different prices. We find that lu-chun, dead-end roads, viaducts, cemeteries, and temples all have different impacts on dwelling units with different prices. Generally, the negative impact of bad feng-shui on housing price will be greater for a dwelling unit with a higher price. Our findings are consistent with Chu (1999) in that the rich and famous care about feng-shui more than the others do.

Restricted by the data set, we cannot discuss how good feng-shui affects the housing price in this study. It is no doubt that it will be an interesting question to answer in the future. Moreover, it will also be an interesting issue to check, by using a panel data set, whether feng-shui may actually affect a household's fortune before and after the move into a new dwelling unit.

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