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Research article

The Price Concessions of High- and Low-Priced Housing in a Period of Financial Crisis

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Abstract: This study uses the data from the Taiwan housing market and three methods to estimate the liquidity of high- and low-priced housing markets. The first method in this study used quantile regressions to estimate the relationship between time on the market and final transaction price. The second method involved adding variables representing housing price characteristics to the quantile regression model to control the influence of other housing characteristics and estimate the relationship between time on the market and transaction price. Lastly, this study estimated the price concessions that individual sellers accept to realize an asset. All empirical results showed that lower housing prices imply higher liquidity costs in the final transaction, and the average rate of price concession for low-priced housing was greatest at approximately 7%. The results of this study demonstrate that in an emerging market with a significant divide between rich and poor, when a financial crisis occurs, the most vulnerable sellers of real estate are the poor. The government should pay particular attention to the liquidity of the low-priced housing market and provide adequate avenues of funding to low-income families, to prevent them from becoming the greatest losers in a period of financial crisis.

Keywords: time on the market; price concession; liquidity; hedonic price model; quantile regression

1. Introduction

Compared to other asset markets, real estate's greatest weakness is its lack of liquidity. Surprisingly, despite this truism, few studies have comprehensively analyzed real estate liquidity. Compared to rigorous research conducted on liquidity in other markets, researchers have seldom studied the particular lack of and problems concerning liquidity that demand resolution in the real estate market. The main reason concerns the difficulty in obtaining information. Assets with high liquidity are traded in concentrated markets, making transaction information readily available. A comprehensive collection of information on individual real estate transactions is difficult, which is why scholars have mainly analyzed the housing price index. However, this method does not capture the price concession that each dealer has accepted to realize a return on investment as well as the cost of the waiting. Consequently, the issue of liquidity problems has become a dead-end in real estate market research.

The lack of the literature on real estate market liquidity inhibits traders in making optimal decisions, and also real estate market managers cannot gauge the impact of policies established under various market conditions. Hence, this study wants to use the data from the Taiwan housing market, cases of Taipei residential real estate transactions from 2007 to 2008, to understand the different liquidity of high- and low-priced housing.

The liquidity of an asset refers to the time and cost involved in asset realization. It measures the cost of time and the final transaction. In the real estate market, the length of time on the market represents its cost; meanwhile, a transaction includes not only procedural fees and taxes, but also the difference between the asset and transaction price, which is termed the selling price concession. Excluding procedural fees and taxes, in discussing the liquidity of different real estate with different standards, the most representative factors are time on the market and selling price concessions. The former represents the cost of time in liquidity; the latter is the implied monetary cost of transaction[1]. Although studies have mentioned the time on the market and selling price concessions as well as related variables, few have focused on real estate market liquidity. The relationship between these two variables has remained unexamined because they relate to varying pricing strategies of sellers.

Asabere and Huffman (1993) investigated the bargaining room for sellers pricing strategies and the relationship between final transaction price and time on the market. They found that the length of time on the market required for the final real estate transaction price closely approximated market price, matching the length of time required for ordinary transactions. The length of time on the market required for the final transaction price of real estate to exceed the market price was longer than the length of time required for ordinary transactions. Under these conditions, the real estate market is a seller's market and sellers may gain higher net income. The length of time on the market required for a real estate transaction price lower than the market price requires less than the length of time required for ordinary transactions. These

[1]"Implied monetary cost" refers to the fact that this cost is not necessarily actually paid monetarily in the way that procedural fees, commissions, and taxes are paid.

circumstances indicate a buyer's market; sellers provide more discounts and the market environment influences the bargaining capacity of their pricing strategies.

Regardless of market, this study believes that the conditions are not only influenced by externally but also by the seller's personal financial needs. If the seller has lower needs or more funding sources, he or she may have adequate waiting. In this case, a lengthier time on the market may result in a more satisfactory selling price. In contrast, if the seller has greater personal financial need or fewer avenues for funding and is anxious to sell the house, he or she will respond to a lengthier time on the market by continually reducing the selling price. The result is a lower final transaction price.

Although information on the financial circumstances of sellers is unobtainable, observations of market liquidity for lower-priced and higher-priced housing may prove or disprove the above theory. In general, sellers of higher-priced housing have greater financial ability and more adequate time to await a sale. Therefore, they do not often experience conceding the housing value those results from expediting a transaction. However, sellers of lower-priced housing generally have less financial ability and fewer avenues for funding; therefore, their financial needs when selling real estate are greater. For instance, anxiety to close results in more willingness to concede the original markup. In doing so they save time and energy.

Therefore, apart from observing housing market liquidity, this study separately observed the liquidity of housing markets with varying selling price standards. The first approach used quantile regression to estimate the relationship between time on the market and final transaction price; the second approach added the characteristics of housing price as a control variable to more rigorously examine the relationship between time on the market and final transaction price. Lastly, this study estimated the price concessions that individual dealers accept to realize asset returns.

For analysis, this study used information on the Taiwanese real estate market between 2007 and 2008. Taiwan is an emerging market and its economic growth and real estate market development have both been rapid. Housing prices in Taipei City, in particular, have grown at an astounding rate. Using information on the real estate market between 2007 and 2008, coinciding with the subprime mortgage crisis and Lehman financial crisis, made liquidity easier to observe and study. In addition, like other developed and developing countries, Taiwan faces large wealth inequality. Therefore, observing the liquidity of lower- and higher-priced housing facilitated a deeper understanding of problems that the average housing price index alone could not reveal. This understanding assisted researchers in determining the greatest victims of the great contraction induced by real estate derivatives.

The paper is organized as follows: Section 2 reviews the literatures. Section 3 illustrates the methodology used in this paper. Section 4 presents the data and discusses the empirical results. Section 5 concludes the paper.

2. Literature Reviews

Few previous studies have focused on real estate liquidity; most references have superficially examined variables that influence or determine market liquidity. The section below describes the

results past literature research on variables related to real estate liquidity:

2.1. Price Concessions

Concerning price concessions, past references focused on the relationship between the original seller price and the final transaction price, determining the overestimation value. Belkin et al. (1976), Miller and Sklarz (1987), Larsen and Park (1989), Ferreira and Sirmans (1989), and Kang and Gardner (1989) used comparisons of this difference (final transaction price was viewed as the equilibrium price, which replaced the real estate value) to estimate the influence of these two variables on the expected sales time. Results indicated that greater overestimation of list price as compared to final transaction price implied a lengthier than expected market time. However, considering that price-loss measurements from transaction for other assets are calculated by subtracting the final transaction price from the equilibrium market price, it could be said that the actual focus of the above references was the seller pricing strategies. Therefore, the results are inapplicable to measuring the cost of transaction in liquidity.

If the same variable definition and formula are used, and information on final transaction price is available, then the equilibrium market price may be estimated. This study used the final transaction price and real estate variable characteristics to estimate housing prices. Using all evaluation samples, the level of price concession (price loss from the transaction cost) was calculated from the final transaction price for each sample.

Miller and Sklarz (1987) felt that, based on the cost of time-sensitive opportunities, the seller seeks the greatest net present value (NPV). In theory, the greatest present value for the final transaction price of real estate equals the market value. Therefore, the final transaction price could serve as a reference for market price. To avoid sample bias, a large number of samples calculate the average level of final transactions, yielding a reasonable market price; however, a large number of samples have feature differences, so for use in segmentation, other real estate characteristics should be considered.

After Rosen (1974) proposed the hedonic price model, many domestic and international studies (Asabere and Huffman (1993), Yavas and Yang (1995), Jud et al. (1995), and Anglin et al. (2003)) were able to find the determinant of the expected market price. This study referred to the variables used in the above literature references, integrating them into the model for more accurate estimations for calculating the cost of liquidity from selling price concessions.

2.2. Time on the Market

Trippi (1977) and Miller (1978) identified that real estate agents and sellers have two contradictory purposes: to maximize final transaction prices and minimize market time. Therefore, the seller's pricing strategy, whether or not the transaction is made, and the length of time on the market are all important academic discussions Belkin et al. (1976), Larsen and Park (1989), Ferreira and Sirmans (1989), and Kang and Gardner (1989) proposed that when the list price of the seller and the final transaction price are relatively high, a longer market selling period results.

However, the level of influence of an overly high list price on the market time largely depends on other conditions.

Asabere and Huffman (1993) investigated the bargaining room for sellers pricing strategies and the relationship between final transaction price and time on the market. They found that the length of time on the market required for the final real estate transaction price closely approximated market price, matching the length of time required for ordinary transactions. The length of time on the market required for the final transaction price of real estate to exceed the market price was longer than the length of time required for ordinary transactions. Under these conditions, the real estate market is a seller's market and sellers may gain higher net income. The length of time on the market required for a real estate transaction price lower than the market price requires less than the length of time required for ordinary transactions. These circumstances indicate a buyer's market; sellers provide more discounts and the market environment influences the bargaining capacity of their pricing strategies.

Unlike Asabere and Huffman (1993), this study believes that the conditions are not only influenced by externally but also by the seller's personal financial needs. If the seller has lower needs or more funding sources, he or she may have adequate waiting. In this case, a lengthier time on the market may result in a more satisfactory selling price. In contrast, if the seller has greater personal financial need or fewer avenues for funding and is anxious to sell the house, he or she will respond to a lengthier time on the market by continually reducing the selling price. The result is a lower final transaction price.

Although information on the financial circumstances of sellers is unobtainable, observations of market liquidity for lower-priced and higher-priced housing may prove or disprove the above theory. In general, sellers of higher-priced housing have greater financial ability and more adequate time to await a sale. Therefore, they do not often experience conceding the housing value that results from expediting a transaction. However, sellers of lower-priced housing generally have less financial ability and fewer avenues for funding; therefore, their financial needs when selling real estate are greater. As a result, they might accept more price concessions for meeting personal financial needs. To observe this inference, this paper is intended as an investigation of the liquidity in high- and low-priced housing markets.

Additionally, if housing characteristics are not considered and only the relationship between list price, market selling time, and final transaction price are measured, the results are inevitably biased. For instance, whether the list price is too high is relative. If analysis is based on the levels of absolute prices, a contradictory outcome may result, such as that obtained by Cubbin (1974), who found that a higher list price implied a shorter selling period. This differed from commonly accepted information, yet Cubbin felt that this outcome might have been inadequate market information, and in evaluating quality of housing, buyers would use the seller's list price as an important indicator.

However, the outcome of the work of Cubbin (1974) may have resulted from higher listing prices coinciding with higher market prices. Regardless of pricing overestimations and high deviation between list price and expected market price significantly influenced his research results. Yavas and Yang (1995), Springer (1996), Glower et al. (1998), and Anglin et al. (2003)

considered the influence of list price and expected market price, or the deviation degree of the standard list price on the market-selling period. However, the empirical results by Yavas and Yang (1995) and Glower et al. (1998) were suboptimal. Springer (1996) and Anglin et al. (2003) did not use a simultaneous equation model to investigate the interactive relationship among the seller's pricing strategy, the final transaction price, and the selling period. This study used additional considerations concerning housing characteristics to evaluate concessions of various pricing standards.

Based on the above literature review, it is evident that past studies have researched individual variable effects on real estate market liquidity. Nevertheless, this study used a quantile regression to estimate the relationship between the selling period and final transaction price, evaluating the price concessions of housing with various selling price standards. In doing so, it observed the market liquidity of housing based on differing selling price standards.

3. Methodology

This study uses three methods to estimate the liquidity of high- and low-priced housing markets. The first method uses quantile regressions to estimate the relationship between time on the market and final transaction price. The second method adds variables representing housing price characteristics to the quantile regression model to control the influence of other housing characteristics and estimate the relationship between time on the market and transaction price. Lastly, this study estimates the price concessions that individual sellers accept to realize an asset. Three methods are described in the following.

3.1. The Quantile Regression of Time on the Market and Transaction Price

After Koenker and Bassett (1978) proposed the approach of quantile regression, several papers used this method to analyze different subjects. For example, Deaton (1997) applied quantile regression for demand analysis; Buchinsky (2001) used it to estimate a woman's return to education in the United States; and Bassett and Chen (2001) adopted this method's index models to characterize mutual fund investment styles.

The advantage of this approach is its capacity to permit estimation of various quantile functions in a conditional distribution. Empirical studies have been interested in analyzing the behavior of a dependent variable given the information contained in a set of explanatory variables. The traditional approach uses the ordinary least squares to estimate a linear regression model; however, this method only provides the estimation of median (0.5^{th} quantile) function. By using quantile regression, each quantile regression characterizes a particular point of the conditional distribution. Putting different quantile regressions together will be further useful, especially when the conditional distribution is heterogeneous. Since the goal of this paper is to emphasize on observing the various relationships between transaction price and time on the market, a quantile regression model is used to provide more details of the relationship. The model is briefly illustrated as follows.

Suppose there is a linear specification for the conditional quantiles of Y,

$$Y_i = X_i\beta + u_i \tag{1}$$

where, Y_i is the transaction price of a house; X_i is k × 1 regressors, which is constant, and the time on the market of the house; β is the coefficients the model wants to estimate, and the goal of the quantile regression model is to estimate β for different conditional quantile functions; and u_i is error term.

Suppose the conditional mean of Y is $\mu(X) = X'\beta$, the approach of ordinary least squares is to estimate the mean,

$$\min_{\mu \in R} \sum_{i=1}^{n} (Y_i - \mu)^2 \tag{2}$$

That is:

$$\min_{\beta \in R^p} \sum_{i=1}^{n} (Y_i - X_i'\beta)^2 \tag{3}$$

Solving Equation (3) will give the estimation of median (0.5^{th} quantile) function. For the other quantiles, we let τ stand for quantile variable. The conditional quantile function can be written as

$$Q_E(\tau|X) = X'\beta(\tau) \tag{4}$$

To obtain estimation of the conditional quantile functions, we need to solve

$$\min_{\beta \in R^p} \sum_{i=1}^{n} \rho_\tau (Y_i - X_i'\beta) \tag{5}$$

to minimize the following equation:

$$\min_{\hat{\beta}} \left[\tau \sum_{Y_i \geq \hat{\beta} X_i} \left| Y_i - \hat{\beta} X_i \right| + (1-\tau) \sum_{Y_i < \hat{\beta} X_i} \left| Y_i - \hat{\beta} X_i \right| \right] \tag{6}$$

where, $X_i'\hat{\beta}_\tau$ is an approximation to the τth conditional quantile of Y. When τ is close to zero (one), $X_i'\hat{\beta}_\tau$ characterizes the behavior of Y at the left (right) tail of the conditional distribution.

Koenker and d'Orey (1987) proposed that the minimization problems could be solved by linear programming methods.

3.2. Hedonic Price Model Using Quantile Regression

After Rosen (1974) proposed the approach of hedonic price model, many studies (Asabere and Huffman (1993), Yavas and Yang (1995), Jud et al. (1995), and Anglin et al. (2003)) were able to find the determinant of the expected market price. The paper uses the hedonic price model to control the influence of other housing characteristics and estimate the relationship

between time on the market and transaction price. The model described as follows.

$$HP_i = a_0 + a_1 LS_i + a_2 S_i + a_3 R_i + a_4 LR_i + a_5 BR_i + a_6 F_i + a_7 TF_i + a_8 A_i + a_9 GAR_i$$
$$+ a_{10} FORM1_i + a_{11} FORM2_i + a_{12} FORM3_i + \varepsilon_i$$

where *HP* is final transaction price; *LS* is registered number of pings (1 ping is approximately 3.3 m^2) of land; *S* is total number of pings in the building; *R* is number of rooms in the building; *LR* is number of living rooms in the building; *BR* is number of bathrooms; *F* is specific floor in the building; *TF* is total building height; *A* is age of the building; *GAR* is number of parking spaces; *FORM1* is apartment building; *FORM 2* is suite; *FORM3* is duplex[2].

3.3. The Estimation of Price Concessions

In this part, this paper estimates the price concessions that individual sellers accept to realize an asset. First, I use the hedonic price model and estimated coefficients given above, incorporate the housing characteristics of a home to find the expected market price of the house, i.e., the expected market price is:

$$\hat{HP}_i = \hat{a}_0 + \hat{a}_1 LS_i + \hat{a}_2 S_i + \hat{a}_3 R_i + \hat{a}_4 LR_i + \hat{a}_5 BR_i + \hat{a}_6 F_i + \hat{a}_7 TF_i + \hat{a}_8 A_i + \hat{a}_9 GAR_i$$
$$+ \hat{a}_{10} FORM1_i + \hat{a}_{11} FORM2_i + \hat{a}_{12} FORM3_i$$

Then, this study estimated the price concessions by calculating transaction price minus the expected market price, and the price concession rate is the price concession divided by transaction price.

4. Data and Empirical Results

4.1. Data

This study examined whether the liquidity of housing markets with dissimilar standards of housing price differed. This study used information from the Taiwanese housing market to research this topic, which was appropriate because Taiwan is an emerging market and its economic growth and the development of its real estate market in recent years have been rapid. In particular, the growth of the housing market in Taipei City has been astounding. Additionally, the problems of asset bubbles and an expanding divide between rich and poor in this market have been worsening, so observation of the difference between the high priced housing market

[2] This study used information on four types of residences: building, apartment, suite, and duplex. The model used dummy variables to control the differences between the types of residence. For example, if a residence were an apartment, suite, or duplex, the dummy variable for the correct type of residence would show a value of 1; if not, the dummy variable would show a value of 0. In this example, if the dummy variables for apartment, suite, and duplex all showed a value of 0, this result would demonstrate that the sampled residence is a building.

and the low priced housing market is particularly needed.

This study used information on housing sale transactions from 2007–2008 for research. Because these two years coincided with the subprime mortgage crisis and the Lehman financial crisis, the economy during this period was more volatile, which facilitated easier observation of the cost of liquidity in the real estate market. The information used in this study was gathered from official reports on transactional trends in the Taiwanese real estate market. Gigahouse, Taiwan's Real Estate Portal, produced these reports by compiling information on transactions and prices from the 12 largest real estate agencies in Taiwan. As mentioned above, the Taipei City housing market has been the foremost real estate market in Taiwan, and its volume of transactions comprises a large part of the total amount of transactions in the Taiwanese housing market. During the sampling period, 8,568 samples were collected from Taipei City alone, so this study selected the housing market in Taipei City as a case study and investigated its liquidity. Table 1 shows the variables used in this study and corresponding statistics.

Table 1. Descriptive statistics for relevant variables.

	HP	*LS*	*S*	*R*
Sample Size	8594.0000	8392.0000	8594.0000	8568.0000
Range	27946.0000	1086.3000	509.5600	30.0000
Mean	1178.1000	7.8587	31.3880	2.4915
Variance	978740.0000	188.7400	318.9200	1.8045
Std. Deviation	989.3100	13.7380	17.8580	1.3433
Coef. Of Variation	0.8397	1.7482	0.5690	0.5392
Std. Error	10.6720	0.1500	0.1926	0.0145
Skewness	7.6978	59.3470	6.2973	1.3268
Excess Kurtosis	134.2500	4555.3000	122.8700	22.1440
Min	54.9200	0.0000	2.8600	0.0000
5%	362.5400	1.3100	11.0650	0.0000
10%	460.1800	1.8500	13.4900	1.0000
25% (Q1)	659.7100	3.7200	21.1900	2.0000
50% (Median)	950.1500	7.0500	29.4800	3.0000
75% (Q3)	1409.8000	9.8300	37.5520	3.0000
90%	2058.0000	13.0100	48.4100	4.0000
95%	2601.3000	16.0430	58.7370	4.0000
Max	28001.0000	1086.3000	512.4200	30.0000

Notes: where *HP* is final transaction price; *LS* is registered number of pings (1 ping is approximately 3.3 m^2) of land; *S* is total number of pings in the building; *R* is number of rooms in the building.

Table 1. Descriptive statistics for relevant variables (continued).

	LR	*BR*	*F*	*TF*
Sample Size	8568.0000	8568.0000	8489.0000	8568.0000
Range	9.0000	9.0000	29.0000	30.0000
Mean	1.6807	1.5742	4.8661	8.1359
Variance	0.4532	0.6219	10.6300	18.0780
Std. Deviation	0.6732	0.7886	3.2603	4.2519
Coef. Of Variation	0.4005	0.5010	0.6700	0.5226
Std. Error	0.0073	0.0085	0.0354	0.0459
Skewness	-0.2747	2.6263	1.2711	1.0684
Excess Kurtosis	5.3708	13.9430	1.8451	1.2200
Min	0.0000	0.0000	-2.0000	0.0000
5%	0.0000	1.0000	1.0000	4.0000
10%	1.0000	1.0000	2.0000	4.0000
25% (Q1)	1.0000	1.0000	3.0000	5.0000
50% (Median)	2.0000	1.5000	4.0000	7.0000
75% (Q3)	2.0000	2.0000	6.0000	12.0000
90%	2.0000	2.0000	10.0000	14.0000
95%	2.0000	3.0000	12.0000	16.0000
Max	9.0000	9.0000	27.0000	30.0000

Notes: *LR* is number of living rooms in the building; *BR* is number of bathrooms; *F* is specific floor in the building; *TF* is total building height.

Table 1. Descriptive statistics for relevant variables (continued).

	A	*GAR*	*ST*
Sample Size	8430.0000	8594.0000	8593.0000
Range	248.0000	4.0000	1176.0000
Mean	21.2880	0.1683	43.1880
Variance	130.1000	0.1428	3358.7000
Std. Deviation	11.4060	0.3778	57.9540
Coef. Of Variation	0.5358	2.2456	1.3419
Std. Error	0.1242	0.0041	0.6252
Skewness	0.6688	1.9549	4.4962
Excess Kurtosis	17.8560	3.4281	38.4580
Min	0.0000	0.0000	1.0000
5%	1.0000	0.0000	2.0000
10%	2.8000	0.0000	3.0000
25% (Q1)	12.5000	0.0000	10.0000
50% (Median)	23.7000	0.0000	28.0000
75% (Q3)	29.3000	0.0000	54.0000
90%	34.0000	1.0000	91.0000
95%	37.5000	1.0000	142.0000
Max	248.0000	4.0000	1177.0000

Notes: *A* is age of the building; *GAR* is number of parking spaces; *FORM1* is apartment building; *FORM 2* is suite; *FORM3* is duplex.

Table 1 demonstrates that the factors of the illustrated houses differed significantly, particularly the factor of price. Although the average house price was approximately 11,780,000 NTD, the lowest price stood at 540,000 NTD, while the highest price stood at 280,000,000 NTD. On such a housing market, the characteristics of high-priced and low-priced housing differed greatly. Past studies largely used average regression to examine the housing market, but this method did not reveal the divide between rich and poor. This study sought to discuss subjects closely related to homeowners: the topic of liquidity, and specifically whether the liquidity of high-priced and low-priced housing markets differed. Information also showed that time on the market for housing differed; some houses were sold within a single day, whereas other houses were on the market for 1,177 days (more than 3 years). This study also discusses the effect that time on the market has on liquidity.

4.2. Empirical Results

This study first observed the relationship between time on the market and final transaction price. What influence did longer time on the market have on final transaction price? Results of estimations of this effect are shown in Table 2.

Table 2 The quantile regression of time on the market and transaction price.

Model: $HP_i = a_0 + a_1 ST_i$

Quantile	*Coefficient (a_1)*	*t- Statistic*	
0.10	-0.0891	-1.3497	
0.20	-0.2124	-2.7069	***
0.30	-0.0692	-0.6449	
0.40	0.0242	0.2075	
0.50	-0.0007	-0.0062	
0.60	0.0424	0.2681	
0.70	0.0719	0.3431	
0.80	0.3662	1.1169	
0.90	1.0804	3.9088	***

Notes: * denotes significance at 10% level; ** denotes significance at 5% level, and *** denotes significance at 1% level.

Table 2 shows that for low-priced housing, longer time on the market negatively affected the final transaction price; the longer the time on the market, the greater the decrease in transaction price. This may be because as time on the market lengthens, the financial needs of the seller become more severe, and he/she reduces the price out of eagerness to make the sale. This reduction in price is the cost of liquidity borne by the seller. However, for high-priced housing, particularly for the top 10 % of houses in the high-priced housing group, longer time on the market implied higher final transaction prices. This result indicated that sellers of

high-priced housing have sufficient funds and opt to wait for a ideal price before selling their houses. The cost of liquidity borne by these sellers is in the form of time, rather than decrease in price. During the sampling period, the interest rate in Taiwan was extremely low due to the financial crisis; therefore, for those who could obtain financing from banks, the financial cost of longer time on the market was very low. The optimal strategy was to exchange cost of liquidity in the form of time for a higher transaction price.

The estimated coefficients of time on the market are shown in Fig. 1. Figure1 shows that houses in a higher price quantile had higher coefficients. The dotted line in the figure shows the standard deviation of coefficients, within a range of +/-2 units. This standard deviation was estimated using the OLS method. If coefficients calculated under other quantiles crossed this line, they were considered significantly different from the coefficient estimated under the 0.5 quantile. According to the figure, the coefficient estimated under the 0.95 quantile was the highest, at 1.61. This value was significantly higher than coefficients estimated under other quantiles.

Therefore, for sellers of high priced housing, the optimal strategy was to await a preferable price before selling the house. A longer time on the market implied greater funds or more plentiful avenues for funding, which allowed the seller to wait for a higher final transaction price.

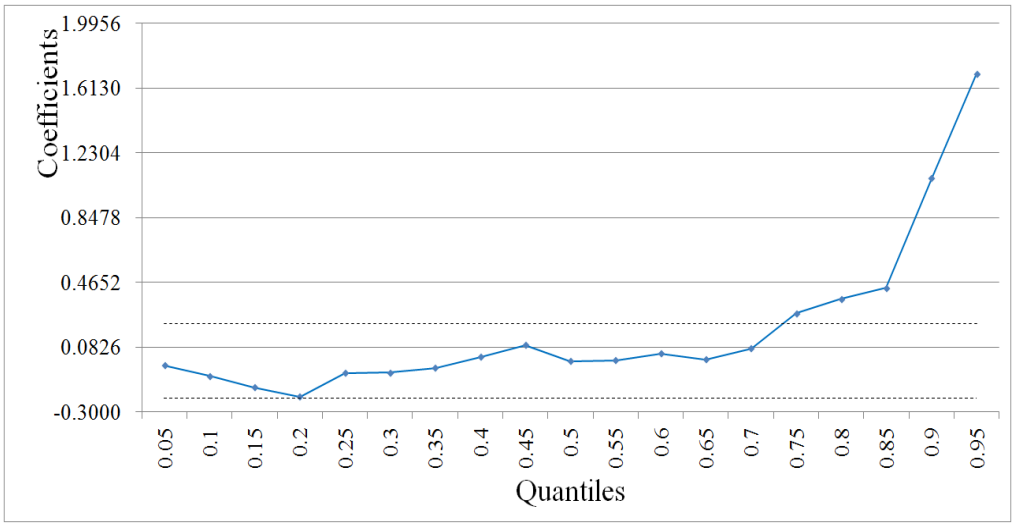

Figure1. The coefficients of the quantile regression of time on the market and transaction price.

In the above section, I only estimated the influence that time on the market had on transaction price, and did not control other housing characteristics, which could result in a bias of estimation results. Therefore, in the section below, this study considers the influence of other housing characteristics. To observe the market liquidity of housing price standards under different quantiles, this study used quantile regression in the estimation model of housing characteristics. Then we can observe the relationship between time on the market and final transaction price after variables of housing characteristics had been controlled. Results are shown in Table 3.

Table 3 shows that, after variables of housing characteristics had been controlled, the coefficients of time on the market under 0.1, 0.3, 0.4, 0.5, and 0.8 quantiles were all significantly negative. These results demonstrated that under these quantiles, longer time on the market implied reduced transaction prices. Apart from the 0.8 quantile, the coefficients estimated under the other quantiles were less than or equal to the coefficient estimated under the 0.5 quantile. The coefficient of time on the market estimated under the 0.8 quantile was -0.0099, which significantly differed from coefficients estimated under lower quantiles. These results showed that, for low-priced housing, the longer the time on the market, the more negative its influence on final transaction price. This outcome was consistent with the results in Table 2, and demonstrated that the liquidity of low-priced housing was worse than the liquidity of high-priced housing. Sellers of low-priced housing experienced a higher implied monetary cost of liquidity.

However, as explained in the literature review, time on the market and final transaction price are both endogenous variables related to the strategy of the seller. To observe more clearly the cost of liquidity borne by the seller, we should observe discount rates in housing price. By considering housing characteristics, this study determined the equilibrium housing price and then observed the difference between equilibrium price and actual transaction price. The purpose of this observation was to determine the average rate of price concession (discount price ratio) faced by traders selling houses in the real estate market.

Table 4 shows the housing price characteristics model used for determining equilibrium house price. Based on the coefficients in Table 4, this study substituted each model characteristic with a case-specific house price characteristic to calculate the expected price for each housing case.

Table 5 shows the average rate of price concession faced by sellers when selling houses at prices under various quantiles. The discount ratio was calculated as follows: actual price-expected price (calculated from the results of Table 4)/actual price.

Table 5 shows that cases with lowest housing price experienced the greatest ratio of loss from discount rates. This loss percentage was approximately 7%. This result was consistent with the results produced by the two previous methods of estimation. All experimental results showed that the cost of liquidity experienced by traders selling houses at various standards of housing price differed. The lower the house price, the higher the cost of liquidity experienced.

Table 3. The results of Hedonic Price Model (incorporating time on the market).

Model: $HP_i = a_0 + a_1 LS_i + a_2 S_i + a_3 R_i + a_4 LR_i + a_5 BR_i + a_6 F_i + a_7 TF_i + a_8 A_i + a_9 GAR_i + a_{10} FORM1_i + a_{11} FORM2_i + a_{12} FORM3_i + a_{13} ST_i + \varepsilon_i$

Quantile	*Q1*		*Q2*		*Q3*		*Q4*		*Q5*	
a_0	7.0041		-14.8071		-15.4926		-28.4459		-3.4226	
	(0.2654)		(-0.5688)		(-0.6287)		(-1.1365)		(-0.1394)	
a_1	-1.2059		-1.2695		0.1017		0.9761	**	0.0346	
	(-0.6808)		(-0.6447)		(0.1054)		(2.4173)		(0.0208)	
a_2	22.6134	***	27.4451	***	30.3324	***	33.4671	***	36.5546	***
	(17.2394)		(26.6165)		(49.4177)		(32.0607)		(34.2570)	
a_3	-7.7309		-9.1929		-11.8119	*	-17.6801	***	-24.3140	***
	(-1.1409)		(-1.5241)		(-1.8893)		(-2.7422)		(-3.5742)	
a_4	18.2735	*	3.4729		4.5369		2.9006		-7.4938	
	(1.7897)		(0.4088)		(0.7064)		(0.3177)		(-0.7973)	
a_5	51.2301	***	46.7608	***	47.2266	***	43.0717	***	52.0997	***
	(4.8358)		(6.3694)		(9.1560)		(5.2634)		(5.6758)	
a_6	1.9962		2.5190		3.0298	*	2.6784		2.2365	
	(1.2059)		(1.5375)		(1.8253)		(1.5258)		(1.2738)	
a_7	-1.5192		0.4954		-0.0921		1.1000		0.6831	
	(-1.0100)		(0.3526)		(-0.0550)		(0.6315)		(0.3829)	
a_8	-0.8795		-0.5465		0.3206		1.0911	**	1.1212	**
	(-1.4566)		(-0.8802)		(0.5640)		(2.0205)		(2.2029)	
a_9	0.8341		-19.9230		-22.7363		-15.0463		-11.1310	
	(0.0469)		(-1.1490)		(-1.4463)		(-0.7864)		(-0.6696)	
a_{10}	-105.0689	***	-117.3764	***	-167.2413	***	-189.1176	***	-203.9932	***
	(-8.8305)		(-9.1337)		(-13.8964)		(-14.5029)		(-14.7898)	
a_{11}	-47.7735	***	-55.3693	***	-72.7574	***	-69.6461	***	-81.8634	***
	(-4.5259)		(-4.9566)		(-6.3953)		(-5.3965)		(-6.0342)	
a_{12}	122.7993	***	183.4900	***	140.4250	***	150.3586	***	165.2631	***
	(2.8313)		(3.6929)		(2.5653)		(2.9258)		(2.6661)	
a_{13}	-0.1624	*	-0.1235		-0.1397	***	-0.1612	***	-0.1860	***
	(-1.7170)		(-1.5815)		(-2.7128)		(-3.3976)		(-3.5970)	
Adj. R-squared	0.3388		0.3647		0.3879		0.4083		0.4305	

Table 3. The results of Hedonic Price Model (continued).

Quantile	*Q6*		*Q7*		*Q8*		*Q9*	
a_0	12.8366		0.7013		37.8471		29.5828	
	(0.4889)		(0.0260)		(1.0513)		(0.6761)	
a_1	0.7845		1.0803		3.9549		16.7469	*
	(0.6081)		(0.2544)		(0.5538)		(1.7316)	
a_2	40.0902	***	43.8662	***	48.9188	***	54.4266	***
	(34.7080)		(32.9396)		(28.8593)		(24.8125)	
a_3	-29.5211	***	-37.5646	***	-45.8194	***	-54.1278	***
	(-3.7447)		(-4.6787)		(-5.7179)		(-4.2802)	
a_4	-19.1497	*	-21.8293	**	-30.6275	***	-28.7545	*
	(-1.7526)		(-2.3104)		(-3.1421)		(-1.8532)	
a_5	57.9998	***	60.3628	***	54.0364	***	36.7420	**
	(5.4102)		(5.5930)		(6.3954)		(2.0193)	
a_6	3.5495	**	3.2932	*	2.8605		2.5393	
	(2.0012)		(1.8321)		(1.2052)		(0.7596)	
a_7	-2.1092		-1.3010		-3.3321		0.9494	
	(-1.1186)		(-0.6140)		(-1.0937)		(0.2263)	
a_8	1.2077	**	1.1201	**	1.1560	*	-1.1490	
	(2.3119)		(2.0787)		(1.8057)		(-1.3898)	
a_9	-12.7058		-25.0926		-19.2186		-11.9863	
	(-0.8543)		(-1.5623)		(-0.8551)		(-0.3180)	
a_{10}	-225.6367	***	-211.0528	***	-236.1542	***	-209.5160	***
	(-14.8528)		(-11.3857)		(-8.1201)		(-6.3887)	
a_{11}	-68.8059	***	-43.3125	***	-41.8839	**	-26.4080	
	(-4.5706)		(-2.6371)		(-2.3052)		(-1.2530)	
a_{12}	333.3583	***	529.6701	***	634.6415	**	787.2961	
	(2.8832)		(4.7497)		(2.2137)		(1.2604)	
a_{13}	-0.1093		-0.0214		-0.0099	**	0.0739	
	(-1.0458)		(-0.2358)		(-0.0843)		(0.5387)	
Adj. R-squared	0.4532		0.4769		0.5067		0.5556	

Notes: The t-statistics are included in the parentheses. * denotes significance at 10% level; ** denotes significance at 5% level, and *** denotes significance at 1% level. *HP* is final transaction price; *LS* is registered number of pings (1 ping is approximately 3.3 m^2) of land; *S* is total number of pings in the building; *R* is number of rooms in the building; *LR* is number of living rooms in the building; *BR* is number of bathrooms; *F* is specific floor in the building; *TF* is total building height; *A* is age of the building; *GAR* is number of parking spaces; *FORM 1* is apartment building; *FORM 2* is suite; *FORM 3* is duplex.

Table 4. The expected transaction price.

Model: $$HP_i = a_0 + a_1 LS_i + a_2 S_i + a_3 R_i + a_4 LR_i + a_5 BR_i + a_6 F_i + a_7 TF_i + a_8 A_i + a_9 GAR_i + a_{10} FORM1_i + a_{11} FORM2_i + a_{12} FORM3_i + \varepsilon_i$$

Quantile	*Q1*		*Q2*		*Q3*		*Q4*		*Q5*	
a_0	6.4073		-21.9401		-25.0519		-32.1960		-17.7758	
	(0.2490)		(-0.8495)		(-1.0259)		(-1.3072)		(-0.7155)	
a_1	-0.9991		-0.7363		0.0988		0.9041	**	-0.2984	
	(-0.5532)		(-0.4242)		(0.1012)		(2.2612)		(-0.1692)	
a_2	22.6211	***	27.6111	***	30.3379	***	33.3540	***	36.6056	***
	(17.0046)		(26.5321)		(44.6508)		(32.5947)		(34.7396)	
a_3	-7.0089		-9.3329		-10.2559		-15.6145	***	-23.8622	***
	(-1.0216)		(-1.5253)		(-1.6134)		(-2.5131)		(-3.6018)	
a_4	17.9288	*	0.9585		3.1988		3.2426		-6.0090	
	(1.7489)		(0.1118)		(0.5019)		(0.3458)		(-0.6330)	
a_5	49.5558	***	44.1358	***	45.0882	***	40.4265	***	52.9840	***
	(4.6193)		(5.5861)		(8.7929)		(4.8635)		(5.8755)	
a_6	2.2497		2.5851		2.9256	*	2.8563		2.3413	
	(1.3586)		(1.5987)		(1.7671)		(1.6184)		(1.3335)	
a_7	-2.0043		0.5490		0.2363		0.9005		0.8410	
	(-1.3067)		(0.3935)		(0.1412)		(0.5303)		(0.4677)	
a_8	-1.0318	*	-0.5000		0.3784		1.1076	**	1.1526	**
	(-1.7382)		(-0.8047)		(0.6610)		(2.0649)		(2.2637)	
a_9	-1.3167		-23.3361		-22.3912		-11.3497		-13.8491	
	(-0.0748)		(-1.3329)		(-1.3954)		(-0.5929)		(-0.8288)	
a_{10}	-105.2748	***	-116.8666	***	-165.3440	***	-191.8522	***	-203.0702	***
	(-8.7898)		(-9.1520)		(-13.7186)		(-14.8022)		(-14.4307)	
a_{11}	-42.3216	***	-54.9273	***	-73.6357	***	-70.3511	***	-79.0905	***
	(-4.1583)		(-4.9204)		(-6.4663)		(-5.4162)		(-5.7368)	
a_{12}	115.4978	***	171.0083	***	142.5794	***	152.2527	***	170.5234	***
	(2.6344)		(3.6806)		(2.4388)		(3.0231)		(2.6510)	
Adj. R-squared	0.3384		0.3645		0.3877		0.4080		0.4304	

Notes: The t-statistics are included in the parentheses. * denotes significance at 10% level; ** denotes significance at 5% level, and *** denotes significance at 1% level. *HP* is final transaction price; *LS* is registered number of pings (1 ping is approximately 3.3 m^2) of land; *S* is total number of pings in the building; *R* is number of rooms in the building; *LR* is number of living rooms in the building; *BR* is number of bathrooms; *F* is specific floor in the building; *TF* is total building height; *A* is age of the building; *GAR* is number of parking spaces; *FORM1* is apartment building; *FORM 2* is suite; *FORM3* is duplex.

Table 4. The expected transaction price (continued).

Quantile	*Q6*		*Q7*		*Q8*		*Q9*	
a_0	12.6182		1.2492		37.3363		36.1131	
	(0.4856)		(0.0476)		(1.0724)		(0.8541)	
a_1	0.6767		0.9358		4.1141		16.7198	*
	(0.4469)		(0.2260)		(0.5797)		(1.7293)	
a_2	40.1676	***	43.8958	***	48.9114	***	54.2908	***
	(34.6250)		(33.2240)		(28.8517)		(25.1254)	
a_3	-29.7332	***	-38.0131	***	-45.6761	***	-53.5843	***
	(-3.7755)		(-4.7640)		(-5.7368)		(-4.3922)	
a_4	-19.1975	*	-21.6054	**	-30.8227	***	-27.1346	*
	(-1.7257)		(-2.3033)		(-3.1746)		(-1.7513)	
a_5	56.1008	***	60.5897	***	53.8717	***	36.3782	**
	(5.2221)		(5.6609)		(6.3926)		(2.0738)	
a_6	3.4716	**	3.3531	*	2.8656		2.9943	
	(1.9512)		(1.8666)		(1.2211)		(0.8994)	
a_7	-2.1951		-1.4274		-3.3312		0.5029	
	(-1.1647)		(-0.6785)		(-1.0989)		(0.1185)	
a_8	1.1724	**	1.1190	**	1.1509	*	-1.1358	
	(2.2312)		(2.0802)		(1.8019)		(-1.3833)	
a_9	-12.7207		-24.7770		-19.8459		-13.1315	
	(-0.8506)		(-1.5402)		(-0.8753)		(-0.3449)	
a_{10}	-223.9593	***	-211.0648	***	-236.8305	***	-213.0690	***
	(-14.5865)		(-11.5049)		(-8.1681)		(-6.5700)	
a_{11}	-69.0550	***	-42.5618	***	-41.6075	**	-27.5665	
	(-4.6054)		(-2.5853)		(-2.2867)		(-1.3298)	
a_{12}	337.7001	***	528.3946	***	629.4685	**	784.4062	
	(2.8959)		(4.7988)		(2.1894)		(1.2557)	
Adj. R-squared	0.4532		0.4769		0.5068		0.5556	

Notes: The t-statistics are included in the parentheses. * denotes significance at 10% level; ** denotes significance at 5% level, and *** denotes significance at 1% level. *HP* is final transaction price; *LS* is registered number of pings (1 ping is approximately 3.3 m^2) of land; *S* is total number of pings in the building; *R* is number of rooms in the building; *LR* is number of living rooms in the building; *BR* is number of bathrooms; *F* is specific floor in the building; *TF* is total building height; *A* is age of the building; *GAR* is number of parking spaces; *FORM1* is apartment building; *FORM 2* is suite; *FORM3* is duplex.

Table 5. The average rate of price concession.

Quantile	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Coefficient	-0.0741	-0.0055	-0.0026	-0.0018	-0.0015	-0.0021	-0.0019	-0.0028	-0.0058

Notes: the ratio is calculated by actual price - expected price (calculated from the results of Table 4)/actual price.

5. Conclusion

In the previous studies, little attention had been given to the liquidity of real estate market. The lack of the literature on real estate market liquidity inhibits traders in making optimal decisions, and also real estate market managers cannot gauge the impact of policies established under various market conditions.

This paper is intended as an investigation of real estate market liquidity. I use the data from the Taiwan housing market, cases of Taipei residential real estate transactions from 2007 to 2008, and use three approaches to estimate the liquidities of high- and low-priced housing markets. The first method in this study used quantile regressions to estimate the relationship between time on the market and final transaction price. Results indicated that low-priced housing remained on the market for a lengthier period, which resulted in a lower final transaction price. One possible reason is that after the seller has waited a long time to realize a sale, he or she settles for a lower selling price to meet personal financial needs. This reduction in price is the cost of liquidity borne by the seller. However, for high-priced housing, a longer time on the market significantly increases the final transaction price, indicating that sellers of high-priced housing have ample finances to wait for a higher price.

The second method involved adding a variable representing housing price characteristics to the quantile regression model to control the influence of other housing characteristics and estimate the relationship between time on the market and transaction price. Results confirmed that sellers of low-priced housing experience a significantly greater cost of liquidity.

Lastly, this study estimated the price concessions that individual dealers accept to realize an asset. Empirical results showed that the average rate of price concession for low-priced housing was greatest at approximately 7 %. The study outcomes showed that housing sellers with different housing price standards experience significantly different liquidity costs. Lower housing prices imply higher liquidity costs in the final transaction.

The outcomes of this study demonstrate that in an emerging market with a significant divide between rich and poor, when a financial crisis occurs, the most vulnerable sellers of real estate are the poor. Due to financial need, poor sellers are anxious to sell houses and experience a high proportion of loss from discount rates. These outcomes could serve as a reminder that, in conditions of financial crisis, the government should pay particular attention to the liquidity of the low-priced housing market and provide adequate avenues of funding to low-income families, to prevent them from becoming the greatest losers in a period of financial crisis.

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Conflict of Interest

All authors declare no conflict of interest.

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