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學術論著

法拍屋次市場之競標行為研究

Bidding Behavior in the Foreclosure Sub-Market

謝富順*

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摘　要

法拍屋市場中，競標者的下標行為，決定於眾多的法拍屬性，因此分析各法拍屬性對於每坪價格影響將相當重要，尤其是臺灣法拍市場中特有的特徵屬性，如「點交與否」。本文之研究可解釋過去在研究房屋單價與面積之間呈現正、負相關兩種不同的現象。雖然，Zietz et al.(2008)及Shie & Chang(2010)提出分量迴歸相對於OLS的迴歸分析較為正確，本文亦同意此論點。但本研究發現，研究個別次市場的重要性比使用不同的分析方法還要來的重要，尤其是在不動產此類高差異性的市場之中，次市場的競標行為將因為在未妥善的區隔分析下而遭到扭曲，更甚而導致錯誤的競標行為，本文雖為研究拍賣市場，但亦提供了蒐尋市場在往後的分析上有更進一步的方法。

關鍵詞：法拍屋、點交、分量迴歸

ABSTRACT

The behavior of bidders depends on the various attributes of foreclosure. Thus, the analysis of foreclosure attributes is critical to deriving a price per floor area, especially since the market for foreclosed houses in Taiwan has unique characteristics such as “with or without a final walkthrough”. The results of this study can explain the contradictory results of positive and negative correlations between the price per floor area and floor area in previous studies but not in a sub-market for foreclosed houses without a final walkthrough. Although Zietz et al. (2008) and Shie & Chang (2010) argued that quantile regression analysis is more accurate than OLS regression, the results of this study suggest that even a good analytical model will generate erroneous outcomes without appropriate market segmentation. Therefore, the importance of investigating sub-markets is more critical than that of using different analytical methods. In particular, in high-diversity markets such as the real estate market, the lack of appropriately segmented markets could result in distorted and even erroneous bidding behavior in sub-markets.

Key words: foreclosed houses, final walkthrough, quantile regression

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1. Introduction

Residential housing has strong heteroscedasticity. The foreclosed house market in Taiwan is unique for the purchase of real estate, and the price of residential housing is affected by the conditions and features of the foreclosure. Most of the previous literature regarding residential housing is in agreement that residential housing should be divided into several sub-markets, such as new houses, pre-sale houses, finished houses, rental houses, and the heteroscedasticity of the housing itself. One of the main reasons for segmenting residential sub-markets is to reduce the price gap. In the Taiwanese foreclosure mechanism, proclamations of whether a final walkthrough is performed have apparently segmented the characteristics of products and formed sub-markets. More in-depth investigations on the bidding price of this sub-market have not been conducted in previous studies. This study is the first to investigate the sub-market of final walkthroughs, and has made a substantial contribution to the study of bidding behavior on foreclosed houses.

Understanding foreclosed housing is crucial because the number and price of foreclosed housing units are generally closely connected to the economic climate. When the economic climate is favorable, the number of foreclosed housing units decreases and the price increases. By contrast, under a depressed economy, the number of foreclosed housing units increases and the price declines. Thus, understanding the foreclosed housing market can yield an accurate forecast of the tendency of the entire real estate market. Chiang et al. (2011) indicated that the price relationship between foreclosed housing and existing housing helps real estate businesses estimate the number of new housing constructions and take-up capacity in the future. In addition, the price relationship helps buyers consider the decision in purchasing existing housing for residential purpose.

Grigsby et al. (1987) considered defining a typical sub-market with a substitute to be appropriate; that is, substitutes between sub-markets are relatively low (poor subsitutes), but substitutes within sub-markets should be high (close substitutes). Rothenberg et al. (1991) also considered that the most critical element of a sub-market is the strength of its substitution. Bourassa et al. (2003) emphasized the improtance of defining a residential sub-market; particularly for the purpose of accurate appraisal, residential sub-markets should be more clearly defined. Previous literature has generally classified residential sub-markets into the following types: 1) Structural characteristics; 2) housing unit characteristics; 3) spatial characteristics; 4) household characteristics; and 5) neighborhood and environmental characteristics. However, little research has been conducted in the past on sub-markets segmented under the unique conditions (such as with or without a final walkthrough) of the foreclosed houses in Taiwan. This study contributes to the diversity of literature regaring sub-markets.

The causes of foreclosed houses in Taiwan include the following factors: 1) Debts, such as execution of promissory notes[1]; 2) collateral auctioning, which is also the most common cause of foreclosure[2]; and 3) back taxes[3], which is less common in the market of foreclosed houses.

As described above, the claims of banks in Taiwan mostly originate from private loans that use real estate as collateral. Thus, once a contract for this type of loan is breached, the loan is rewritten on

a bank's books as a non-performing loan (NPL). Banks have two main approaches for handling NPLs: a "bank-auctioned house" held by the banks themselves or a third party, and a "foreclosed house" auction entrusted to the courts. "Foreclosed houses" are auctioned by district courts in Taiwan entrusted by banks, and the auction mechanism adopted is a "first price sealed-bid auction", whereas most other countries adopt the English auction (Lusht, 1996; Mayer, 1998; Dotzour et al., 1998; Marcus, 2001; Quan, 2002). Therefore, buyers and sellers in Taiwan do not have room to bargain. Furthermore, in the current auction system in Taiwan, bidders have no advance knowledge of the numbers of bids or the degree of competition for the object being bid upon.

Christy & Zaichkowsky (2003) stated that experienced bidders are better able to grasp the bidding situation, are more aware of the presence of a competitor, and can make decisions on their bidding strategies. However, in the Taiwanese foreclosed house market, bidders are not influenced by the behavior of other bidders because they do not know if other bidders have bid on the same object. A bidder has to deduce whether the object would attract other bids based on his or her subjective valuation of the object being bid upon. In contrast, in the general housing market, buyers and sellers have plenty of time for negotiation, and can decide whether to buy or sell a house. Buyers and sellers can also discover the degree of competition on the house they wish to buy or sell during the negotiation process; this market is called a "search market" in the literature. Therefore, bidding behavior in the foreclosed house market is known to be different from that of the search market. Radosveta & Salmon (2004) also stated that bidders generally prefer English auctions, because bidders would know the number of bids and bidding behavior associated with the object bid upon; consequently, English auctions carry a lower risk than sealed-bid auctions. Furthermore, compared with sealed-bid auctions, bidders in English auctions have greater intention to bid, and the prices of winning bids are frequently higher.

The difference between bidding behavior in the market for foreclosed houses and the search market in Taiwan can be described from several perspectives. First, unlike in the search market, in which the internal conditions of a house can be closely inspected, the inspection of a foreclosed house is not permitted; consequently, information regarding the internal conditions of a foreclosed house is unavailable. Second, the buying and selling of a foreclosed house is unique, as the foreclosure procedure is more complex than that of a typical housing purchase, and negotiation is not allowed. Third, the number of purchasers of a foreclosed house is comparatively small because of the uniqueness of the market, but bidders must set a price in advance and price negotiation is not permitted because of the foreclosure system; therefore, most bidders of foreclosed houses have professional capabilities. To win a bid, a bidder must comply with certain criteria for bid prices.[4]

Finally, another unique feature of the foreclosed house market is the potential for purchase with or without a final walkthrough. A court determines whether to conduct a final walkthrough based on housing conditions, such as whether the house is vacant, rented, or being resided in, and the complexity of the property. Each district court proclaims whether a final walkthrough is permitted. If a foreclosure proclamation states a final walkthrough at the conclusion of the auction, a bidder can

apply to the court for a final walkthrough. In contrast to objects for which a final walkthrough is not granted, this procedure ensures that a bidder can more smoothly obtain access to the house through the public power of the court.

Therefore, whether or not a final walkthrough is permitted is of critical relevance to foreclosure purchasers, and has a positive effect on the price. According to the preliminary results of this study, the number of concluded auctions is significantly greater for objects that allow a final walkthrough than for those do not. This result indicates that permission for a final walkthrough is a critical factor for bidders in the bidding process. From the above discussion, the chief goal of a bidder participating in the foreclosure market is to obtain the winning bid at the most appropriate price. The research motivation of the authors in this study is to determine the optimal bidding strategy through a study of past bidding behavior.

The granting of permission for a final walkthrough of a foreclosed house has apparently segmented the different features of objects. Because banks do not grant loans for objects for which buyers are prohibited from conducting a final walkthrough, a bidder must have sufficient cash; therefore, permission for a walkthrough is also of critical relevance to a bidder. If the foreclosed house won by a bidder is occupied by the owner, who is also the debtor, and a final walkthrough is permitted, the winner of the auction could apply to the court to release and transfer the ownership of the property to him or her. A bidder can obtain this information in advance from the website of each district court; therefore, a bidder can evaluate this factor prior to bidding.

A house for which a final walkthrough is prohibited is naturally a house that is in relatively worse condition in terms of its attributes, property rights, and adequacy of funding; therefore, bidders would have a different bidding strategy. Lin & Huang (2007) concluded that prices were comparatively higher for foreclosed houses for which final walkthroughs were permitted, but this study holds the opinion that this conclusion is inaccurate, considering the dummy variable for final walkthroughs in the study by Lin & Huang (2007) to be overly simplified. Additionally, the result of the study was obtained via regression analysis, and could only explain the average price of foreclosed houses. For example, Lin & Huang (2007) indicated that the chances of obtaining a winning bid could only be increased by increasing the bidding price. However, whether this statement is true demands further clarification. To determine whether bidder behavior for a foreclosed house differs by permission for a final walkthrough, this study considers that foreclosed houses should be analyzed as pertaining to different markets in accordance with whether permission for a final walkthrough is granted. Therefore, to analyze bidding behavior in this study, this study segments houses into those with and without permission for a final walkthrough.

The remainder of the paper proceeds as follows. In the next section is literature review. The methodology introduces the flexible quantile regression model for independent stochastic variables. The data and empirical analysis is explained in the fourth section. The fifth section concludes the article.

2. Literature Review

Since the proposal for price estimation by the hedonic equation method by Rosen (1974), most subsequent literature regarding real estate pricing models has agreed that those purchasing houses derive satisfaction from the various characteristics of real estate. Therefore, this study takes the hedonic price theory as the empirical basis for this study. Additionally, to highlight the hedonic price theory, this study consider such characteristic factors such as the area or floor on which the foreclosed housing is located, the timing of its inclusion in the auction to reflect economic prospects, and factors available in the auction proclamation.

Consistent with suggestions made in books and articles that "location" is the most important factor to be considered when purchasing a house,[5] studies have proven that location has a profound influence on house prices. Location signifies the convenience of transportation; thus, a house purchaser should consider the location, convenience of transportation, region, road width, distance between the house and MRT stations, parking space, the visibility of power transmission facilities, and distance to markets. From the aspect of region, Taipei City has 12 administrative districts.[6] The region of a foreclosed house has an apparent influence on housing price; therefore, this study divides major areas by dummy variables, and take the early development zone and the southern suburbs of Taipei City as baseline variables, and designate these areas as LOC1 (Wanhua, Wenshan, and Datong districts), the northern suburb as LOC2 (Shilin and Beitou districts), the eastern suburb as LOC3 (Neihu and Nangang districts), the old central area as LOC4 (Zhongzheng, Zhongshan and Songshan districts), and the new urban center as LOC5 (Xinyi and Daan districts), (Liao & Chang, 2009). Because of limited access to information, other factors are not analyzed in this study.

After determining the location, a house buyer should next consider the factors of the house itself, such as the floor area, age of the building, the number of above ground floors, the floor of the building on which the housing is located, the number of bathrooms, and the area of public facilities. Empirical results of these factors are consistent in the literature, with the exception of floor area. As for floor location, the first floor can frequently be used for commercial operation in Taiwan, and thus has relatively higher price; whereas the price for the fourth floor is significantly lower because of the influence of Chinese beliefs. As for living space, previous literature such as the studies of Miller (1982), Chau et al. (2001), and Zietz et al. (2008) has used total price as an explanatory variable and investigated the influence of various characteristic attributes subsequently. Literature has regarded housing area as one of the characteristics. Empirical studies have found that area has a significant positive effect on housing price.

However, in reviewing empirical studies in the literature, Sirmans et al. (2005) found that of the 69 studies reviewed, 62 studies indicated that area had a positive effect on housing price, 4 studies claimed that the effect was negative, and 3 studies stated that the effect was insignificant. Some scholars believe that a major factor considered by house buyers was unit price; that is, price per floor area, instead of the total price of the house. Two opinions exist in the literature on the relationship

between floor area and unit price. Studies by Brownstone & De Vany (1991), Colwell & Munneke (1997), and Isakson (1997) indicated that the higher the floor area, the lower the unit price for floor area of houses; but Tabuchi (1996) and Lin & Evans (2000) held the opposite conclusions. Therefore, one of the foci of this study is to investigate the relationship between floor area and unit price.

The attributes described above can be observed before bidding in most foreclosure markets, but some attributes such as the number of bathrooms, the age of the house, the bidding approach, and the competitiveness of the market cannot be analyzed. Therefore, the process of purchasing a foreclosed house is very different from that of purchasing a house in search market; in addition to the "final walkthrough" attributes described above, another attribute that is unique to the foreclosure market is "the number of rounds of auction".

No discount is offered at the first auction of a foreclosed house after appraisal; this is called the "first auction." According to the existing auction system in Taiwan, the prices of all foreclosed houses unsold in the previous auction are reduced by 20% in the subsequent auction, and an object can be auctioned a maximum of four times. It is worth noting that if no bids have been entered by the third round of auction, the price of the property is not immediately reduced by 20%, and the property goes into a "Dutch auction," which is also known as the fourth Dutch auction procedure. Instead, the reserve price of the property in the third auction must be announced for three months, which is called the "bidding proclamation" in court, to execute a special auction procedure; the property enters the fourth Dutch auction process only if no one bids on the property, and if the creditor applies for a Dutch auction during this period. Therefore, the fourth auction is defined as a Dutch auction procedure, and properties sold during the "bidding proclamation" period are regarded as third-auction properties in this study. From the above description, the earlier a property is sold, the higher the price will be. Therefore, this study considers that different auction rounds will produce different outcomes. In this study, dummy variables are used to investigate the effect of the round of auction on bidding strategies.

This study analyzes bidding behavior by segmenting properties with and without final walkthrough permission, and improves the disadvantages of using only general regression analysis to describe the overall "mean" of data as done in previous literature. This study applies the quantile regression (QR) method proposed by Koenker & Bassett (1978) to thoroughly discuss the quantile estimations of different groups based on different quantiles. This approach allows us to understand the distribution condition of the entire information by different quantiles. Kahneman & Tversky (1979) proposed prospect theory to determine the risk preferences of people in uncertainty environments. They proposed certainty and reflection effects, indicating that people exhibit different risk attitudes in profit and loss situations. People tend to select certainty effect in profit situations. Under such conditions, the value function of people is concave, and they exhibit risk aversion behavior. However, when confronted with losses, people tend to select risks, presenting a convex value function and the behavior of risk pursuers. These behaviors further explain the importance of using QR, because the behaviors of people possibly differ in different quantiles, particularly quantiles of two extremities.

3. Methodology

This study used ordinary least squares (OLS) and least absolute deviation (LAD) regression analysis to process the data. Regression analysis is a widely applied analytical model in past literature. However, since Koenker & Bassett (1978) proposed the QR method, numerous studies have used this method to re-analyze old issues or to study new issues. In addition, prospect theory developed by Kahneman and Tversky (1979) indicated that the preferences of people differ depending on the situation; thus, prospect theory is suitable to be analyzed using QR. The advantage of the QR method is that it calculates the quantile coefficient estimations of different groups by using different quantiles without eliminating any data or dealing with heterogeneity and nonnormality. Thus, QR is a general model that is applicable to the data of this study. OLS and LAD could describe "means" or "medians" but they cannot explain two-tailed phenomena. Alternatively, the QR approach not only allows for the understanding of the distribution condition of the entire data set, it can also complement the shortcomings of the OLS and LAD methods.

The focus of this study was to analyze bidding behavior in the foreclosure market. Previous studies have taken total prices as the main analytical targets. However, this study argue that in general, total prices always increase with the increase of floor area, but that the total price of a house is generally irrelevant to whether the price is high in the buying/selling process of a house; the most critical reference indicator is the price per unit of floor area (PPFA). PPFA is defined in this study as the auction price (AP) divided by floor area (FA).[7] Both OLS and LAD only estimate the conditional mean (OLS) and conditional median (LAD) of the explained variable PPFA, but they cannot describe the conditional distribution behavior of the entire PPFA. In contrast, QR is a tool that allows a more comprehensive description of the conditional distribution behavior of PPFA.

Numerous factors must be considered for bidding behavior in foreclosed houses to derive constructive recommendations. For the characteristic attributes of the foreclosure market, attributes specific to this market were added in this study in addition to referencing general search markets; these attributes were organized as shown in Table 1.

Therefore, this study defines x'=[1, FA, GA, DNOA1~DNOA3, TFL, FL, GROUND, HIGH4, D2007Q2~D2010Q1, LOC2~LOC5, DHO], and defines $F_{Y \mid X}(PPFA)$ as conditional distribution for PPFA.[8] For other characteristic attributes, this study uses the following regression model as our research model:

$$PPFA_i = x'_i\beta + \varepsilon_i \quad \text{..... (1)}$$

Where $\varepsilon_i \sim N(0, \sigma^2)$, then the β estimation formula of θ^{th} is as follows. To simplify the description, $y=PPFA$ was also formulated.

Proposition 1.

If $y_i = x'_i\beta + \varepsilon_i$ where $\varepsilon_i \sim N(0, \sigma^2)$ then

Table 1. Variable definitions

Variable	Unit	Definition
PPFA	NTD/ping	Price per floor area
FA	ping	Size of house in ping (the unit of area in Taiwan, 1 ping = 3.30579 square meters)
GA	ping	Lot size in ping
DNOA1	0 or 1	1 if it is the first auction, 0 otherwise
DNOA2	0 or 1	1 if it is the second auction, 0 otherwise
DNOA3	0 or 1	1 if it is the third auction, 0 otherwise
DNOA4	0 or 1	1 if it is the fourth auction, 0 otherwise
TFL	floor	The total floor number of the building where the auction case is located
FL	floor	The floor of the auction case in the building
GROUND	0 or 1	1 if it is the first floor, 0 otherwise
HIGH4	0 or 1	1 if it is the fourth floor, 0 otherwise
D2007Q1	0 or 1	1 if 2007Q1, 0 otherwise
D2007Q2	0 or 1	1 if 2007Q2, 0 otherwise
D2007Q3	0 or 1	1 if 2007Q3, 0 otherwise
D2007Q4	0 or 1	1 if 2007Q4, 0 otherwise
D2008Q1	0 or 1	1 if 2008Q1, 0 otherwise
D2008Q2	0 or 1	1 if 2008Q2, 0 otherwise
D2008Q3	0 or 1	1 if 2008Q3, 0 otherwise
D2008Q4	0 or 1	1 if 2008Q4, 0 otherwise
D2009Q1	0 or 1	1 if 2009Q1, 0 otherwise
D2009Q2	0 or 1	1 if 2009Q2, 0 otherwise
D2009Q3	0 or 1	1 if 2009Q3, 0 otherwise
D2009Q4	0 or 1	1 if 2009Q4, 0 otherwise
D2010Q1	0 or 1	1 if 2010Q1, 0 otherwise
LOC1	0 or 1	1 if house in Wanhua, Wenshan and Datong District, 0 otherwise
LOC2	0 or 1	1 if house in Shilin and Beitou District, 0 otherwise
LOC3	0 or 1	1 if house in Neihu and Nangang District, 0 otherwise
LOC4	0 or 1	1 if house in Zhongzheng, Zhongshan and Songshan District, 0 otherwise
LOC5	0 or 1	1 if house in Xinyi and Daan District, 0 otherwise
DHO	0 or 1	1 if house with final walkthrough permission, 0 otherwise

$$\hat{\beta}(\theta) = \arg\min_{\beta} V(\beta;\theta) \quad \text{..... (2)}$$

where

$$\begin{aligned} V(\beta;\theta) &\equiv \frac{1}{N}\left[\theta \sum_{i:y_i \geq x_i'\beta} |y_i - x_i'\beta| + (1-\theta) \sum_{t:y_i < x_i'\beta} |y_i - x_i'\beta|\right] \\ &= \frac{1}{N}\sum_{i=1}^{N} \left(\theta - 1_{\{y_i - x_i'\beta < 0\}}\right)(y_i - x_i'\beta) \quad \text{..... (3)} \\ &= \frac{1}{N}\sum_{i=1}^{N} \rho_\theta (y_i - x_i'\beta) \end{aligned}$$

$1_{\{A\}}$ is an indicator function; it is 1 when it complies with conditional expression {A}.

ρ_θ is a verification function.

Calculation of coefficient of determination R^2 is required in OLS to determine the explanatory power of the model. Koenker & Machado (1999) divided QR into limited and unlimited regression equations. Variables for which explanatory power is required in unlimited regression equations must be divided into two groups:

$$y_i=x'_i\beta+\varepsilon_i=x'_{i1}\beta_1+x'_{i2}\beta_2+\varepsilon_i \quad (4)$$

Proposition 1 was used to solve the equation to obtain:

$$\hat{\beta}(\theta)=\left[\hat{\beta}_1(\theta)',\hat{\beta}_2(\theta)'\right]' \quad (5)$$

The setting for limited regression equation is as follows:

$$y_i=x'_{i1}\beta_1+\varepsilon_i \quad (6)$$

Similarly, by using Proposition 1, $\tilde{\beta}_1(\theta)$ was obtained as a QR estimation function; Koenker & Machado (1999) recommended using the following QR goodness-of-fit measure (pseudo R-squared) equation:

$$R^2_{QR}=1-\frac{V\left(\hat{\beta}_1(\theta),\hat{\beta}_2(\theta);\theta\right)}{V\left(\tilde{\beta}_1(\theta),0;\theta\right)} \quad (7)$$

where

$$V(\beta_1,\beta_2;\theta)=\frac{1}{N}\sum_{i=1}^{N}\rho_\theta\left(y_i-x'_{i1}\beta_1-x'_{i2}\beta_2\right) \quad (8)$$

To compare with OLS, x_{i1}=1 in Eq. (7), and the estimation value of QR will be the sample quantile of y; that is $\hat{q}(\theta)$ can be obtained from Proposition 1; therefore:

$$R^2_{QR}=1-\frac{V\left(\hat{\beta}(\theta);\theta\right)}{V\left(\hat{q}(\theta),0;\theta\right)} \quad (9)$$

The above measurement is the explanatory ratio of other explanatory variables on the dependent variables, except the constants.

The above was obtained by assuming that x_t is non-stochastic. Koenker & Bassett (1978) proved that the consistent estimator of $\tilde{\beta}_1(\theta)$ is $\beta(\theta)$, and that asymptotic normal distribution is obtained with appropriate standardization. As stated by Greene (2003, Section 2.3.5)[9], to make the model more flexible, Powell (1984, 1986) allowed x_t to be stochastic, and used the generalized method of moments (GMM) for derivation. Therefore, by assuming x_t to be stochastic, the following proposition was obtained.

Proposition 2.

In the model (1), if x_t is stochastic then:

$$\sqrt{T}\left(\hat{\beta}(\theta)-\beta(\theta)\right)\overset{A}{\sim}N(0, L^{-1}VL^{-1}) \quad (10)$$

where

$$L=-E[x_i x'_i f_{u(\theta)\mid x}(0)] \quad (11)$$

$$V=\theta(1-\theta)E[x_i x'_i] \quad (12)$$

Therefore, if $f_{u(\theta)\mid x}$ is non- stochastic, then $f_{u(\theta)\mid x}(0)=f_{u(\theta)}(0)$.

$$\sqrt{T}\left(\hat{\beta}(\theta)-\beta(\theta)\right)\overset{A}{\sim}N\left(0, \frac{\theta(1-\theta)}{f^2_{u(\theta)}(0)}E\left[x_i x'_i\right]\right) \quad (13)$$

In this study, this study used Proposition 2 as the empirical mode test.

4. Data and Results

The data source of this study was foreclosure data from the Taipei District Court of Taiwan; 2,913 pieces of sealed-bid data from the Taipei District Court were obtained from January 1, 2007 to March 31, 2010.[10] These data included apartments, townhouses, and land auctions; these three types of properties are very different in function and attributes. Because previous literature has primarily focused on apartments, and to compare the results of this study on the same basis with those of previous studies, this study also focused on apartments. After eliminating townhouses, land auctions, missing values, and properties with floor space less than three ping (excluding three ping), 2,031 pieces of data were acquired for this study. This study focused on the bidding behavior in the sub-market with and without final walkthrough permission; therefore, the data were further divided into those with and without final walkthrough permission, and 1,534 and 497 pieces of data were acquired, respectively. Table 2 shows a summary of the statistics for all samples, with and with final walkthrough permission; factors to be considered from Table 1 are also included.

In Table 2, means, the standard deviations (SD) and *t*-statistics were determined to verify whether the means for foreclosed houses with and without final walkthrough permission were similar. Though the PPFA for foreclosed houses with final walkthrough permission was higher in comparison to those without permission, the difference was insignificant. For the number of auctions, most foreclosed houses were sealed in the second (DNOA2) and the third (DNOA3) auctions.

This study determined whether the prices in the foreclosure market were affected by economic prospects by observing the trends in PPFA for each sub-market and the full sample. The foreclosure market in Taiwan was found to be affected by the subprime mortgage crisis, and the PPFA declined in

Table 2. Descriptive statistics (2007Q1~2010Q1)

	All		With final walkthrough		Without final walkthrough		
Variable	Mean	SD	Mean	SD	Mean	SD	t-statistic
PPFA	391637.7	266144.5	395110.9	242992.3	380917.9	327499.0	0.8900
FA	39.3924	73.7940	40.2581	78.6557	36.7203	56.1812	1.0979
GA	9.3473	13.8080	9.4849	13.5170	8.9227	14.6759	0.7563
DNOA1	0.2201	0.4144	0.2229	0.4164	0.2113	0.4086	0.5512
DNOA2	0.3752	0.4843	0.3931	0.4886	0.3199	0.4669	3.0015 ***
DNOA3	0.3028	0.4596	0.3012	0.4589	0.3078	0.4621	-0.2803
DNOA4	0.1019	0.3026	0.0828	0.2757	0.1610	0.3679	-4.3578 ***
TFL	8.2688	4.0859	8.3344	4.0690	8.0664	4.1350	1.2607
FL	4.7543	3.4264	4.8103	3.4547	4.5815	3.3351	1.3175
GROUND	0.1452	0.3524	0.1428	0.3499	0.1529	0.3603	-0.5499
HIGH4	0.2718	0.4450	0.2744	0.4464	0.2636	0.4410	0.4759
D2007Q1	0.0689	0.2534	0.0717	0.2581	0.0604	0.2384	0.9033
D2007Q2	0.0788	0.2695	0.0860	0.2805	0.0563	0.2308	2.3601 **
D2007Q3	0.0857	0.2799	0.0854	0.2796	0.0865	0.2814	-0.0773
D2007Q4	0.0935	0.2913	0.0997	0.2997	0.0744	0.2628	1.7998 *
D2008Q1	0.0926	0.2899	0.0984	0.2980	0.0744	0.2628	1.7100 *
D2008Q2	0.1118	0.3152	0.1199	0.3250	0.0865	0.2814	2.2129 **
D2008Q3	0.0630	0.2431	0.0652	0.2469	0.0563	0.2308	0.7302
D2008Q4	0.0547	0.2274	0.0528	0.2237	0.0604	0.2384	-0.6235
D2009Q1	0.0527	0.2235	0.0600	0.2375	0.0302	0.1713	3.0441 ***
D2009Q2	0.1068	0.3090	0.1037	0.3049	0.1167	0.3214	-0.7965
D2009Q3	0.0689	0.2534	0.0600	0.2375	0.0966	0.2957	-2.5100 **
D2009Q4	0.0842	0.2777	0.0717	0.2581	0.1227	0.3285	-3.1616 ***
D2010Q1	0.0384	0.1922	0.0254	0.1575	0.0785	0.2692	-4.1683 ***
LOC1	0.3077	0.4617	0.3116	0.4633	0.2958	0.4569	0.6690
LOC2	0.0758	0.2648	0.0782	0.2686	0.0684	0.2527	0.7409
LOC3	0.1561	0.3630	0.1525	0.3597	0.1670	0.3734	-0.7571
LOC4	0.3191	0.4662	0.3207	0.4669	0.3139	0.4645	0.2852
LOC5	0.1413	0.3484	0.1369	0.3439	0.1549	0.3622	-0.9765
DHO	0.7553	0.4300					

Notes: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

the fourth quarter of 2008; since then, it has been in a gradual recovery, and has reached a new peak in the first quarter of 2012 (Figure 1). Also, the trends for foreclosed houses with or without permission for a final walkthrough were similar before the fourth quarter of 2008, but trends for these two sub-markets were divergent after this period (Figure 1), indicating that prices in different sub-markets should not be explained using the same model.

To investigate the similarities and differences between sub-markets and the differences within sub-markets, this study divided the full sample into sub-markets of those foreclosed houses with or without permission for a final walkthrough. Under the model in Eq. (1) model, QR and OLS were

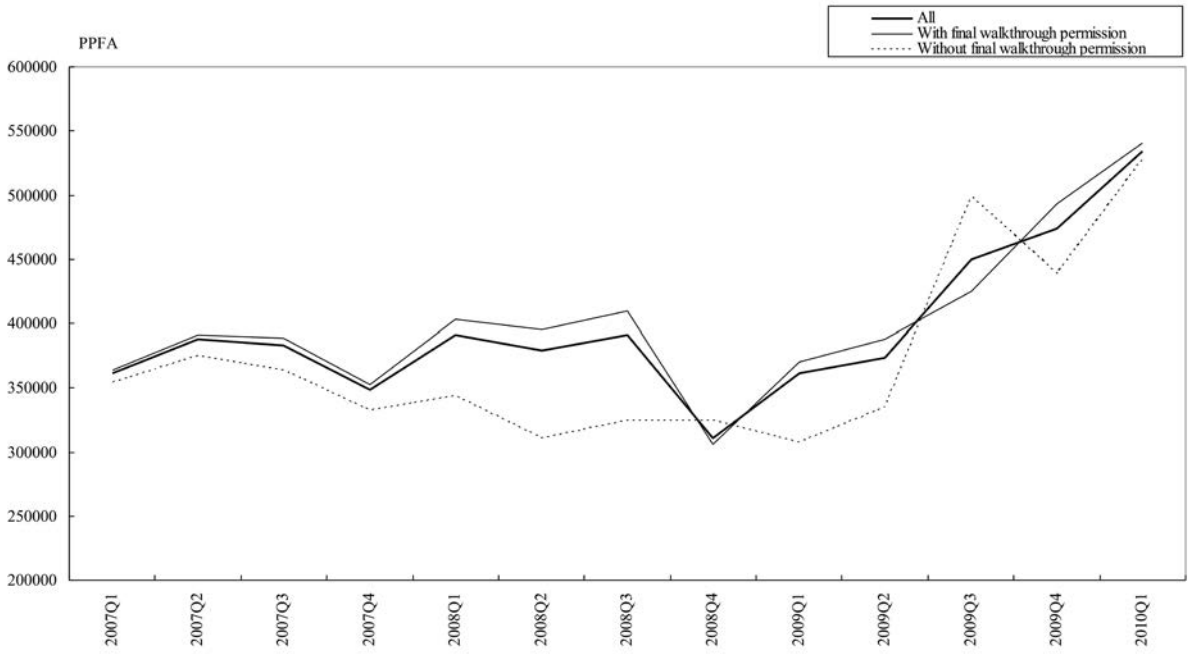

Figure 1. The trend of PPFA for each quarter

applied to estimate and compare these two analytical methods; the results were organized and displayed in Table 3. In QR, 19 quantiles were estimated and were 0.05, 0.1, ... , 0.9, and 0.95. To simplify Table 3, 0.8 and 0.2 quantiles are eliminated, and the results were not affected. Proposition 2 was used to test QR.

The regressions correlation of OLS and QR demonstrated significance. Except for the difference existing in the positive and negative correlations in the regression of OLS and QR in FA, other factors have correlations similar to those of PPFA. First, the results for FA in OLS indicate that FA and PPFA are positively correlated if the fixed price is high; that is, the larger the FA, the higher the fixed price per ping. This result is consistent with those of studies by Miller (1982), Chau et al. (2001), Zietz et al. (2008), and Shie & Chang (2010). Different quantiles of FA and QR gave different results; a quantile smaller than 0.35 signified a negative correlation, and a quantile greater than 0.4 signified a positive correlation. These results differ from those of Zietz et al. (2008), but the results for the quantile lower than 0.35 are consistent with those reported in Brownstone & de Vany (1991), Colwell & Munneke (1997), and Isakson (1997). In economic implications, as stated by Shie & Chang (2010), when the unit price per ping is low (quantile lower than 0.35), the unit price increases as the ping decreases, thereby meeting the law of diminishing marginal utility.

Second, the Taiwanese and Chinese consider the number 4 to be unlucky; this phenomenon can be observed from the HIGH4 coefficient, which showed a negative correlation. Generally, the price of housing on the first floor of a building is higher, and this phenomenon can also be observed from the positive correlation in GROUND. Third, both OLS and QR showed that DHO and PPFA were positively correlated. As discussed previously, the prices for foreclosed housing with permission for a final walkthrough were comparatively higher. Finally, as indicated in a study by Zietz et al. (2008), the

Table 3. Price per floor area models with QR and OLS: all samples

$PPFA_i = x'_i\beta + \varepsilon_i$

Variable	OLS	Quantile Regression				
		0.95	0.90	0.85	0.75	0.70
C	56044.3364	67675.9289	12580.3934	29385.2322	19816.0951	38002.7888
	(1.6347)	(0.9928)	(0.2935)	(0.8590)	(0.6815)	(1.4355)
FA	401.8989 ***	3049.6245 ***	1503.7812 ***	685.4701 ***	661.9202 ***	513.8454 ***
	(5.3581)	(20.4492)	(16.0337)	(9.1589)	(10.4047)	(8.8716)
GA	1542.2974 ***	3500.1027 ***	3205.6358 ***	2046.1638 ***	1550.4105 ***	607.0708 *
	(3.7899)	(4.3260)	(6.2999)	(5.0393)	(4.4921)	(1.9319)
DNOA1	74412.8695 ***	65536.9267	81296.3622 ***	106872.1306 ***	100411.5831 ***	92929.7292 ***
	(3.6125)	(1.6002)	(3.1564)	(5.1998)	(5.7475)	(5.8424)
DNOA2	53244.7942 ***	38713.3346	53078.5149 **	67940.4452 ***	72049.2539 ***	69146.7593 ***
	(2.7946)	(1.0220)	(2.2280)	(3.5738)	(4.4586)	(4.6999)
DNOA3	8617.3629	4333.6871	20037.3254	22815.9570	23922.0493	22973.5569
	(0.4479)	(0.1133)	(0.8328)	(1.1884)	(1.4659)	(1.5462)
TFL	18338.1376 ***	26237.5557 ***	28761.9986 ***	25405.2322 ***	21530.1862 ***	19532.3754 ***
	(10.8154)	(7.7831)	(13.5664)	(15.0167)	(14.9716)	(14.9183)
FL	-3880.9174	7642.1653	4304.7584	8546.9062	1790.2284	2085.2103
	(-0.7315)	(0.7245)	(0.6490)	(1.6146)	(0.3979)	(0.5090)
GROUND	79115.7409 ***	161865.3446 ***	174549.1497 ***	159569.3336 ***	126986.9198 ***	108068.7276 ***
	(4.0081)	(4.1244)	(7.0721)	(8.1019)	(7.5852)	(7.0900)
HIGH4	-28507.5341 **	-25384.6044	-17840.5950	-34398.8906 ***	-28700.9003 ***	-27101.7676 ***
	(-2.2141)	(-0.9916)	(-1.1081)	(-2.6776)	(-2.6282)	(-2.7259)
D2007Q2	25874.5476	81015.5745	48403.0534	14665.7144	15415.5244	12394.1493
	(0.9446)	(1.4876)	(1.4132)	(0.5366)	(0.6635)	(0.5860)
D2007Q3	6759.7929	39106.2356	20078.0178	-3831.2874	9770.1641	1045.3076
	(0.2504)	(0.7285)	(0.5947)	(-0.1422)	(0.4266)	(0.0501)
D2007Q4	11224.1902	57273.6891	42836.5463	12869.4343	5582.8103	5825.8533
	(0.4238)	(1.0878)	(1.2937)	(0.4871)	(0.2486)	(0.2849)
D2008Q1	33148.3037	86035.2412	60757.9587 *	122.9133	18208.3901	19166.1741
	(1.2443)	(1.6244)	(1.8240)	(0.0046)	(0.8059)	(0.9317)
D2008Q2	27409.7594	77283.4625	74106.4197 **	48626.7566 *	44737.8721 **	45757.2093 **
	(1.0735)	(1.5225)	(2.3213)	(1.9088)	(2.0660)	(2.3209)
D2008Q3	38747.9352	97522.8682 *	71742.7579 **	51985.7112 *	58188.7546 **	59842.3946 ***
	(1.3327)	(1.6870)	(1.9734)	(1.7919)	(2.3596)	(2.6654)
D2008Q4	-26088.2534	22599.3580	21627.9684	-10602.3211	-7494.6258	-5661.6092
	(-0.8604)	(0.3749)	(0.5705)	(-0.3504)	(-0.2914)	(-0.2418)
D2009Q1	20408.6337	63100.7414	60833.7103	29730.4620	43088.7489 *	37158.6427
	(0.6655)	(1.0350)	(1.5865)	(0.9717)	(1.6567)	(1.5692)
D2009Q2	36548.9697	88255.0274 *	74613.5254 **	46661.1385 *	49900.2959 **	44998.4700 **
	(1.4091)	(1.7114)	(2.3007)	(1.8030)	(2.2684)	(2.2467)
D2009Q3	114907.3966 ***	146415.4080 ***	124496.5923 ***	104541.0988 ***	122364.2143 ***	115485.1381 ***
	(4.0253)	(2.5797)	(3.4879)	(3.6703)	(5.0540)	(5.2390)
D2009Q4	123564.0654 ***	269287.1488 ***	212247.4980 ***	177817.7408 ***	148025.4726 ***	136480.6497 ***
	(4.5391)	(4.9755)	(6.2356)	(6.5466)	(6.4114)	(6.4927)
D2010Q1	204205.6023 ***	617548.6100 ***	334994.8116 ***	259294.5308 ***	196299.7357 ***	166242.8183 ***
	(6.0485)	(9.2001)	(7.9356)	(7.6973)	(6.8555)	(6.3768)
LOC2	71841.5412 ***	114587.5105 ***	124371.3405 ***	123870.2614 ***	113280.4099 ***	94577.7219 ***
	(3.3432)	(2.6820)	(4.6288)	(5.7772)	(6.2155)	(5.6997)
LOC3	67169.4834 ***	66000.1718 **	54262.4003 ***	63893.3861 ***	63039.7032 ***	64476.6774 ***
	(4.0502)	(2.0017)	(2.6168)	(3.8612)	(4.4818)	(5.0348)
LOC4	99844.1755 ***	140266.5161 ***	161406.8870 ***	133485.2735 ***	112155.2963 ***	104011.3600 ***
	(7.3808)	(5.2153)	(9.5425)	(9.8896)	(9.7754)	(9.9573)
LOC5	184463.3774 ***	171208.4919 ***	213386.8490 ***	238940.1868 ***	234801.2339 ***	226376.3296 ***
	(10.7527)	(5.0196)	(9.9479)	(13.9592)	(16.1377)	(17.0890)
DHO	25601.3651 **	8231.8374	26406.7820 *	27159.1228 **	45409.2851 ***	35627.1215 ***
	(2.0486)	(0.3313)	(1.6899)	(2.1780)	(4.2842)	(3.6919)
R^2	0.2243	0.2649	0.2516	0.2479	0.2389	0.2328

Notes: Table shows regression coefficients; t-values are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The goodness-of-fit measure for the quantile regressions are pseudo R^2_{QR} in Eq. (9).

Table 3. Price per floor area models with QR and OLS: all samples

$PPFA_i = x'_i\beta + \varepsilon_i$ (Continuous)

Variable	Quantile Regression					
	0.65	0.60	0.55	0.50	0.45	0.40
C	36203.1113	31835.9791	40843.4548 *	63605.7096 ***	61379.7987 ***	58270.8583 ***
	(1.4710)	(1.3315)	(1.8271)	(2.9298)	(2.9544)	(2.9456)
FA	294.4035 ***	230.3255 ***	229.7692 ***	215.3812 ***	74.3129	32.6992
	(5.4677)	(4.4030)	(4.6982)	(4.5347)	(1.6349)	(0.7555)
GA	763.4891 ***	734.7785 ***	712.4582 ***	347.7196	331.3226	392.8217 *
	(2.6136)	(2.5890)	(2.6852)	(1.3494)	(1.3435)	(1.6730)
DNOA1	97127.3887 ***	97649.5350 ***	90586.2748 ***	84159.6703 ***	83967.1275 ***	90539.4233 ***
	(6.5686)	(6.7974)	(6.7448)	(6.4522)	(6.7268)	(7.6177)
DNOA2	71928.4452 ***	75933.3271 ***	69362.8208 ***	63663.5764 ***	59518.5954 ***	63646.8874 ***
	(5.2590)	(5.7145)	(5.5835)	(5.2768)	(5.1550)	(5.7894)
DNOA3	25196.9718 *	36036.9169 ***	30705.2097 **	23791.7059 *	20239.4182 *	29516.0477 ***
	(1.8242)	(2.6855)	(2.4475)	(1.9527)	(1.7358)	(2.6586)
TFL	18592.6859 ***	18199.3774 ***	16608.3591 ***	15096.1576 ***	14535.0874 ***	14202.9008 ***
	(15.2757)	(15.3906)	(15.0231)	(14.0605)	(14.1463)	(14.5174)
FL	2381.8409	2508.1272	1885.1923	46.9544	2143.1705	25.9155
	(0.6254)	(0.6779)	(0.5450)	(0.0140)	(0.6667)	(0.0085)
GROUND	98421.1749 ***	88505.8761 ***	68511.3353 ***	55413.4605 ***	63565.4489 ***	57360.8736 ***
	(6.9459)	(6.4292)	(5.3233)	(4.4334)	(5.3141)	(5.0363)
HIGH4	-24268.6924 ***	-18454.2923 **	-22441.2871 ***	-20145.4747 **	-21217.1088 ***	-19213.0143 ***
	(-2.6257)	(-2.0551)	(-2.6731)	(-2.4709)	(-2.7193)	(-2.5861)
D2007Q2	12220.5767	18341.4408	29562.2217 *	25439.7241	24758.6027	19146.0495
	(0.6215)	(0.9601)	(1.6552)	(1.4667)	(1.4916)	(1.2114)
D2007Q3	-1630.8504	782.7066	-3139.6141	475.2418	-268.7185	1244.0772
	(-0.0841)	(0.0416)	(-0.1783)	(0.0278)	(-0.0164)	(0.0799)
D2007Q4	7411.6501	-4984.9977	-2621.0776	-1453.8458	-8896.1624	-13048.1095
	(0.3899)	(-0.2699)	(-0.1518)	(-0.0867)	(-0.5544)	(-0.8539)
D2008Q1	23711.5142	16460.2774	17783.2915	8454.1636	7943.5069	7906.0928
	(1.2399)	(0.8860)	(1.0238)	(0.5012)	(0.4921)	(0.5143)
D2008Q2	37437.2361 **	31813.2606 *	33795.0289 **	28335.2106 *	23412.9751	13784.9247
	(2.0426)	(1.7866)	(2.0301)	(1.7526)	(1.5133)	(0.9357)
D2008Q3	62881.3166 ***	49970.4096 **	38496.0744 **	32408.3340 *	27674.6902	28808.1773 *
	(3.0127)	(2.4643)	(2.0306)	(1.7602)	(1.5707)	(1.7172)
D2008Q4	-3206.8858	-7137.0490	-8077.6644	-17012.3979	-23253.2734	-32731.2048 *
	(-0.1473)	(-0.3375)	(-0.4086)	(-0.8861)	(-1.2655)	(-1.8708)
D2009Q1	29526.1501	29350.7487	28979.9831	22986.2358	19598.8419	1571.3655
	(1.3413)	(1.3724)	(1.4494)	(1.1838)	(1.0547)	(0.0888)
D2009Q2	45181.6307 **	38226.2114 **	36369.0953 **	28869.7413 *	23946.5149	20330.2793
	(2.4267)	(2.1133)	(2.1506)	(1.7578)	(1.5236)	(1.3585)
D2009Q3	104264.0455 ***	96531.3347 ***	95450.6584 ***	78764.4529 ***	79406.0074 ***	59849.9736 ***
	(5.0881)	(4.8487)	(5.1283)	(4.3574)	(4.5903)	(3.6336)
D2009Q4	123157.4759 ***	108790.3165 ***	96133.9505 ***	77944.3826 ***	65495.6802 ***	54709.4802 ***
	(6.3025)	(5.7304)	(5.4163)	(4.5218)	(3.9704)	(3.4831)
D2010Q1	139631.3909 ***	133911.9296 ***	131443.8470 ***	125298.5197 ***	114883.4649 ***	104985.9656 ***
	(5.7615)	(5.6874)	(5.9713)	(5.8610)	(5.6154)	(5.3894)
LOC2	85305.2112 ***	71524.8367 ***	68116.1476 ***	68364.8923 ***	59336.8721 ***	45416.5025 ***
	(5.5301)	(4.7726)	(4.8616)	(5.0242)	(4.5567)	(3.6629)
LOC3	63266.2776 ***	50557.8249 ***	41936.4601 ***	42452.7118 ***	44071.1728 ***	46942.0243 ***
	(5.3143)	(4.3713)	(3.8783)	(4.0426)	(4.3853)	(4.9056)
LOC4	97357.5383 ***	92144.4839 ***	83075.4876 ***	79852.1938 ***	76998.9388 ***	83236.5757 ***
	(10.0258)	(9.7670)	(9.4189)	(9.3221)	(9.3930)	(10.6640)
LOC5	229807.2683 ***	210337.3372 ***	214307.6261 ***	200034.7247 ***	187764.2260 ***	173161.4240 ***
	(18.6613)	(17.5807)	(19.1598)	(18.4144)	(18.0617)	(17.4937)
DHO	30278.6205 ***	24568.7552 ***	25089.9986 ***	20159.9123 **	20089.3737 ***	16970.8881 **
	(3.3751)	(2.8189)	(3.0792)	(2.5475)	(2.6527)	(2.3535)
R^2	0.2269	0.2211	0.2141	0.2077	0.2021	0.1955

Notes: Same as Table 3.

Table 3. Price per floor area models with QR and OLS: all samples

$PPFA_i = x'_i\beta + \varepsilon_i$ (Continuous)

Variable	Quantile Regression					
	0.35	0.30	0.25	0.15	0.10	0.05
C	64861.9617 ***	69575.6519 ***	46734.0826 **	43032.3353 **	57499.5507 ***	42705.4057 *
	(3.3396)	(3.6225)	(2.4658)	(2.2056)	(2.9416)	(1.9245)
FA	-45.0861	-81.1318 *	-221.9584 ***	-517.6107 ***	-526.2838 ***	-826.6198 ***
	(-1.0611)	(-1.9308)	(-5.3528)	(-12.1263)	(-12.3065)	(-17.0264)
GA	568.4411 **	683.6352 ***	833.3090 ***	1146.1615 ***	1425.3794 ***	1863.2573 ***
	(2.4658)	(2.9987)	(3.7042)	(4.9493)	(6.1435)	(7.0740)
DNOA1	82637.2068 ***	77028.5561 ***	72469.1592 ***	56780.0470 ***	51674.6667 ***	6756.6031
	(7.0818)	(6.6751)	(6.3641)	(4.8439)	(4.4001)	(0.5068)
DNOA2	58923.5077 ***	49674.5212 ***	45823.1560 ***	34879.4339 ***	29422.3448 ***	16366.2941
	(5.4592)	(4.6539)	(4.3505)	(3.2169)	(2.7085)	(1.3271)
DNOA3	27201.4320 **	24976.9200 **	25282.8023 **	20725.6067 *	12848.9374	5314.6166
	(2.4955)	(2.3171)	(2.3769)	(1.8928)	(1.1713)	(0.4267)
TFL	14071.2532 ***	13834.3486 ***	13258.9643 ***	11356.8590 ***	10684.2395 ***	10086.8019 ***
	(14.6496)	(14.5644)	(14.1455)	(11.7701)	(11.0523)	(9.1911)
FL	83.3405	638.3312	1031.2912	2880.9962	203.9719	1255.5999
	(0.0277)	(0.2148)	(0.3516)	(0.9543)	(0.0674)	(0.3657)
GROUND	52124.6224 ***	44588.0628 ***	36092.4296 ***	31007.3736 ***	2104.0902	5471.5513
	(4.6614)	(4.0321)	(3.3076)	(2.7604)	(0.1870)	(0.4283)
HIGH4	-18779.3190 **	-18295.1337 **	-16333.8141 **	-23715.2751 ***	-26265.4899 ***	-26293.5157 ***
	(-2.5746)	(-2.5364)	(-2.2948)	(-3.2366)	(-3.5780)	(-3.1550)
D2007Q2	9840.8711	-2326.3346	11057.7266	20673.4739	-324.4947	8156.7960
	(0.6342)	(-0.1516)	(0.7302)	(1.3262)	(-0.0208)	(0.4601)
D2007Q3	-11484.7170	-11054.4733	7719.0612	22458.1123	20456.9655	17580.0719
	(-0.7508)	(-0.7308)	(0.5171)	(1.4616)	(1.3289)	(1.0059)
D2007Q4	-10970.1327	-20959.8971	-5430.5978	4594.7946	1436.6922	1790.3172
	(-0.7313)	(-1.4128)	(-0.3710)	(0.3049)	(0.0952)	(0.1045)
D2008Q1	3477.7524	-9439.8365	8316.4559	18264.9687	7461.4961	10280.9200
	(0.2304)	(-0.6325)	(0.5647)	(1.2048)	(0.4913)	(0.5962)
D2008Q2	7427.0513	528.4813	8471.6117	5993.8380	-2921.8685	-15831.4069
	(0.5135)	(0.0369)	(0.6002)	(0.4125)	(-0.2007)	(-0.9580)
D2008Q3	19009.4849	9571.1579	24538.7287	17930.0106	9246.0852	-9628.5834
	(1.1541)	(0.5876)	(1.5267)	(1.0836)	(0.5578)	(-0.5116)
D2008Q4	-41925.6632 **	-39526.8271 **	-21902.0672	-23794.1734	-31841.0693 *	-47591.8557 **
	(-2.4408)	(-2.3270)	(-1.3066)	(-1.3790)	(-1.8419)	(-2.4250)
D2009Q1	-4650.1618	-8684.7180	3734.1737	16991.9321	-13313.5004	-10236.7625
	(-0.2677)	(-0.5055)	(0.2203)	(0.9737)	(-0.7615)	(-0.5158)
D2009Q2	6295.2942	5658.4448	17701.2600	15346.8259	13267.5040	15322.8988
	(0.4285)	(0.3894)	(1.2345)	(1.0398)	(0.8972)	(0.9127)
D2009Q3	52694.7572 ***	41932.7789 ***	62653.5265 ***	49266.5401 ***	41405.0927 **	33289.6788 *
	(3.2585)	(2.6221)	(3.9702)	(3.0327)	(2.5440)	(1.8017)
D2009Q4	40822.1284 ***	35536.9959 **	56188.4054 ***	38475.5737 **	27490.4346 *	12452.3417
	(2.6472)	(2.3303)	(3.7338)	(2.4837)	(1.7713)	(0.7067)
D2010Q1	86779.5317 ***	62503.1468 ***	80268.1855 ***	77695.1467 ***	36096.2580 *	-4412.6130
	(4.5374)	(3.3047)	(4.3008)	(4.0440)	(1.8753)	(-0.2019)
LOC2	41672.6014 ***	33863.0570 ***	29088.9541 **	25310.5196 **	20034.9245	19665.6875
	(3.4233)	(2.8129)	(2.4487)	(2.0698)	(1.6353)	(1.4139)
LOC3	41429.9314 ***	36095.0093 ***	40430.6629 ***	44079.3321 ***	41713.4890 ***	47201.4659 ***
	(4.4099)	(3.8851)	(4.4100)	(4.6706)	(4.4117)	(4.3973)
LOC4	76310.2187 ***	74495.4011 ***	64619.7287 ***	63100.8965 ***	62339.4883 ***	53635.7933 ***
	(9.9579)	(9.8301)	(8.6411)	(8.1969)	(8.0829)	(6.1258)
LOC5	152755.0216 ***	140051.1794 ***	141507.4225 ***	114844.3981 ***	97439.4090 ***	99644.7750 ***
	(15.7184)	(14.5727)	(14.9214)	(11.7639)	(9.9624)	(8.9741)
DHO	15589.0188 **	15929.3662 **	19861.3430 ***	23560.2319 ***	21327.9475 ***	35804.6645 ***
	(2.2020)	(2.2753)	(2.8749)	(3.3128)	(2.9934)	(4.4264)
R^2	0.1902	0.1858	0.1834	0.1743	0.1725	0.1689

Notes: Same as Table 3.

coefficients for most 0.95 quantile and 0.05 quantile varied greatly in their QR coefficients. Therefore, QR should be considered as a reference for bidding price when participating in this sub-market.

However, it merits further examination as to whether these conclusions are applicable to the entire foreclosure market in Taiwan. An experienced auction participant would know that in addition to various attributes, the most critical factor to consider in bidding on a foreclosed house is to look for indications of a court proclamation for a final walkthrough, because foreclosed houses with such permission have the benefit of "compulsory enforcement." Unlike properties that are not permitted for a final walkthrough, for which winning bidders have to solve the issue of ambiguous property rights on their own, courts will intervene in the handover process. Therefore, this study further divided data into different sub-markets based on whether permission for a final walkthrough was given to re-examine differences in the bidding behavior between these sub-markets; the results were organized as shown in Tables 4 and 5.

The results of the sub-market of foreclosed houses with final walkthrough permission (Table 4) were similar to the conclusions shown in Table 3. For correlations of PPFA and FA, those quantiles that were greater than 0.35 signified a positive correlation, and those that were smaller than 0.30 indicated a negative correlation. Interestingly, in the sub-market of foreclosed houses without permission for a final walkthrough, all factors were found to have a significant negative correlation with PPFA; except for FA, which had a 0.05 quantile (Table 5). These results indicate that bidding behavior in sub-markets is different from that in the overall market. Additionally, analyzing the two sub-markets together would distort the results of the sub-market for foreclosed houses without permission for a final walkthrough. For example, for a quantile of 0.95, the FA coefficients were 4999.3089 (Table 4) and -680.4055 (Table 5). In other words, with final walkthrough permission, an increased FA suggests that the bidding price should be increased in bidding decision making. Without final walkthrough permission, the bidding price should be reduced in bidding decision making to lower the house purchase cost when FA increases. In addition, when the quantile of 0.95 shown in Table 3 is used as an example, the FA coefficient was 3049.6245. The results shown in Table 3 were generated by all samples. As discussed, when final walkthrough permission is absent, bidders should increase the bidding price for cases with increased FA. However, such a result contradicts that presented in Table 5. In other words, if the bidder does not separate markets appropriately, error in bidding decisions could be made. Thus, the importance of dividing submarkets was verified.[11]

Finally, to further verify that the submarkets divided in this study presented differences, this study used the Chow test to test the differences between two regression intercepts and coefficients in Tables 4 and 5.[12] The results are listed in Table 6. According to Table 6, at a 1% level of significance, the regression lines between submarkets (Tables 4 and 5) exhibited a significant difference in both OLS and QR. Thus, this study could explain the contradictory results of positive and negative correlations between price per floor area and floor area obtained in previous studies but not in sub-market of without a final walkthrough. The results of this study indicated that even an effective analytical model generates erroneous outcomes without appropriate market segmentation. Therefore, the importance of investigating submarkets is more critical than that of using different analytical methods.

Table 4. Price per floor area models with QR and OLS: samples with final walkthrough permission

$$PPFA_i = x'_i\beta + \varepsilon_i$$

Variable	OLS	Quantile Regression				
		0.95	0.90	0.85	0.75	0.70
C	83823.0594 **	215442.9782 ***	100753.0173 *	90830.3392 **	85634.0059 ***	77526.2837 **
	(2.3611)	(5.5233)	(1.9443)	(2.1871)	(2.5796)	(2.5129)
FA	567.0713 ***	4999.3089 ***	2082.8416 ***	1184.5829 ***	826.9022 ***	708.8467 ***
	(7.9884)	(64.0983)	(20.1020)	(14.2648)	(12.4572)	(11.4906)
GA	1107.6392 ***	2413.8021 ***	3282.8091 ***	1695.9604 ***	527.6322	566.6779
	(2.6199)	(5.1965)	(5.3198)	(3.4291)	(1.3347)	(1.5424)
DNOA1	75454.2481 ***	9598.2450	45480.1883	69113.2559 ***	63711.7072 ***	60146.9648 ***
	(3.3133)	(0.3836)	(1.3682)	(2.5943)	(2.9919)	(3.0392)
DNOA2	50634.5448 **	15323.6627	36532.2032	43224.8619 *	49586.2633 **	46391.3330 **
	(2.3975)	(0.6604)	(1.1851)	(1.7495)	(2.5108)	(2.5276)
DNOA3	18559.2421	-2076.1875	10835.8106	7356.8494	17752.7751	10514.6790
	(0.8646)	(-0.0880)	(0.3458)	(0.2930)	(0.8845)	(0.5637)
TFL	13792.5030 ***	13386.8768 ***	21763.2811 ***	22108.2829 ***	17289.6597 ***	17298.4712 ***
	(7.8558)	(6.9397)	(8.4924)	(10.7641)	(10.5312)	(11.3376)
FL	3177.1026	6814.6640	7739.1017	11765.3082 *	10909.5489 **	10116.6382 **
	(0.5931)	(1.1579)	(0.9898)	(1.8775)	(2.1780)	(2.1732)
GROUND	88111.8131 ***	79778.7248 ***	134444.3287 ***	131473.5794 ***	144128.3708 ***	129215.3267 ***
	(4.2929)	(3.5377)	(4.4877)	(5.4756)	(7.5095)	(7.2444)
HIGH4	-42620.5377 ***	-29392.7057 **	-45761.5138 **	-41080.8773 ***	-31595.1456 **	-29388.7927 **
	(-3.2131)	(-2.0168)	(-2.3636)	(-2.6474)	(-2.5473)	(-2.5495)
D2007Q2	37209.5889	60221.7352 **	58053.6674	7139.3995	12561.1622	17935.1302
	(1.3577)	(2.0000)	(1.4512)	(0.2227)	(0.4901)	(0.7531)
D2007Q3	10425.9815	45916.1744	41064.2005	883.0969	-13198.4204	-17023.1124
	(0.3786)	(1.5174)	(1.0215)	(0.0274)	(-0.5125)	(-0.7113)
D2007Q4	7811.5317	37637.2761	25403.0541	3080.7213	-6397.3656	-6349.6775
	(0.2934)	(1.2867)	(0.6537)	(0.0989)	(-0.2570)	(-0.2745)
D2008Q1	40047.6872	32746.4700	47815.0704	2244.3882	11261.9314	22081.7023
	(1.4910)	(1.1096)	(1.2196)	(0.0714)	(0.4484)	(0.9460)
D2008Q2	34899.7372	58635.8687 **	78247.7081 **	56057.8491 *	47843.1440 **	41274.1341 *
	(1.3590)	(2.0782)	(2.0876)	(1.8660)	(1.9924)	(1.8495)
D2008Q3	52783.2067 *	48333.1188	100855.6334 **	48322.3491	62755.0232 **	56168.8445 **
	(1.7969)	(1.4976)	(2.3523)	(1.4062)	(2.2846)	(2.2003)
D2008Q4	-32348.4488	18729.7073	6063.5136	-23409.5091	-25557.0781	-12633.0206
	(-1.0330)	(0.5444)	(0.1327)	(-0.6391)	(-0.8728)	(-0.4642)
D2009Q1	22945.3161	37980.9598	6772.5270	18954.1365	38271.8618	28832.0389
	(0.7595)	(1.1442)	(0.1536)	(0.5363)	(1.3548)	(1.0982)
D2009Q2	41438.9751	52721.6397 *	70064.9897 *	31779.3112	39883.8355	46524.4515 **
	(1.5604)	(1.8068)	(1.8075)	(1.0229)	(1.6060)	(2.0159)
D2009Q3	79129.7137 ***	71617.0999 **	114544.1803 ***	92972.6628 ***	103625.8470 ***	98131.1445 ***
	(2.6257)	(2.1629)	(2.6040)	(2.6372)	(3.6772)	(3.7470)
D2009Q4	134108.5790 ***	160213.3757 ***	190196.5074 ***	173624.9829 ***	169750.7675 ***	156420.1759 ***
	(4.6609)	(5.0679)	(4.5287)	(5.1583)	(6.3091)	(6.2557)
D2010Q1	185217.8476 ***	489170.8508 ***	376211.5751 ***	297960.1004 ***	230103.8777 ***	234076.3528 ***
	(4.6678)	(11.2202)	(6.4956)	(6.4189)	(6.2014)	(6.7881)
LOC2	59772.5218 ***	39414.8097	92106.1856 ***	125058.3957 ***	107382.4877 ***	99418.4722 ***
	(2.7370)	(1.6426)	(2.8895)	(4.8951)	(5.2583)	(5.2385)
LOC3	92688.5125 ***	56496.6580 ***	73949.2636 ***	72689.8675 ***	70329.5380 ***	66898.5204 ***
	(5.3876)	(2.9888)	(2.9448)	(3.6117)	(4.3717)	(4.4746)
LOC4	99958.9982 ***	91291.9557 ***	151711.1025 ***	143532.8392 ***	116235.0690 ***	107171.7891 ***
	(7.1703)	(5.9602)	(7.4558)	(8.8013)	(8.9165)	(8.8464)
LOC5	184202.9613 ***	104074.9322 ***	198106.0467 ***	225786.5395 ***	232322.5904 ***	227607.5354 ***
	(10.3452)	(5.3199)	(7.6225)	(10.8397)	(13.9532)	(14.7094)
R^2	0.2562	0.3245	0.2710	0.2539	0.2413	0.2322

Notes: Same as Table 3.

Table 4. Price per floor area models with QR and OLS: samples with final walkthrough permission

$PPFA_i = x'_i\beta + \varepsilon_i$ (Continuous)

Variable	Quantile Regression					
	0.65	0.60	0.55	0.50	0.45	0.40
C	85222.5691 ***	82974.5279 ***	83281.9560 ***	83249.3338 ***	86576.9422 ***	86185.9892 ***
	(2.8737)	(2.9713)	(3.1907)	(3.2935)	(3.4817)	(3.6948)
FA	636.1924 ***	352.4847 ***	393.8966 ***	251.8221 ***	273.6226 ***	99.3490 **
	(10.7285)	(6.3126)	(7.5473)	(4.9823)	(5.5031)	(2.1300)
GA	-30.9923	-288.6209	-227.3952	-114.3856	-29.0969	47.0885
	(-0.0878)	(-0.8679)	(-0.7316)	(-0.3800)	(-0.0983)	(0.1695)
DNOA1	58645.1362 ***	61145.2145 ***	66777.7345 ***	66782.6516 ***	68129.6035 ***	66908.8297 ***
	(3.0828)	(3.4134)	(3.9884)	(4.1187)	(4.2711)	(4.4716)
DNOA2	43283.7583 **	39423.6775 **	40988.5924 ***	36429.9943 **	35812.1715 **	32468.2320 **
	(2.4533)	(2.3730)	(2.6397)	(2.4226)	(2.4208)	(2.3397)
DNOA3	5103.5093	8123.7196	12588.0404	5869.5037	6737.7320	7555.4640
	(0.2846)	(0.4811)	(0.7976)	(0.3840)	(0.4481)	(0.5357)
TFL	16551.1493 ***	15907.0265 ***	14536.3771 ***	13536.6929 ***	13614.7968 ***	13571.1411 ***
	(11.2850)	(11.5181)	(11.2612)	(10.8286)	(11.0710)	(11.7642)
FL	6832.9627	5700.8413	5059.9430	8353.0211 **	6790.2095 *	5444.5085
	(1.5270)	(1.3530)	(1.2848)	(2.1901)	(1.8097)	(1.5469)
GROUND	100075.1192 ***	91870.7153 ***	71655.9674 ***	76081.4829 ***	69433.1238 ***	67059.7998 ***
	(5.8368)	(5.6904)	(4.7485)	(5.2061)	(4.8296)	(4.9726)
HIGH4	-30163.6015 ***	-27796.4722 ***	-24185.3119 **	-27292.4883 ***	-26872.4886 ***	-17298.5676 **
	(-2.7222)	(-2.6641)	(-2.4800)	(-2.8898)	(-2.8923)	(-1.9848)
D2007Q2	22701.0043	39638.4168 *	38411.3182 *	36077.0449 *	32896.7649 *	30289.1203 *
	(0.9916)	(1.8387)	(1.9063)	(1.8488)	(1.7137)	(1.6820)
D2007Q3	-3368.7879	-1407.5946	-3487.2434	-923.0512	-4918.4504	-4599.3164
	(-0.1464)	(-0.0650)	(-0.1722)	(-0.0471)	(-0.2550)	(-0.2542)
D2007Q4	-2968.2443	3757.5799	-2238.2499	-9554.8167	-14393.2753	-7994.0304
	(-0.1335)	(0.1794)	(-0.1144)	(-0.5041)	(-0.7719)	(-0.4570)
D2008Q1	33381.5002	39273.2433 *	32485.5667	26692.7073	17553.7114	26597.1582
	(1.4877)	(1.8588)	(1.6450)	(1.3957)	(0.9330)	(1.5070)
D2008Q2	41150.4962 *	51337.3436 **	43128.7303 **	39767.6593 **	28729.3361	26199.1660
	(1.9183)	(2.5415)	(2.2843)	(2.1750)	(1.5972)	(1.5527)
D2008Q3	70030.5493 ***	61213.8558 ***	50837.0722 **	43477.6920 **	39608.5838 *	45004.8364 **
	(2.8539)	(2.6492)	(2.3539)	(2.0788)	(1.9251)	(2.3318)
D2008Q4	-9038.7392	42.0617	-12673.7885	-22001.0094	-33015.0756	-36118.3337 *
	(-0.3455)	(0.0017)	(-0.5505)	(-0.9868)	(-1.5052)	(-1.7555)
D2009Q1	33913.0939	41225.4618 *	40332.9979 *	29987.4237	10606.9498	2257.5105
	(1.3438)	(1.7348)	(1.8159)	(1.3941)	(0.5013)	(0.1137)
D2009Q2	52624.6971 **	56398.0706 ***	50017.3927 **	36799.2014 *	33558.3846 *	23486.7609
	(2.3721)	(2.6998)	(2.5617)	(1.9461)	(1.8040)	(1.3460)
D2009Q3	92989.7329 ***	98889.3987 ***	86824.9774 ***	86524.7988 ***	62594.4969 ***	64223.8773 ***
	(3.6938)	(4.1716)	(3.9186)	(4.0324)	(2.9653)	(3.2434)
D2009Q4	156285.3361 ***	132486.2504 ***	111575.4110 ***	100565.0075 ***	74671.2984 ***	57580.4630 ***
	(6.5022)	(5.8537)	(5.2743)	(4.9088)	(3.7051)	(3.0457)
D2010Q1	188925.7224 ***	158337.1902 ***	100415.8067 ***	94074.7533 ***	91663.3974 ***	83522.8523 ***
	(5.6996)	(5.0729)	(3.4420)	(3.3298)	(3.2980)	(3.2035)
LOC2	74765.3537 ***	72483.0597 ***	69573.4525 ***	59504.9842 ***	58028.7293 ***	42118.7418 ***
	(4.0983)	(4.2194)	(4.3331)	(3.8268)	(3.7935)	(2.9353)
LOC3	63440.8590 ***	58756.8047 ***	50923.7833 ***	51479.1138 ***	52216.1714 ***	45710.5047 ***
	(4.4143)	(4.3418)	(4.0260)	(4.2025)	(4.3331)	(4.0437)
LOC4	102331.0592 ***	93712.8296 ***	87250.4995 ***	82482.3408 ***	78887.0711 ***	73498.2238 ***
	(8.7872)	(8.5460)	(8.5127)	(8.3098)	(8.0789)	(8.0240)
LOC5	219127.9476 ***	211397.9140 ***	199609.3098 ***	184171.3064 ***	176242.1133 ***	161718.2476 ***
	(14.7322)	(15.0934)	(15.2477)	(14.5270)	(14.1312)	(13.8229)
R^2	0.2226	0.2138	0.2060	0.1995	0.1931	0.1859

Notes: Same as Table 3.

Table 4. Price per floor area models with QR and OLS: samples with final walkthrough permission

$PPFA_i = x'_i\beta + \varepsilon_i$ (Continuous)

Variable	Quantile Regression					
	0.35	0.30	0.25	0.15	0.10	0.05
C	74394.1930 ***	79274.2562 ***	74767.2690 ***	80956.4109 ***	98170.4614 ***	82298.4890 ***
	(3.2646)	(3.5084)	(3.4157)	(3.7315)	(4.3608)	(3.0489)
FA	76.2815 *	-71.8741	-255.7883 ***	-569.9268 ***	-645.5478 ***	-874.2726 ***
	(1.6741)	(-1.5908)	(-5.8441)	(-13.1376)	(-14.3409)	(-16.1982)
GA	181.7750	506.3838 *	694.4835 ***	1171.5559 ***	1462.4246 ***	1820.2058 ***
	(0.6698)	(1.8819)	(2.6642)	(4.5345)	(5.4550)	(5.6625)
DNOA1	77099.4593 ***	70177.2234 ***	69063.7712 ***	42354.0071 ***	36720.4556 **	1077.0284
	(5.2743)	(4.8417)	(4.9186)	(3.0433)	(2.5428)	(0.0622)
DNOA2	43825.5936 ***	41343.3675 ***	41679.1073 ***	23305.4988 *	7529.2567	5434.4693
	(3.2327)	(3.0756)	(3.2006)	(1.8057)	(0.5622)	(0.3384)
DNOA3	21118.3949	13822.2169	21774.1702	7532.1964	-3495.7013	-9656.4688
	(1.5327)	(1.0117)	(1.6452)	(0.5742)	(-0.2568)	(-0.5917)
TFL	13068.7254 ***	12863.9145 ***	12889.3705 ***	10976.5634 ***	10268.3747 ***	10479.1187 ***
	(11.5961)	(11.5118)	(11.9067)	(10.2303)	(9.2230)	(7.8500)
FL	6503.2770 *	4229.8868	1457.3327	4628.3473	358.8281	1849.3052
	(1.8913)	(1.2407)	(0.4412)	(1.4138)	(0.1056)	(0.4541)
GROUND	69474.1972 ***	64948.5263 ***	40858.8303 ***	38733.1158 ***	17798.5587	13097.0487
	(5.2732)	(4.9718)	(3.2286)	(3.0880)	(1.3675)	(0.8392)
HIGH4	-18476.1844 **	-17248.3983 **	-22538.6089 ***	-27782.9228 ***	-26303.4867 ***	-26293.0163 ***
	(-2.1700)	(-2.0431)	(-2.7558)	(-3.4274)	(-3.1271)	(-2.6070)
D2007Q2	12483.7349	9955.0516	11984.6803	14775.5680	8201.8674	21374.9482
	(0.7096)	(0.5707)	(0.7092)	(0.8822)	(0.4719)	(1.0258)
D2007Q3	-11457.5954	-1778.7551	4745.8522	20558.6937	20892.5857	23223.3372
	(-0.6481)	(-0.1015)	(0.2795)	(1.2215)	(1.1963)	(1.1090)
D2007Q4	-17756.3982	-12898.5251	-3440.9305	-4028.6117	-3211.4594	3345.1290
	(-1.0391)	(-0.7612)	(-0.2096)	(-0.2476)	(-0.1902)	(0.1653)
D2008Q1	21036.8275	11777.7091	17085.8040	17382.1047	512.4592	10664.7789
	(1.2201)	(0.6889)	(1.0317)	(1.0589)	(0.0301)	(0.5222)
D2008Q2	11939.9149	6814.7101	11602.4235	10653.7403	3595.5916	-8191.0116
	(0.7243)	(0.4169)	(0.7328)	(0.6789)	(0.2208)	(-0.4195)
D2008Q3	26151.5840	31780.2536 *	35145.8002 *	29823.6012 *	11551.3667	6128.1030
	(1.3869)	(1.6998)	(1.9405)	(1.6614)	(0.6201)	(0.2744)
D2008Q4	-48066.5858 **	-32096.9906	-20875.7996	-29494.6327	-37111.5038 *	-47625.6654 **
	(-2.3913)	(-1.6105)	(-1.0812)	(-1.5413)	(-1.8690)	(-2.0003)
D2009Q1	-5475.8443	-2197.1917	7443.7406	5561.4899	-4302.1216	-5385.1557
	(-0.2824)	(-0.1143)	(0.3996)	(0.3012)	(-0.2246)	(-0.2344)
D2009Q2	18575.9149	20103.6243	19439.5694	24453.1375	14457.3727	10068.9598
	(1.0897)	(1.1894)	(1.1872)	(1.5067)	(0.8585)	(0.4987)
D2009Q3	40718.8572 **	45146.2246 **	57927.9226 ***	37924.4368 **	31442.5500	26169.7017
	(2.1049)	(2.3537)	(3.1175)	(2.0592)	(1.6453)	(1.1421)
D2009Q4	53832.2776 ***	44730.4567 **	50439.1997 ***	34638.9684 **	27023.0333	16447.3253
	(2.9147)	(2.4425)	(2.8431)	(1.9699)	(1.4811)	(0.7518)
D2010Q1	60768.1670 **	66395.2618 ***	78089.2394 ***	60205.8500 **	23905.3016	-72472.8276 **
	(2.3858)	(2.6290)	(3.1918)	(2.4828)	(0.9500)	(-2.4021)
LOC2	33264.1373 **	28035.4961 **	19197.9510	7884.7108	17216.1899	9316.2648
	(2.3729)	(2.0170)	(1.4257)	(0.5908)	(1.2432)	(0.5611)
LOC3	44732.3900 ***	40655.4092 ***	43228.2748 ***	49777.5753 ***	51422.3303 ***	52627.8945 ***
	(4.0506)	(3.7129)	(4.0752)	(4.7345)	(4.7135)	(4.0233)
LOC4	69753.2148 ***	64811.5042 ***	62718.5237 ***	58555.0119 ***	65438.1443 ***	54491.8013 ***
	(7.7949)	(7.3045)	(7.2967)	(6.8732)	(7.4024)	(5.1410)
LOC5	147684.0424 ***	132509.7932 ***	129594.2687 ***	109333.5398 ***	98932.4299 ***	101512.6627 ***
	(12.9213)	(11.6926)	(11.8043)	(10.0478)	(8.7620)	(7.4982)
R^2	0.1797	0.1748	0.1726	0.1713	0.1709	0.1661

Notes: Same as Table 3.

Table 5. Price per floor area models with QR and OLS: samples without final walkthrough permission

$$PPFA_i = x'_i\beta + \varepsilon_i$$

Variable	OLS	Quantile Regression				
		0.95	0.90	0.85	0.75	0.70
C	18852.0916	97826.7781	10204.3079	4334.9904	18970.6715	20264.3088
	(0.2293)	(1.3776)	(0.1544)	(0.0685)	(0.3565)	(0.4305)
FA	-1216.1607 ***	-680.4055 **	-1253.0093 ***	-1207.5889 ***	-1066.4544 ***	-820.3966 ***
	(-3.8911)	(-2.5204)	(-4.9878)	(-5.0221)	(-5.2720)	(-4.5852)
GA	6176.9180 ***	9130.2804 ***	8013.8211 ***	5448.9484 ***	5377.3387 ***	3865.6052 ***
	(5.2034)	(8.9047)	(8.3989)	(5.9664)	(6.9989)	(5.6882)
DNOA1	86568.7768 *	128294.5063 ***	160892.7758 ***	184218.3554 ***	155997.0291 ***	167023.1587 ***
	(1.9250)	(3.3029)	(4.4511)	(5.3246)	(5.3596)	(6.4877)
DNOA2	69390.5884 *	47277.8459	80698.1596 **	95596.1524 ***	101092.0383 ***	118961.4130 ***
	(1.6779)	(1.3235)	(2.4277)	(3.0046)	(3.7768)	(5.0247)
DNOA3	-4860.2888	-894.4817	26579.5639	34024.6704	36937.6022	38538.4385 *
	(-0.1197)	(-0.0255)	(0.8142)	(1.0890)	(1.4052)	(1.6576)
TFL	33748.2990 ***	42576.7127 ***	42400.0512 ***	35593.3759 ***	29908.2807 ***	25872.2971 ***
	(7.9262)	(11.5773)	(12.3893)	(10.8660)	(10.8531)	(10.6144)
FL	-22916.9397	-13512.3602	-9335.1242	-5284.5655	-14805.9272	-6601.0048
	(-1.5613)	(-1.0658)	(-0.7913)	(-0.4680)	(-1.5585)	(-0.7856)
GROUND	36843.4953	312671.7931 ***	110406.7686 ***	104235.1821 ***	74051.1390 **	69399.5144 **
	(0.7566)	(7.4335)	(2.8206)	(2.7822)	(2.3494)	(2.4893)
HIGH4	6604.5514	-58982.7117 **	-39801.5784	-21295.9211	-2115.7094	-23598.3565
	(0.2049)	(-2.1185)	(-1.5362)	(-0.8588)	(-0.1014)	(-1.2788)
D2007Q2	-57326.3593	-57951.4864	-48751.5391	-25728.6494	-30330.2005	-37208.7802
	(-0.7448)	(-0.8717)	(-0.7881)	(-0.4345)	(-0.6089)	(-0.8445)
D2007Q3	14751.3454	-12834.2468	25817.4956	18897.5614	40825.3960	23476.2527
	(0.2119)	(-0.2134)	(0.4614)	(0.3528)	(0.9061)	(0.5890)
D2007Q4	24405.2521	-416.0055	34267.9271	41400.5411	37904.1073	41813.5945
	(0.3355)	(-0.0066)	(0.5861)	(0.7398)	(0.8051)	(1.0041)
D2008Q1	7082.4325	76315.7062	74745.2067	6193.3652	15416.1441	-11908.6408
	(0.0981)	(1.2244)	(1.2887)	(0.1116)	(0.3301)	(-0.2883)
D2008Q2	4640.9003	21515.1373	35616.2327	30071.0894	14596.1446	16024.6555
	(0.0667)	(0.3578)	(0.6364)	(0.5614)	(0.3239)	(0.4020)
D2008Q3	-4143.8264	-14313.2896	22827.5774	43887.1223	50364.0410	60104.7285
	(-0.0534)	(-0.2137)	(0.3663)	(0.7357)	(1.0036)	(1.3541)
D2008Q4	-23132.1831	105125.3066	55733.7843	47455.3138	48071.8111	37094.7749
	(-0.3003)	(1.5801)	(0.9002)	(0.8008)	(0.9642)	(0.8412)
D2009Q1	41253.7102	199983.6022 **	224141.4631 ***	88126.0932	78433.0372	89159.4153 *
	(0.4425)	(2.4833)	(2.9909)	(1.2286)	(1.2998)	(1.6704)
D2009Q2	27517.6176	58840.4524	91797.7476 *	75272.0400	58217.0785	44965.2090
	(0.4152)	(1.0278)	(1.7231)	(1.4761)	(1.3571)	(1.1850)
D2009Q3	195896.3260 ***	262550.5321 ***	278930.3687 ***	216603.8021 ***	136679.4460 ***	123336.5328 ***
	(2.8607)	(4.4389)	(5.0676)	(4.1114)	(3.0838)	(3.1461)
D2009Q4	127394.7001 *	214747.5480 ***	217253.5356 ***	192835.0797 ***	143404.1917 ***	126807.0506 ***
	(1.9315)	(3.7696)	(4.0981)	(3.8003)	(3.3594)	(3.3584)
D2010Q1	210865.5772 ***	540414.2174 ***	292001.2889 ***	258234.0999 ***	161077.5807 ***	155956.3546 ***
	(2.9506)	(8.7548)	(5.0833)	(4.6967)	(3.4824)	(3.8119)
LOC2	115966.7930 **	139284.7382 ***	174657.2887 ***	203334.5606 ***	91415.1783 **	97162.5691 ***
	(1.9788)	(2.7516)	(3.7078)	(4.5098)	(2.4100)	(2.8960)
LOC3	26619.0986	-32231.5451	4391.4428	17602.5772	39907.2056	37645.0699
	(0.6469)	(-0.9069)	(0.1328)	(0.5560)	(1.4985)	(1.5981)
LOC4	121152.8035 ***	34198.2439	64647.1582 **	92021.3541 ***	108060.9300 ***	95332.5611 ***
	(3.5271)	(1.1527)	(2.3415)	(3.4822)	(4.8607)	(4.8481)
LOC5	196120.0290 ***	172328.1092 ***	185102.5057 ***	207257.9562 ***	253361.6902 ***	219647.4181 ***
	(4.6438)	(4.7242)	(5.4529)	(6.3789)	(9.2691)	(9.0849)
R^2	0.2660	0.3041	0.3151	0.3077	0.3065	0.3053

Notes: Same as Table 3.

Table 5. Price per floor area models with QR and OLS: samples without final walkthrough permission

$$PPFA_i = x'_i\beta + \varepsilon_i \quad \text{(Continuous)}$$

Variable	Quantile Regression					
	0.65	0.60	0.55	0.50	0.45	0.40
C	20728.5607	18770.6652	32834.5121	37668.1385	48116.2447	39416.9323
	(0.4793)	(0.4536)	(0.8219)	(0.9790)	(1.2219)	(0.9806)
FA	-668.4198 ***	-644.4972 ***	-600.5535 ***	-556.4531 ***	-553.7641 ***	-684.5203 ***
	(-4.0661)	(-4.0974)	(-3.9544)	(-3.8046)	(-3.6993)	(-4.4798)
GA	3163.9088 ***	3187.4342 ***	3226.5799 ***	3206.4359 ***	3238.2127 ***	3275.2704 ***
	(5.0673)	(5.3353)	(5.5937)	(5.7720)	(5.6955)	(5.6435)
DNOA1	150867.7982 ***	155905.5415 ***	129306.4168 ***	122853.3884 ***	124249.3478 ***	128554.0768 ***
	(6.3783)	(6.8886)	(5.9174)	(5.8378)	(5.7687)	(5.8471)
DNOA2	124863.9049 ***	117662.9358 ***	112552.4554 ***	104545.4755 ***	95792.1568 ***	97813.8424 ***
	(5.7403)	(5.6533)	(5.6009)	(5.4021)	(4.8362)	(4.8378)
DNOA3	44365.2171 **	46781.7422 **	45003.0014 **	32341.5656 *	28795.1458	30379.7073
	(2.0769)	(2.2888)	(2.2804)	(1.7017)	(1.4804)	(1.5301)
TFL	24531.4325 ***	23221.3072 ***	22890.3556 ***	22066.3140 ***	20548.7673 ***	19441.8541 ***
	(10.9541)	(10.8369)	(11.0639)	(11.0748)	(10.0766)	(9.3399)
FL	-5628.7249	-3909.4942	-7155.9246	-5950.9964	-7011.3314	-4227.1859
	(-0.7291)	(-0.5292)	(-1.0033)	(-0.8664)	(-0.9973)	(-0.5891)
GROUND	82293.8516 ***	82454.8116 ***	73827.3019 ***	63550.6355 ***	43346.5292 *	45196.0447 *
	(3.2128)	(3.3644)	(3.1199)	(2.7887)	(1.8585)	(1.8983)
HIGH4	-9183.9549	-5680.6492	-4836.9834	-7298.8934	-13050.7914	-16642.2725
	(-0.5417)	(-0.3502)	(-0.3088)	(-0.4839)	(-0.8454)	(-1.0561)
D2007Q2	-33060.6216	-42983.1992	-36617.7388	-27874.2636	-52119.1641	-45220.5581
	(-0.8167)	(-1.1097)	(-0.9791)	(-0.7739)	(-1.4139)	(-1.2018)
D2007Q3	11867.4942	12682.1803	-1541.2792	-242.8637	-9957.1445	-4326.6181
	(0.3241)	(0.3620)	(-0.0456)	(-0.0075)	(-0.2986)	(-0.1271)
D2007Q4	29580.9416	26863.0468	13596.4710	11799.2723	2793.7969	-1291.1666
	(0.7732)	(0.7338)	(0.3847)	(0.3466)	(0.0802)	(-0.0363)
D2008Q1	-13033.5379	-18050.6075	-24632.6973	-20638.2223	-23660.7119	-17638.9589
	(-0.3434)	(-0.4970)	(-0.7025)	(-0.6112)	(-0.6846)	(-0.5000)
D2008Q2	2540.1046	1151.6463	-2806.0972	-1180.5174	-5657.2432	-11175.8411
	(0.0694)	(0.0329)	(-0.0829)	(-0.0362)	(-0.1697)	(-0.3283)
D2008Q3	60725.7031	22744.5608	10802.0310	1783.5295	-21698.8722	-15640.4710
	(1.4891)	(0.5829)	(0.2867)	(0.0492)	(-0.5843)	(-0.4126)
D2008Q4	1288.1288	8252.3519	-8113.2613	-25978.8930	-29327.8490	-36584.3967
	(0.0318)	(0.2129)	(-0.2168)	(-0.7207)	(-0.7950)	(-0.9715)
D2009Q1	23927.8971	18150.3176	-4659.4336	-3756.0655	2140.5698	-49899.6529
	(0.4879)	(0.3868)	(-0.1028)	(-0.0861)	(0.0479)	(-1.0947)
D2009Q2	36767.4580	38081.7548	9477.7058	5039.5088	-7605.6552	-8871.3895
	(1.0547)	(1.1416)	(0.2943)	(0.1625)	(-0.2396)	(-0.2738)
D2009Q3	122871.9817 ***	102495.2483 ***	99797.7505 ***	82985.6251 ***	80159.1423 **	58231.3917 *
	(3.4114)	(2.9740)	(2.9992)	(2.5896)	(2.4440)	(1.7393)
D2009Q4	106414.8376 ***	97849.2147 ***	82012.6643 **	57631.9079 *	46962.9575	43338.9356
	(3.0675)	(2.9479)	(2.5590)	(1.8673)	(1.4867)	(1.3440)
D2010Q1	137150.9606 ***	129860.1971 ***	129853.5151 ***	128777.2597 ***	115065.9187 ***	111927.9831 ***
	(3.6487)	(3.6106)	(3.7393)	(3.8506)	(3.3617)	(3.2035)
LOC2	86570.5514 ***	72950.8283 **	72941.1834 **	70913.7532 **	70935.6251 **	70610.9636 **
	(2.8084)	(2.4734)	(2.5614)	(2.5857)	(2.5272)	(2.4644)
LOC3	28861.8901	32688.1650	30851.7523	32806.0009 *	37218.0310 *	39046.5379 *
	(1.3335)	(1.5785)	(1.5430)	(1.7037)	(1.8885)	(1.9410)
LOC4	89183.6955 ***	80913.7078 ***	79594.4368 ***	71811.5927 ***	79985.5090 ***	88466.1815 ***
	(4.9364)	(4.6807)	(4.7688)	(4.4676)	(4.8619)	(5.2680)
LOC5	208510.5069 ***	194810.6634 ***	195227.5865 ***	186995.7082 ***	197611.5285 ***	198024.5526 ***
	(9.3867)	(9.1657)	(9.5133)	(9.4618)	(9.7696)	(9.5908)
R^2	0.3078	0.3041	0.2972	0.2900	0.2801	0.2689

Notes: Same as Table 3.

Table 5. Price per floor area models with QR and OLS: samples without final walkthrough permission

$$PPFA_i = x'_i\beta + \varepsilon_i$$ (Continuous)

Variable	Quantile Regression					
	0.35	0.30	0.25	0.15	0.10	0.05
C	75509.1855 *	68483.3308 *	63335.6745	31383.9376	21012.1344	61688.9127
	(1.9281)	(1.7437)	(1.6070)	(0.7503)	(0.4305)	(1.1204)
FA	-673.6043 ***	-690.9820 ***	-659.2162 ***	-666.5220 ***	-594.7805 ***	-174.4025
	(-4.5246)	(-4.6283)	(-4.3999)	(-4.1917)	(-3.2053)	(-0.8332)
GA	3368.5761 ***	3403.1346 ***	3563.2621 ***	3869.1568 ***	3738.1665 ***	2005.1059 **
	(5.9573)	(6.0015)	(6.2617)	(6.4065)	(5.3039)	(2.5222)
DNOA1	88031.4545 ***	95697.4171 ***	85697.9956 ***	77934.4313 ***	70312.5029 ***	-21805.8297
	(4.1096)	(4.4548)	(3.9753)	(3.4064)	(2.6334)	(-0.7241)
DNOA2	78116.4968 ***	81772.2802 ***	73662.0510 ***	55752.0296 ***	52699.8080 **	16706.6971
	(3.9655)	(4.1394)	(3.7157)	(2.6498)	(2.1463)	(0.6032)
DNOA3	14013.5663	26501.3672	39038.4070 **	46859.7998 **	45091.2681 *	23107.1384
	(0.7244)	(1.3661)	(2.0052)	(2.2679)	(1.8700)	(0.8496)
TFL	16618.0688 ***	16496.9565 ***	14703.5554 ***	15443.0506 ***	16188.2772 ***	9804.9366 ***
	(8.1938)	(8.1112)	(7.2039)	(7.1292)	(6.4038)	(3.4387)
FL	-6271.8479	-11247.3784	-3780.4356	-1148.2968	-3166.4814	-1156.7258
	(-0.8971)	(-1.6042)	(-0.5373)	(-0.1538)	(-0.3634)	(-0.1177)
GROUND	23321.6654	-3287.1359	-12262.0469	-8008.9098	-20390.0370	-8046.2935
	(1.0054)	(-0.1413)	(-0.5253)	(-0.3233)	(-0.7052)	(-0.2467)
HIGH4	-19735.2671	-14987.1986	-16597.3442	-12946.5935	-26981.1047	-45702.4518 **
	(-1.2854)	(-0.9734)	(-1.0741)	(-0.7895)	(-1.4099)	(-2.1172)
D2007Q2	-41231.3152	-35728.4377	-43227.8642	-34723.2964	-31672.1839	-2016.8354
	(-1.1247)	(-0.9718)	(-1.1717)	(-0.8868)	(-0.6931)	(-0.0391)
D2007Q3	-80.8152	4957.7247	-8871.1634	-2204.0732	2980.3877	-12032.3095
	(-0.0024)	(0.1491)	(-0.2658)	(-0.0622)	(0.0721)	(-0.2581)
D2007Q4	-6490.8648	-440.6087	-21655.3843	-268.3157	11042.9924	-17329.2484
	(-0.1873)	(-0.0127)	(-0.6211)	(-0.0073)	(0.2557)	(-0.3557)
D2008Q1	-12999.6863	-246.6134	3528.2134	4942.0993	-24084.2979	-136.0506
	(-0.3782)	(-0.0072)	(0.1020)	(0.1346)	(-0.5621)	(-0.0028)
D2008Q2	-19747.4981	-5787.1788	-16438.4295	-41350.0137	-23090.8207	-23593.5563
	(-0.5955)	(-0.1740)	(-0.4925)	(-1.1674)	(-0.5586)	(-0.5060)
D2008Q3	-40564.7556	-25693.9985	-25454.3759	-15874.4446	-30100.9708	-61373.8124
	(-1.0984)	(-0.6937)	(-0.6849)	(-0.4024)	(-0.6539)	(-1.1820)
D2008Q4	-49172.8710	-54621.1051	-45228.9357	-79256.3348 **	-73006.4762	-97342.9858 *
	(-1.3402)	(-1.4845)	(-1.2249)	(-2.0224)	(-1.5964)	(-1.8871)
D2009Q1	-6004.7801	-18583.6847	-28783.0109	-41395.4282	-48870.3494	-104352.6709 *
	(-0.1352)	(-0.4173)	(-0.6440)	(-0.8727)	(-0.8829)	(-1.6713)
D2009Q2	-23592.0975	-24330.5128	-24025.4882	-15569.9456	-6302.3747	-15506.8087
	(-0.7473)	(-0.7685)	(-0.7562)	(-0.4617)	(-0.1602)	(-0.3494)
D2009Q3	46151.1983	39302.8695	39171.7549	32744.7285	36730.4305	39007.6729
	(1.4149)	(1.2015)	(1.1933)	(0.9399)	(0.9034)	(0.8506)
D2009Q4	34941.4734	42492.6688	31287.7543	28112.3014	32246.9178	11318.7107
	(1.1122)	(1.3487)	(0.9896)	(0.8378)	(0.8235)	(0.2563)
D2010Q1	108085.8946 ***	99455.8274 ***	73984.5213 **	40780.2418	42797.3972	-1230.4758
	(3.1751)	(2.9133)	(2.1596)	(1.1216)	(1.0086)	(-0.0257)
LOC2	54085.1096 *	62301.9031 **	43169.3846	31426.5848	23519.4942	40604.7788
	(1.9374)	(2.2255)	(1.5366)	(1.0540)	(0.6759)	(1.0346)
LOC3	33113.3024 *	32343.1384	22926.8623	14253.6716	16212.4568	14049.0434
	(1.6894)	(1.6455)	(1.1623)	(0.6809)	(0.6636)	(0.5098)
LOC4	92506.4448 ***	90305.7487 ***	86982.0679 ***	66108.3727 ***	69372.5156 ***	36378.9129
	(5.6539)	(5.5038)	(5.2826)	(3.7830)	(3.4017)	(1.5815)
LOC5	187914.8401 ***	185721.7668 ***	164982.1591 ***	131848.0764 ***	109887.5660 ***	95971.1420 ***
	(9.3411)	(9.2061)	(8.1492)	(6.1364)	(4.3825)	(3.3933)
R^2	0.2591	0.2488	0.2375	0.2212	0.2066	0.2089

Notes: Same as Table 3.

Table 6. Chow test in QR and OLS

Quantile	F-statistic	p-value	Quantile	F-statistic	p-value
0.05	-40.1195	0.0000 ***	0.95	-40.3785	0.0000 ***
0.10	-39.8086	0.0000 ***	0.90	-39.2831	0.0000 ***
0.15	-39.9180	0.0000 ***	0.85	-40.1281	0.0000 ***
0.20	-40.3097	0.0000 ***	0.80	-39.5429	0.0000 ***
0.25	-40.2292	0.0000 ***	0.75	-40.0583	0.0000 ***
0.30	-40.1909	0.0000 ***	0.70	-40.4575	0.0000 ***
0.35	-40.1647	0.0000 ***	0.65	-40.5128	0.0000 ***
0.40	-40.2662	0.0000 ***	0.60	-40.6281	0.0000 ***
0.45	-40.2288	0.0000 ***	0.55	-40.5016	0.0000 ***
0.50	-40.4765	0.0000 ***	OLS	-40.1631	0.0000 ***

Notes: Table shows Chow test F-statistic. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

5. Conclusion

As stated by Zietz et al. (2008) and Shie & Chang (2010), the marginal effect in conventional OLS model results in over-estimation of the properties with comparatively low prices, and under-estimation of properties with comparatively higher prices. In comparison, QR provides a more accurate analysis. In this study, QR is used to analyze sub-market models, meaning that the relative importance of PPFA sample data is segmented by different weights; that is, the analysis of the behavior of different quantiles and the segmentation of the sub-markets is distinguished by PPFA.

Though QR has advantages in analysis, because housing price is discovered in this study to be affected by numerous characteristic factors, this study discovers a critical variable for segmenting markets: namely, whether the property is given permission for a final walkthrough. This study observes that in the sub-market of those foreclosed houses for which a final walkthrough is permitted, as the price per ping exceeds a certain threshold, the law of diminishing marginal utility is not applicable in the relationship between floor area and the unit price per ping. For the sub-market of foreclosed houses for which a final walkthrough is not permitted, the property conditions are of relatively lower worth, and a diminishing marginal effect appears. The results of this study could also explain the phenomenon that the price of a property with a high price would increase, and the price of a property with a low price would decrease.

This study uncovers the importance of examining sub-markets in high-diversity markets such as that of real estate. Competitive behavior in sub-markets will be distorted if the market is not segmented appropriately (Tables 3-5), and erroneous results will be generated even with QR analysis. That is, analyzing foreclosed houses without the final walkthrough permissions using the data listed in Table 3 would result in incorrect bidding strategies. The results of this study met the characteristics of a typical submarket with an appropriate substitute as defined by Grigsby et al. (1987); that is,

substitutes between submarkets are relatively low, but substitutes within submarkets should be high. According to empirical data, this study recommend that, in different submarkets (e.g., a quantile of 0.95), the bidder with final walkthrough permission should decide to increase the bidding price when FA increases. However, when the final walkthrough permission is absent, the bidding price should be reduced in bidding decision making to lower the house purchase cost when FA increases. Therefore, though this result may be attributed to the uniqueness of the foreclosure market in Taiwan, this study suggests that the market be appropriately segmented for future discussion of issues related to housing prices.

Finally, in the twenty characteristics appearing most often in hedonic pricing model studies proposed by Sirmans et al. (2005), variables such as Square Feet demonstrated this contradiction; furthermore, other variables such as Age, Stories, Bathrooms, Rooms, Bedrooms, Full Baths, Fireplace, Air Conditioning, Basement, Distance, Time on Market, and Time trend also demonstrated an inconsistent relationship with unit price. Consequently, the question as to which variables are the most influential factors affecting housing prices must be discussed further. Regarding variables such as the number of rooms, this study observed that for consumers who are interested in buying expensive housing, the number of rooms is of less importance compared to room space. Thus, this study recommend that future studies further examine these variables. However, because some of the variables cannot be determined using the data provided by courts, this study suggest that courts revise the policy of data declaration, such as increasing information on bathrooms, rooms, bedrooms, and full baths, to offer additional references for bidders and researchers, thereby facilitating in-depth investigation.

Note

1: In Taiwan, a house is foreclosed frequently because a debtor does not return debt owed to a creditor; and to preserve his or her claim, the creditor can make a claim to a court for the execution of a promissory note based on the evidence of debt or promissory note. After providing the debtor with 15 days notice, and in the absence of a declaration of objection from the debtor, the court will grant a final verdict for promissory note to the creditor, which enables the creditor to obtain a voucher of the creditor's right. Subsequently, the creditor can apply to the court for the seizure of the debtor's housing on the grounds of this voucher, and use the purchase money obtained from the housing auction to clear the debt.

2: The reason for collateral auctioning is a debtor's inability to repay a collateralized debt, which leads the creditor to appeal to a court for seizing the collateralized property of the debtor. The collateralized property is subsequently auctioned, and becomes a foreclosed house.

3: According to Article 39 of the Tax Collection Act of Taiwan, any taxpayer who fails to pay the tax due within 30 days after expiration of the statutory period for payment of such tax shall be referred to the court by the tax collection authorities for compulsory enforcement. The money obtained from the auctioning of the tax defaulter's seized real estate will be used to clear the overdue tax.

4: For example, with or without a final walkthrough, the number of auctions, floor area, etc.

5: For example, Trump & Mclver (2004) "Trump: How To Get Rich".

6: The location of administrative districts can find in the following website: http://english.taipei.gov.tw/np.asp?ctNode=27185&mp=100002.

7: The unit of floor area in Taiwan is "ping"; 1 ping = 3.30579 square meters.

8: Similar to the studies by Liao & Chang (2009) and Shie & Chang (2010), macroeconomic variables were not considered because temporal factors of seasons were controlled in this study.

9: Greene (2003): "Social scientists are almost never able to analyze experimental data, and relatively few of their models are built around non-stochastic regressors. Clearly, for example, in any macroeconomic model, it would be difficult to defend such an asymmetric treatment of aggregate data."

10: Cross-section data were used. The scope of the data was the most complete data that could be collected during the research period.

11: In this study, the dependent variable was revised to total price (i.e., auction price; AP). Tables 3 to 5 were used again for comparison. The results showed that all of the FA coefficients that were the focus of this study were positively correlated. This result was not surprising because the total price was determined using PPFA multiplied by FA. Based on this result, we determined the variable that was required to be considered to improve the accuracy of bidding decision making was PPFA.

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