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EFFECTS OF BUYERS' RESERVE PRICES AND NUMBER OF BROKERS ON SEARCHING FOR HOUSING: AN EMPIRICAL STUDY BASED ON EXPERIMENTAL DATA

At the housing market, buyers face the problem of how to work with brokers in order to protect their own interests. Usually, buyers do not provide personal information directly to brokers and entrust several brokers to search for housing simultaneously. This study seeks to explore the effects of buyers' reserve prices and the number of brokers on the search for housing: we utilized the experimental methods to collect data and used a non-parametric test to examine the effects of the above 2 factors on the search for housing. Our findings show that: 1) there is no significant effect of the buyer directly providing reserve price information to brokers on the process of searching for housing and the results of searching; 2) increasing the number of brokers adds to buyer's earnings, increases the degree of match between housing attributes and buyer's preferences, shortens search time, enhances competition among brokers and decreases the frequency of buyer's search. Buyers should not keep their reserve price information confidential and they should entrust several brokers to search for housing simultaneously.
Keywords: *experimental economics; reserve prices; brokers; searching for housing, housing market.*
JEL Classification: *C91; D82; R31.*

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ВПЛИВИ РЕЗЕРВОВАНИХ ЦІН ПОКУПЦІВ ТА КІЛЬКОСТІ БРОКЕРІВ НА ПОШУК ЖИТЛА: ЕМПІРИЧНЕ ДОСЛІДЖЕННЯ НА ОСНОВІ ЕКСПЕРИМЕНТАЛЬНИХ ДАНИХ

У статті поставлено за мету дослідити впливи резервованих цін покупців та кількості брокерів на пошук житла: для збору даних застосовано експериментальні методи, а для їх обробки — непараметричний тест для вивчення впливів двох вищевказаних чинників на пошук житла. Зроблено висновки: 1) немає істотного впливу безпосереднього надання покупцем брокеру інформації про резервовану ціну на процес пошуку житла і результати пошуку; 2) збільшення кількості брокерів збільшує вигоди покупця і ступінь відповідності між характеристиками житла і тим, чому надає перевагу покупець, скорочує час пошуку, підвищує конкуренцію між брокерами і знижує частоту пошуку житла покупцем. Покупцям не слід робити інформацію про свої резервовані ціни конфіденційною і слід доручати пошук житла кільком брокерам одночасно.
Ключові слова: *експериментальна економіка; резервовані ціни; брокери; пошук житла; ринок житла.*
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Хун Чжан, Ян Чжан
ВЛИЯНИЕ РЕЗЕРВИРОВАННЫХ ЦЕН ПОКУПАТЕЛЕЙ И КОЛИЧЕСТВА БРОКЕРОВ НА ПОИСК ЖИЛЬЯ: ЭМПИРИЧЕСКОЕ ИССЛЕДОВАНИЕ НА ОСНОВЕ ЭКСПЕРИМЕНТАЛЬНЫХ ДАННЫХ

В статье поставлена цель исследовать влияние резервированных цен покупателей и количества брокеров на поиск жилья: для сбора данных применен экспериментальные

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методы, а для их обработки — непараметрический тест для изучения влияния двух вышеуказанных факторов. Наши выводы: 1) существенного влияния предоставление покупателем брокеру информации о резервируемой цене на процесс поиска жилья и результаты поиска нет, 2) увеличение количества брокеров увеличивает выгоды покупателя и степень соответствия между характеристиками жилья и предпочтениями покупателя, сокращает время поиска, повышает конкуренцию между брокерами и снижает частоту поиска жилья покупателем. Покупателям не следует делать информацию о своих резервируемых ценах конфиденциальной и следует поручать поиск жилья нескольким брокерам одновременно.
Ключевые слова: экспериментальная экономика; резервированные цены; брокеры; поиск жилья; рынок жилья.

1. Introduction. There is a major asymmetry in the information between brokers and buyers at the resale housing market. Brokers have a large amount of information on policy, market supply and so on. By contrast, buyers only have information on personal payment capabilities and psychological reserve prices. As the objectives of brokers to pursue maximization of profit may damage the benefits of buyers, buyers often feel that brokers are not completely reliable. On the one hand, buyers feel that brokers are willing to make positive efforts to assist them in their purchase as early as possible. On the other hand, buyers feel that brokers, in order to urge them to purchase as soon as possible and hence charge commission, often provide false information, conceal housing defects and overstate the situation of the shortage in housing.

In this situation, buyers face the problem of how to work with brokers in order to protect their own interests. In general, buyers mainly take 2 measures to protect their profits: one is not to provide personal information directly to brokers, e.g. their own payment capabilities and psychological reserve prices, so as to prevent such information from being utilized by brokers and leading to housing being bought at high prices; the second measure is to protect their own interests by giving rise to competition between brokers, i.e. entrusting several brokers to search for housing at the same time.

However, it is still unclear whether either of these measures really plays a role as well as what the actual mechanism of actions involved is. The purpose of this study is to explore the effects of buyers' reserve prices and the number of brokers in the search for housing. Based on our study, several useful suggestions will be provided to buyers at the housing market. The final aim of this study is to reduce the inequality at the housing market.

Many scholars have studied the effects of brokers' services and attributes on the result and process of the search for housing (Huang and Rutherford, 2007; Turnbull and Dombrow, 2007; Waller and Jubran, 2012). Currently, research on the effect of buyer behavior strategy selection on the housing search is very scarce (Anglin, 1997). We found that the main barrier is the difficulty in obtaining a valid and reliable set of data. Data released by statistics departments are not collected especially for each type of research, meaning that in most cases this field data is not suitable for research. Also, searching for housing is a time consuming and cross-regional process, making it difficult to observe, follow and record. What is more, field data is generated from the events that have occurred at a specific time and in a specific place which cannot be replicated, therefore making it difficult to verify the accuracy of the data (Yavas and Sirmans, 2005).

In order to overcome the data barrier, this paper applies experimental economics methods to collect data and conduct research based on experimental data. Data collected in experiments are used to estimate the size of the effect, to test the validity of economic theories and to shed light on market mechanisms (Roth, 2002). In a controlled experiment, we are able to keep everything else constant and study the effects of key factors on the object of the research. It is easy to observe, to follow, and to record the whole housing search process, especially some of psychological factors which are difficult to observe in a real market, in the laboratory. Compared with the real housing search process, the experimental process is simpler. There is no significant difference between subjects' behavior in the experiment and brokers' behavior at a real market, because both subjects' behavior and brokers' behavior are influenced by an incentive for profits (Smith, 1982).

To our knowledge, this is the first attempt to apply experimental economics methods to study the housing search. It is thus an important extension to the existing literature on experimental study and the field of searching for housing in general. Scholars seldom adopt experimental economics methods in their research of real estate economics. As far as experimental real estate economics is concerned, only a few papers on experimental real estate economics can be found (Northcraft and Neale, 1986; Yavas et al., 2001; Ong et al., 2003; Yavas and Sirmans, 2005; Nuriddin and Yavas, 2012).

The remainder of this paper is organized as follows: Section 2 introduces the basic theory and states the hypotheses; Section 3 describes the experimental design and implementation; Section 4 presents the results and discussion and Section 5 presents the conclusions.

2. Basic Theory and Hypotheses. The first basic theory is information asymmetry. Information asymmetry at the resale housing market is highly significant. Brokers possess significant information superiority, having more information on housing prices, housing attributes etc. By contrast, buyers only have more information on personal payment capability and psychological reserve prices. Therefore, buyers have a disadvantageous information status.

Provision of buyers' reserve price information to brokers will increase the information asymmetry between them. This will cause buyers to be at more of a disadvantage. As a result, the benefits of buyers may be lowered and the interests of brokers will increase. In addition, buyers accept that highly priced housing also reflects buyers' preferences for housing attributes, so that brokers can learn buyers' preferences indirectly and improve their recommendations. Thus, the success rate of recommendations will increase and the search time will decrease. Therefore, Hypothesis No. 1 is proposed as follows:

H1: The buyer directly providing their reserve price information to brokers will reduce buyer's earnings, increase the degree of match between housing reserve price attributes and buyer preferences, shorten the search time and increase broker's earnings.

Provision of buyer's reserve price information directly to each broker means brokers have the same degree of understanding of buyer's reserve price information, which reduces the degree of information asymmetry between different brokers and may therefore give rise to more intense competition between brokers. At a highly competitive market, brokers will recommend better houses more frequently and the

frequency of buyer's search will increase. Therefore, Hypothesis No. 2 is proposed as follows:

H2: Buyers directly providing their reserve price information to brokers will increase competition among brokers and increase the frequency of search.

The second basic theory is market competition. Market competition is individuals and firms striving for a greater share of a market in which to sell or buy goods and services. Internal motives for market competition lie in financial interest driving economic agents. There are two kinds of basic methods of competition between brokers: price competition and attribute competition. Price competition means competition in the aspects of recommended price and intermediary commission between different brokers when recommending the same house to buyers. Attribute competition means that brokers recommend houses with different attributes to buyers according to their judgments of buyers' preferences, so as to prompt to buy the house recommended by them.

The more competitors there are at the resale housing market, the more intense market competition is. As a result, brokers need to improve the quality of their service and lower service prices. This will increase buyer's earnings, improve the degree of match between housing attributes and buyer's preferences, and shorten search time. Of course, brokers' earnings will decrease. Therefore, Hypothesis No. 3 is proposed:

H3: Increasing the number of brokers will increase buyers' earnings, improve the degree of match between housing attributes and buyers' preferences, shorten search time and reduce brokers' earnings.

As the number of brokers commissioned by buyer increases, the increase in the number of competitors at the market will exacerbate fierce competition between brokers. Similarly, fierce competition between brokers will prompt buyers to search more frequently. Therefore, Hypothesis No. 4 is as follows:

H4: Increasing the number of brokers will increase competition among them and decrease the frequency of search.

3. Experimental Design and Implementation. The methodology of the experiment and corresponding procedure included the following 5 components: firstly, there were only 2 kinds of roles in this experimental resale housing market: a buyer and brokers. One buyer and 2 (or 6) brokers were assigned for each experiment. Brokers were human subjects, whereas a buyer was represented by a computer. All houses at the experimental market met the buyer's basic requirements. All attributes of the house were the same except attributes A and B. The quality of attributes A and B was equally divided into a range of 10 levels from 0 to 1. To avoid the use of fractional numbers, we relabeled A and B with integers from 1 to 10. In fact, there are many attributes of houses at a real market. However, we only studied 2 of them in our experiment, because this design not only reflected the multi-attributes of a housing product but also contributed to the ease of operability of the experiment.

Secondly, brokers should clearly note the house price and the levels of attributes A and B when they recommend a house to the buyer. The buyer would calculate all the utility values of the recommendations by the buyer's earnings function and declare the information on the current most satisfactory house, including the broker's serial number, the recommended price and the levels of attributes A and B. The above steps would be repeated until one of the following rules was satisfied to stop the process:

firstly, the buyer should stop searching if no new house can replace it for 60 seconds - this condition reflects that fact that the buyer cannot find other houses better than the current most satisfactory house in the long term, so the buyer decides to stop searching and buy the current most satisfactory house; secondly, if no house satisfies the first condition within 3 minutes, then the buyer should buy the current best house at the end of period — at a real market, due to time constraints such as wedding date, relocation date, or opening of a child's school, buyers often must make a decision before a deadline.

Thirdly, the buyer evaluated the value of a house using 3 attributes: price, and attributes A and B. Throughout, we used the subscript "b" for the buyer. In our experiments, the buyer's earnings function was:

$$E_b(A,B,P) = a_b \times A^{a_b{}'} + b_b \times B^{b_b{}'} - P(1+2.5\%), \qquad (1)$$

where $0 < a_b$ and $0 < a_b < 1$ were the attribute A related constants. The constant a_b represents the value that one unit of attribute A can provide. The expression $A^{a_b{}'}$ represents the total units of attribute A contained in the recommended house. $0 < b_b$ and were attribute B related constants. The constant   represents the utilities that one unit of attribute B can provide. The expression $B^{a_b{}'}$ represents the total number of units of attribute B contained in the recommended house. The expression P represents the house price. The expression $P \times 2,5\%$ represents the commission.

The constants of the buyer's earnings function were unchanged within the period and changed between periods.

The currency in the experiment was "points". The subject's earnings were commission. The subject's expenditures were the recommendation fee, of 0.1 points each time. So the subject's experimental performance was commission minus expenditures. The performances in the 3 practice periods were not included in the final performance. The incentive mechanism included 2 parts: basic salaries and rewards. The basic salaries of each subject were CNY 100. Rewards were determined by the subject's performance. At the end of the experiment, subjects could exchange experimental currency into CNY, at the rate of one to one.

We used a 2x2 design, where one variable under study was the buyer's reserve price information (indirectly or directly provided) and the other was the number of brokers (2 or 6). Each session consisted of 7 periods, as shown in Table 1.

Table 1. **Information Design of Sessions**

Session Number	Buyer's Reserve Price Information	Number of Brokers
S1	Indirectly provided	2
S2	Directly provided	2
S3	Indirectly provided	6
S4	Directly provided	6

This experiment was conducted by 16 brokerages from 3 real estate agencies in Beijing. Any one subject could only take part in one session. This arrangement isolates learning effects. Additionally, because our subject pool was relatively homogeneous, it is reasonable to think that any effects relating to differences between the 4 sessions were small. For subjects, many scholars recruit students. A statistical sam-

ple of students is a convenient and inexpensive source of data for researchers. For instance, such samples are often referred to in the research results reported (Mestelman and Feeny, 1988) and later (Dyer, Kagel and Levin, 1989). The research compared the behavior of professionals with that of students and found little difference between the two. In our opinion, however, students are not experienced in the buying or selling of housing and it is therefore very hard to guarantee that students' behavior is the same to that of real brokers. Therefore, we recruited real estate brokers as our subjects. Real brokers will improve the reliability of our conclusions.

The experiment was programmed and conducted with the experimental software z-Tree (Fischbacher, 2007). In addition, in order to avoid any misunderstandings in the experiment, the computer interface was translated into Chinese.

The following 6 indices were designed to evaluate the change in the search.

Index 1: Buyer Earnings Ratio, BER. The BER is the percentage of the buyer's actual earnings out of the buyer's theoretical earnings.

Index 2: Euclidean Distance

$$ED = \sqrt{(A_t - A_a)^2 + (B_t - B_a)^2},\qquad(2)$$

where A_t and B_t are the level of the transacted house's attributes and where A_a and B_a are the level of the theoretical best house's attributes. This index can be used to represent the degree of match between buyer's demand and house's attributes.

Index 3: Search Duration, SD. The SD is the range from the beginning of the period to the time the search stopped. The unit is seconds.

Index 4: Broker Earnings, BE. The BE is the broker's commission minus their recommended expenditure.

Index 5: Average Time Interval between Searches, AITS. The AITS indicates the frequency of broker's recommendations.

Index 6: Number of Recommendations, NR. The NR is the total number of all brokers' recommendations during one period.

The experimental results are presented in accordance with the above 6 evaluation indices, as shown in Table 2.

4. Results and Discussion. The first result refers to the effects of the buyer directly providing their reserve price information to brokers in the search for housing. Hypotheses 1 and 2 will be tested to support the first result.

Test of H1. The indices BER, ED, SD and BE were used to test H1. According to the test results of the normal distribution and the homogeneity of variance, the experimental results of BER, ED, SD and BE did not conform to normal distribution, with the Mann-Whitney U test used to test H1. The Mann-Whitney U test is a powerful non-parametric substitute to the standard t-test when data has at least one ordinal measurement. When examining data generated from human subjects, it is typical to assume that this data does not meet the assumptions required for a t-test (Chen-Ritzo at al., 2005). The test results of H1 are shown in Table 3.

Table 3 shows that the P-value of BER is 0.430, which is larger than 0.05, thus we conclude that the difference between the buyer's reserve price information indirectly provided as well as that directly provided was not significant at the 5 % level. Thus, the null hypothesis was accepted. Similarly, we also find no significant difference in ED, SD and BE between 2 samples. Therefore, H1 is rejected.

Table 2. **Experimental Results**

Variables	Index		Period							Mean
			1	**2**	**3**	**4**	**5**	**6**	**7**	
Buyer's Earnings	Buyer's Earnings Ratio, BER (%)	1	98.25	95.76	99.06	99.40	91.21	99.59	95.39	96.95
		2	97.99	96.77	97.58	98.80	99.47	100	100	98.74
		3	100	100	100	100	100	100	100	100
		4	100	100	100	100	100	100	100	100
Degree of Match	Euclidean Distance, ED	1	8.06	8.60	0	4.00	8.00	2.83	6.40	5.41
		2	0	6.71	2.00	0	2.00	9.06	0.00	2.82
		3	0	0	0	0	0	0	0	0
		4	0	0	0	0	0	0	0	0
Search Time	Search Duration, SD (seconds)	1	90	78	88	141	180	82	99	108.29
		2	180	83	180	78	180	123	149	139.00
		3	96	157	71	89	112	134	68	103.86
		4	69	71	75	69	66	91	74	73.57
Broker's Earnings	Broker's Earnings, BE (points)	1	3.58	2.25	5.63	2.53	1.55	2.51	2.20	2.89
		2	5.63	2.70	3.23	5.63	2.78	3.20	5.60	4.11
		3	5.60	1.88	5.60	5.60	5.18	5.26	5.60	4.96
		4	5.60	1.88	5.60	5.60	5.18	5.26	5.60	4.96
Frequency of Buyer's Search	Average Time Interval Between Searches, AITS (seconds)	1	18.00	19.50	17.60	15.67	20.00	16.40	16.50	17.67
		2	18.00	16.60	22.50	19.50	18.00	20.50	16.56	18.81
		3	5.33	4.49	4.44	5.24	4.67	4.47	4.53	4.74
		4	4.60	4.18	3.57	3.63	4.13	5.06	3.70	4.12
Degree of Broker Competition	Number of Recommendations, NR	1	5	4	5	9	9	5	6	6.14
		2	10	5	8	4	10	6	9	7.43
		3	18	35	16	17	24	30	15	22.14
		4	15	17	21	19	16	18	20	18.00

Table 3. **Test Results of H1**

Null hypotheses		Mann-Whitney U Test: P-Value
No significant effects of the buyer directly providing their reserve price information to brokers on	BER	0.430
	ED	0.362
	SD	0.504
	BE	0.233

Test of H2: AITS and NR indices were used to test H2. For the same reason, we used the Mann-Whitney U test for H2.

Table 4 shows that the P-value of AITS is 0.800, which is larger than 0.05, thus we conclude that the difference between indirectly providing a reserve price and directly providing a reserve price was not significant at the 5% level. Thus, the null hypothesis was accepted. Similarly, we also find no significant difference in NR between the 2 samples. Therefore, H2 is also rejected.

Table 4. **Test Results on H2**

Null hypotheses		Mann-Whitney U Test: P-Value
No significant effects of the buyer directly providing their reserve price information to brokers on	AITS	0.800
	NR	0.872

Test of H3. BER, ED, SD and BE were used to test H3. For the same reason, we used the Mann-Whitney U test again.

Table 5 shows that the P-values of BER, ED, and SD are less than the significant level of 0.05, thus the null hypotheses were rejected. By comparing the means of the two samples, we found that the number of brokers is positively correlated with the value of BER, positively correlated with the value of ED, and negatively correlated

with the value of SD. The p-value of BE is 0.190, which is larger than 0.05, so there are no significant effects of increasing the number of brokers on the value of BE. Therefore, H3 is partly proven.

Table 5. **Test Results of H3**

Null Hypotheses		Mann-Whitney U Test: P-Value
No significant effects of increasing the number of brokers on	BER	0.000
	ED	0.000
	SD	0.010
	BE	0.190

Test of H4. AITS and NR indices were used to test H4. As previously, we used the Mann-Whitney U test.

Table 6. **Test Results of H4**

Null Hypotheses		Mann-Whitney U Test: P-Value
No significant effects of increasing the number of brokers on:	AITS	0.000
	NR	0.000

Table 6 shows that the P-value of AITS and NR is 0.000, which is less than 0.05, thus the null hypotheses were rejected. Compared to the means of the 2 samples, we find that the number of brokers is positively correlated with the value of AITS and positively correlated with the value of NR. Therefore, H4 is proven.

5. Conclusions. This paper utilized the experimental economics method to examine the effects of buyers' reserve price information and the number of brokers on the search for housing at the resale housing market, concluding that: 1) there is no significant effect of the buyer directly providing reserve price information to brokers on the process of searching for housing and on the results of searching; 2) increasing the number of brokers adds to buyer's earnings, increases the degree of match between housing attributes and buyer's preferences, shortens search time, enhances competition among brokers and decreases the frequency of buyer's search. Buyers should not keep their reserve price information confidential and they should entrust several brokers to search for housing simultaneously.

The novelty of this paper lies in the application of the experimental economics method to the study on housing search. This newly developed experiment-based method can be used either as a stand-alone method to collect reliable data and to interpret it where other methods cannot be used or to supplement and support findings obtained using other methods.

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