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The Effects of Demand Specification and Search Patience on the Buyer Search Process in China's Resale Housing Market: An Experimental Study

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Through the implementation of an experimental design, this study examines the effect of buyer demand specification and search patience on the home buying process. We find that there are no significant effects of demand specification on the behavior of brokers and the search results. When the search patience of a buyer is higher, the earnings of the buyer are greater, matching degree is higher, search duration is longer, number of broker recommendations is greater, and attribute competition is fiercer.

Keywords

Demand Specification; Search Patience; Experimental Methods; Resale Housing Market

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1. Introduction

Buying a home is almost certainly the largest and most stress-filled purchase a person will make in his/her lifetime. Adding to the stress of buying any large asset is often the simultaneity of a major life change, such as taking an out-of-town job, getting married, or having children. While many formal objective models have been created to measure the effects of time on the market (TOM), search costs, and price (Courant 1978; Baryla and Zumpano 1995; Turnbull 1996; Elder, Zumpano and Baryla 1999; Cronin 1982; Wheaton 1990; and Kim 1992), commonsense suggests that the unique individual behavior of buyers can also impact the home buying process (Anglin, 1997).

The existing literature has not sufficiently considered these buyer-specific inputs into the home buying process. For instance, would clearer specification of housing preference shorten the search duration and increase the wealth of buyers? Real estate agents use the phrase “buyers are liars” to describe the frustration of showing a potential buyer exactly what s/he asked for, only to realize that the buyer truly does not know what s/he wants. More formally stated, buyers want to effectively communicate their true preference set to their agents to reduce search costs and frustration, but are often ineffective at doing so. Externally introduced stress that stem from a major relocation or other life style change (marriage/children), no doubt adds to the ineffectual communication skills of buyers. Yet, traditional empirical studies assume that people are always perfectly rational (the homo economicus assumption found in traditional models of home search behavior), thus ignoring such exogenous effects on buyer behavior.

The stress of buying a new home changes more than just the ability to effectively communicate during the home buying process. It also often imposes a time constraint. Taking a new job, getting married, or having children are all associated with a specific time in the future at which the buyer needs to have completed the transaction. In any of these examples, the buyer cannot afford to be as patient as s/he could be in the absence of such a triggering event. As such, a second research question is, “Would more buyer patience result in a home purchase at a lower price?”

Field data are not ideal for examining these relationships because buyer demand specification and buyer search patience are not observable in transactions data. That is, selling price and TOM do not at all reflect the underlying communications between a buyer and his/her agent, nor does it reflect the willingness of a buyer to patiently wait for the “right” house to come along. As such, we use the experimental approach of Ikromov and Yavas (2012a, 2012b) and Yavas, Miceli, and Sirmans (2001) to understand these behavioral effects on the home buying process.

Ikromov and Yavas (2012a, 2012b) explain that through the careful construction of an experimental design, it is possible to isolate each variable of interest while truly holding everything else constant within the decision-making process. Alternatively, when using field data, so many variables are changing simultaneously that researchers must rely on complex econometric techniques in an attempt to *effectively* hold all else constant and isolate the desired variables of interest. Even then, with transaction data, not all variables are observable. This is exactly the case with buyer demand specification and search patience. As a result, this study uses the experimental design approach used in Ikromov and Yavas (2012a, 2012b). One exception is that we use both a student and professional broker sample, whereas Ikromov and Yavas (2012a, 2012b) use only a student sample.

We conclude that there are no significant effects of demand specification on the behavior of brokers and search results. When the search patience of a buyer is higher, the earnings of the buyer are greater, matching degree is higher, search duration is longer, number of broker recommendations is more, and attribute competition is fiercer.

2. Buyer Search in China's Resale Housing Market

Since the founding of the People's Republic of China in 1949, China has been implementing a public housing allocation system of “unified management, unified distribution, rent to cover maintenance”. The housing of urban residents is mainly resolved by units that residents belong to, with only an extremely small number of houses that can be traded. The housing market scale is very small, and the buyer housing search is mainly channeled through relatives and friends or personal advertisements. In June 1998, the government decided to stop the physical housing allocation system and implement monetary housing. Since then, the Chinese housing market has expanded rapidly, as has the evolution of the role that brokers play in housing transaction services. Presently, there are more than one million broker practitioners in China who are involved with the vast majority of resale housing transactions in the market. The unique history of the Chinese housing market has caused the home search process in China to be very different from that in the United States. We will summarize these characteristics and integrate them into the design and implementation of the experiment.

First, brokers in the resale housing market in China provide broker services for buyers and sellers and only act as the middle person. The development history of brokers in the resale housing market in China is short, and the services are simple and mainly on deal-making for buyers and sellers. In the housing transaction process, brokers do not represent the savings of buyers or sellers, but play their roles mainly at the matching stage. In the bargaining stage, brokers are only responsible for bargaining arrangements and providing

services for buyers and sellers, but have no substantive effects on the bargaining outcome. As a result, this study focuses on the searching and matching functions of brokers in the home buying process, not on their lesser important negotiating role.

Secondly, a broker does not charge any fees before achieving a transaction, but will eventually receive an agent fee of 0.5% - 3% of the housing transaction price from the buyer, with no fee from the seller. To expedite the sale at a higher price, the seller simultaneously asks several different brokers from different companies to sell his/her house. As a result, different brokerage companies almost always carry the same property listings. To expedite the search process, a buyer also often asks several brokers from different companies simultaneously to recommend houses that meet his/her specific specifications.

Thirdly, buyers and brokers interact throughout the entire home buying process, whereas contact between buyers and sellers is limited to the bargaining phase. The buyer search process in China can be divided into three main phases: (1) a buyer specifies his/her preferences to a broker, (2) the broker incorporates this preference set, then recommends houses to the buyer, and (3) when the search results in a match, the buyer bargains with the seller to negotiate a transaction.

In more detail, a buyer first describes his/her housing preferences to a broker, albeit to varying degrees of effectiveness. S/he not only provides the basic housing requirements, but also communicates unique individual tastes and preferences. Secondly, to meet the preference specifications of the buyer, the broker selects specific houses from the company database and recommends them to the buyer. If the buyer agrees to view the property, the broker will lead him/her to see the house in person. Subsequent to visiting the home, the buyer must then decide if the search process will continue or if s/he would like the agent to begin the bargaining phase. The entering of the bargaining phase represents the third and final component of the home search process. The search process of the buyer is completed when an agreement is reached between the buyer and seller.

Fourthly, China has not yet built a sound real estate market information system (like the Multiple Listing Service in the United States), and thus has no way to systematically and comprehensively conduct collection, management, statistics and publication of data on real estate development, mapping, trading, registration and other aspects. Instead, relevant data on the housing market, especially on the resale housing market, are few and fragmented. In addition, the appearance of “true and false contracts”¹ is

¹ A “true contract” refers to one where the actual transaction price of buyers and sellers is accurately reflected, whereas a “false contract” describes one of two possibilities. One kind of false contract is provided with a higher price to allow for the application

widespread in the Chinese resale housing market. The lack of research data severely hampers research on Chinese housing search issues. Taking into account the shortage of effective research data in China, we employ experimental methods to collect more usable data, and conduct research on the housing search process based on the experimental evidence.

3. Experimental Design

One buyer and four brokers are designated in each session of the experiment.² The brokers are human subjects, whereas the buyers are represented by a computer.³ Other than an imposed time constraint, the brokers are free to recommend houses at any time during the search process. All houses within the experimental market meet the basic requirements of the buyer. In fact, all of the attributes of the homes are held constant except for Attributes A and B. Attributes A and B may represent any relevant characteristic of the home, such as size, school district, number of bedrooms, and so on and so forth. The desirability of Attributes A and B are evenly spaced on a 10-point scale. The four brokers have the same housing source database.⁴

of a larger mortgage from the lender. The second is a lower reported price designed to reduce real estate taxes owed.

² This design reflects the second and third characteristics of the housing search in China. First, the buyer will pay the agent fee only after the housing transaction is completed. As a result, usually more than one broker will be commissioned to provide services. The 2012 market survey results from the Institute of Real Estate Studies at Tsinghua University shows that on average, 4.2 brokers are commissioned to provide services in the buyer housing search process, so in the experiment, four brokers are designed to simultaneously provide services for the buyer. Secondly, the participants in the housing search process include the buyers, sellers and brokers, but the housing search process is mainly the dynamic interaction process between the buyers and brokers. Therefore, the paper designed only two roles in the experiment, the buyers and brokers, while sellers are reflected by the house for sale in the housing source database.

³ In this study, computers are employed as buyers to accurately reflect buyer demand specification and search patience in the experiment, so as to analyze the impacts of buyer behaviors on the housing search process. If buyers are human subjects, then it is difficult to ensure that the demand specification and search patience of the buyer remain unchanged in the same experiment group, and it is also difficult to accurately measure the differences of the demand specification and search patience between different experiment groups. In addition, the purpose of allowing human subjects on behalf of the brokers is to ensure that the experimental environment is consistent with the real housing market environment as much as possible, and give full consideration to human features on “bounded rationality”, “bounded willpower”, “bounded self-interest”, and so forth and so on.

⁴ This design reflects the second characteristic of the housing search in China. As there is no need for sellers to pay any fee, usually sellers will commission more than one broker for their house sale. As a result, there is little difference between the housing source databases of all the brokers. Therefore, according to the experimental design, the four brokers have the same housing source database.

We employ a 2 x 2 experimental design that consists of four sessions: (1) a buyer with an unclear demand specification and high search patience; (2) a buyer with a clear demand specification and high search patience; (3) a buyer with an unclear demand specification and low search patience; and (4) a buyer with a clear demand specification and low search patience. Each session contains 10 periods; the first three periods are the practice periods, while the last seven periods are the formal testing periods.

To isolate the effect of the demand specification of the buyer within the experiment, the reservation price of the buyer is revealed to the brokers in Sessions 2 and 4, but not provided in Sessions 1 and 3. To examine the impact of the search patience of the buyer on the home buying process, the following termination rules are invoked. In Sessions 1 and 2, the buyer would buy the current “best home” if no new recommended house is found within 60 seconds, whereas in Sessions 3 and 4, the wait time is reduced from 60 to 30 seconds. The periods in the two sessions with high buyer search patience lasted for five minutes, while the two sessions with low buyer search patience lasted for three minutes, as shown in Table 1.

Table 1 Design of Sessions

Session	Demand specification (Buyer response)	Buyer patience (Period and wait times)
1	Unclear (Current “best home”)	High (5 min and 60 sec)
2	Clear (Current “best home” and reserve price of buyer)	High (5 min and 60 sec)
3	Unclear (Current “best home”)	Low (3 min and 30 sec)
4	Clear (Current “best home” and reserve price of buyer)	Low (3 min and 30 sec)

Within the experiment, the brokers select the house price and the levels of Attributes A and B when recommending the house to the buyer. The buyer provides feedback to all of the brokers by sharing which house currently represents the “best home” available. The brokers are then able to adjust their strategy and recommend a new house to the buyer. The above steps repeat until one of the previously discussed termination rules is satisfied. In an actual home search process, naturally occurring time constraints such as a wedding date, relocation date, or birth of a child, often necessitate a purchase decision by a specific deadline.

Each house in our model is associated with a price and only two measured non-price attributes, A and B. We use subscript “b” to represent the buyer and “s” to represent the broker. Within the experimental framework, the reservation price function of the buyer is defined as follows:

$$P_b(A, B) = a_b \times A^{a'_b} + b_b \times B^{b'_b} \quad (1)$$

where $0 \leq a_b$ and $0 \leq a'_b \leq 1$ are the related constants of Attribute A. The constant a_b represents the utility that one unit of Attribute A brings to the buyer. The expression $A^{a'_b}$ represents the total units of Attribute A possessed by the recommended house. Consistently, $0 \leq b_b$ and $b'_b < 0$ are the related constants of Attribute B. The constant b_b represents the utility that one unit of attribute B brings to the buyer. The expression $B^{b'_b}$ represents the total units of Attribute B possessed by the recommended house. The constant number of the reservation price function of the buyer is consistent within the trading period, but varies from one trading period to the next. The parameters of the reservation price function of the buyer are listed in Table 2.

The savings function of the buyer is defined as follows:

$$E_b(A, B, P) = P_b(A, B) - P \quad (2)$$

where P denotes the house trading price. The reservation price function of the seller is defined as follows:

$$P_s(A, B) = a_s \times A^{a'_s} + b_s \times B^{b'_s} \quad (3)$$

where $0 \leq a_s$ and $0 \leq a'_s \leq 1$ represent the related constants of Attribute A. The constant a_s represents the demand specification of one unit of Attribute A. The expression $A^{a'_s}$ represents the total units of Attribute A contained in the house of the seller. Similarly, $0 \leq b_s$ and $b'_s < 0$ represent the related constants of Attribute B. The constant b_s represents the demand specification of one unit of Attribute B. The expression $B^{b'_s}$ represents the total units of Attribute B contained in the house of the seller. We use the same values within the demand specification function of the buyer in all sessions to represent the unchanged property listings, as shown in Table 2. The earnings function of the broker is defined as follows:

$$E_{br}(A, B, P) = P - P_s(A, B) \quad (4)$$

In order to most appropriately align performance within the experimental design setting with naturally occurring incentives to maximize one's personal wealth, we compensate participants based on their actual decision-making within the experiment. The currency used during the experiment is simply termed "points". The earnings of the subject are calculated based on the previously defined earnings function. We also incorporate brokerage fees upon transaction to arrive at a net wealth position for each session.¹ The incentive mechanism includes two parts: basic salary and rewards. The basic salary for a student subject is 50 China Yuan (spendable local currency), whereas the basic salary for a professional subject is 200 China Yuan.² Moreover, the rewards for both groups are strictly determined by the performance of the subject. At the end of the experiment, the subjects exchange experimental currency (points) into China Yuan, at the rate of one to one.

4. Sample Participants

Although Mestelman and Feeny (1988) and Dyer, Kagel and Levin (1989), among many others, find little difference when contrasting the behavior of professionals with students when it comes to wealth maximization experiments, and while Yavas, Miceli, and Sirmans (2001) and Ikromov and Yavas (2012a, 2012b) used a convenience sample of student participants in their real estate experiments, we are still not sure that student subjects can replace professional subjects in buyer search experiments, because the buyer search process is far from the daily life of students, and students are not familiar with the complex search process and the special characteristics of housing and the housing market. Yet no direct experimental evidence show that student subjects can replace professional subjects in similar experiments. So, this study makes an additional contribution in that we sample from both students and actual brokers who are currently working for broker firms. A comparison of our sub-sample results provides a direct test of the extent to which substitution should be deemed acceptable in experiments between convenient and actual subject samples.

4.1 Sample of Professional Brokers

We recruited 32 brokers from two brokerage enterprises: Home Link and Century 21 China. Home Link is the largest local brokerage enterprise and Century 21 China is the biggest foreign brokerage enterprise in Beijing.

¹ Performance during the three practice periods did not factor in the overall compensation of the participant, but was instead used to familiarize subjects with the mechanics of the experimental marketplace.

² We design this salary according to the hourly salary of the brokers and hourly part-time job salary of students in real life.

Approximately 75% of all resale house transactions are matched by either Home Link or Century 21 China in Beijing.

All participants were informed that they would earn more than 200 China Yuan during an experiment that lasts for less than 100 minutes. More than 100 brokers opted into the experiment from the two companies. From these, 16 (8 males and 8 females) were randomly selected (subject to an even distribution of males and females)³ from Home Link and 16 (8 males and 8 females) were randomly selected from Century 21 China. The experiments were conducted in March 2013 in Beijing.

4.2 Sample of Postgraduate Students

We also recruited 32 postgraduate students from two universities: Tsinghua University and the Beijing Civil Engineering and Architecture University. Both universities offer real estate economics classes as well as real estate majors. The potential sample participants consisted of 66 postgraduate students in the Department of Construction Management at Tsinghua University and 157 postgraduate students in the Department of Economics and Management at the Beijing Civil Engineering and Architecture University. All participants were informed that they would earn more than 50 China Yuan during an experiment that would last for less than 100 minutes. Twenty-two of the 66 Tsinghua University students and 51 of the 157 Beijing Civil Engineering and Architecture University students opted into the experiment. From these, 16 (8 males and 8 females) were randomly selected from Tsinghua University and 16 (8 males and 8 females) were randomly selected from the Beijing Civil Engineering and Architecture University. The experiments were conducted in April 2012 in Beijing.

Within each participant type, the 16 subjects from the same place are equally divided into four groups with each subject only taking part in one of the four

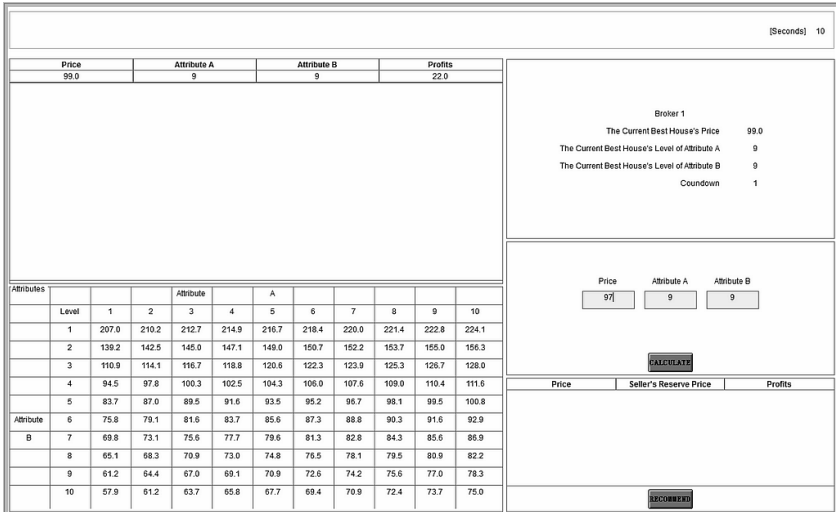
³ In order to hold the potential influence of gender on the behavior of the subjects, we ensured even gender distribution. Many previous studies (Crellin, Frew and Jud, 1988; Abelson, Kacmar and Jackofsky, 1990; Sirmans and Swicegood, 1997; Jud and Winkler, 1998) have examined the effects of the sex of the broker on compensation and other factors. They find that the gender of the broker has a positive or negative influence on the compensation. Turnbull and Dombrow (2007) find that sex does not influence the performance or outcomes of a broker, but specializing in listing yields higher prices. Due to the limited number of samples, other characteristics of the subjects, such as age, experience, education etc., are not taken into account in our study. In the case of working years, the working years of brokers in the Chinese housing market is basically between 0 to 15 years. If year is taken as the grouping step, the subjects can be divided into 16 categories based on different working years. As there are only four brokers in each round of experiment, it is difficult to cover subjects with a variety of different working years in the same experiment group. In summary, the impacts of the subject characteristics such as subject age, working years, and educational background on the experimental results are not considered in the paper. These are left for an in-depth study in the future.

sessions. This standard procedure is followed to prevent the unintended influence of learning curve effects. Due to the randomized selection process and homogeneity within each sample of participants, it is reasonable to conclude that any effects related to differences between the four sessions are unrelated to variables that exist outside the experimental design.

5. Experimental Procedures

Consistent with Ikromov and Yavas (2012a, 2012b) and Chen-Ritzo et al. (2005), our experiment is programmed and conducted by using the experimental software known as z-Tree (Fischbacher, 2007).⁴ To avoid any misunderstanding of the experiment, the computer interface is translated into Chinese, as shown in Figure 2. The computer interface consists of five boxes. The upper box is the period time display box, where subjects see the remaining time for the current period. The two boxes in the middle and lower-right-hand sides are the recommending boxes. Subjects key in the house price and levels of Attributes A and B into the text boxes which are entitled “Price”, “A”, and “B” separately. Then, the participant can calculate his/her potential earnings by clicking the “CALCULATE” button. Once ready to make the recommendation appear on the screens of others, the participant can recommend a house by clicking the “RECOMMEND” button.

Figure 2 Computer Interface Screen Capture



The price and attribute information of the recommended house is then listed in the upper left-hand side boxes and sorted in chronological order. When the

⁴ z-Tree (Zurich Toolbox for Ready-Made Economic Experiments) was developed at the University of Zurich.

recommended house is the current “best house,” the house information and the name of the broker who recommended the house are displayed in the upper right-hand side box as is the 30 or 60 second countdown.⁵ Recall that the countdown terminates the trading session if no new recommended house can replace the current best house within 30 (or 60) seconds. The countdown clock is restarted if a newly recommended house replaces the current “best house” before the 30 (or 60) second clock counts down to zero. Finally, the left-bottom box is designed to display information related to the demand specifications of the seller. The subjects can use this information to modify previous recommendations in an attempt to replace the current “best house”.

The pre-experiment process begins when subjects read trading instructions on their own (see Appendix). These same instructions are then read aloud by the person who is conducting the experiment followed by an opportunity for participants to ask questions. Next, the subjects are shown exactly how to use the software through a group demonstration. Finally, the subjects complete an experimental understanding test before starting the actual experiment. Once the experimenter is certain that all of the subjects understand the instructions, the subjects participate in three practice periods. The three practice periods are intended to allow the subjects to become familiar with the computer interface and learn how to recommend a house to a buyer. The three practice sessions are followed by seven actual trading sessions where performance directly correlates to compensation. This process is repeated for all four trading sessions. Participants are then compensated before leaving the experimental trading room.

6. Results and Discussion

The results are automatically recorded by the experimental software, z-Tree. Each of the following indexes is stored for subsequent analysis: earnings, competition, matching, and search time indexes. The earnings index includes the house transaction price, and buyer and broker earnings. The competition index includes the number of recommendations, amount of price competition, and amount of attribute competition. The number of recommendations is the total number of all broker recommendations in each trading period. Price competition refers to the total number of recommendations of all the brokers that reflect the same attributes as those associated with the current “best home” attributes (implying a reduced price). Attribute competition refers to the total number of all the recommendations by a broker where at least one attribute of the recommended house represents an improvement over the current “best home” attributes.

⁵ Before we conducted the experiment, we tested if 30 seconds is too short a period to calculate and recommend a home. The test results showed that the subjects, on average, need 10 seconds to make a recommendation.

The matching index is defined as the Euclidean distance:

$$ED = \sqrt{(A_a - A_t)^2 + (B_a - B_t)^2} \quad (5)$$

where A_a and B_a represent the level of the actual attributes of the transaction house, and A_t and B_t are the levels of the attributes of the theoretical best house.

Finally, the search time index measures the search duration, defined as the time that elapses between the beginning of the trading period to the time that the search ceases (either due to the purchase of a home or the end of the trading session). The experimental results of the professionals and postgraduate students are reported in Tables 3 and 4, respectively.

Table 5 reports a summary of the Wilcoxon-Mann-Whitney rank-sum⁶ statistical testing that is used to quantify the impact of both buyer demand specification and search patience on the home buying process.

6.1 Professionals

Based on the significant p-value, there are no significant effects of demand specification on the earnings of the buyer, matching degree and search duration. In terms of search patience, the results indicate that the earnings of the buyer are greater, matching degree is higher, and search duration is longer when the buyer is more patient.

6.2 Postgraduate Students

Based on the significant p-value, we conclude with 99% confidence that the ratio of the earnings of the buyers in a clear demand specification sample are significantly greater than the ratio of the earnings of the buyers in an unclear demand specification sample. Based on the Euclidean distance measure, we find that when buyers provide brokers with less clearly defined demand specifications, the result is significantly less accurate matching (99% confidence level) on the part of the brokers. Interestingly, there is no significant difference in search time that stems from differential demand specifications. In sum, the earnings of the buyer are greater and the matching degree is higher when the demand of the buyer is more clearly specified; however search time is unaffected. In terms of search patience, the results indicate that neither earnings nor matching is significantly affected. However, search time is significantly greater (at the 99% level).

⁶ The Mann-Whitney U test can be used to test the difference between two groups when the distribution of two groups is asymmetrical or unknown (Mann and Whitney, 1947). This test has the great advantage of possibly being used for small samples of subjects. It has greater efficiency than the t-test on non-normal distributions, such as a mixture of normal distributions, and is nearly as efficient as the t-test on normal distributions. This test goes by several different names, including the Mann-Whitney U test, Wilcoxon-Mann-Whitney test, or Wilcoxon Rank-Sum test.

Table 3 Experimental Results for Professionals

Index system		Subjects	Sessions	Periods							Mean
				1	2	3	4	5	6	7	
Earnings index	Transaction price	HL	Session 1	120.0	93.0	223.0	225.0	213.0	119.0	225.0	174.0
			Session 2	223.0	87.0	224.3	224.2	208	221.5	225.0	201.9
			Session 3	127.0	101.0	111.0	155.9	219.0	224.0	217.0	165.0
			Session 4	211.0	103.0	140.0	217.0	208.0	211.0	229.0	188.4
		CC	Session 1	154.0	76.0	224.1	224.1	207.0	210.3	224.1	188.5
			Session 2	224.1	75.1	224.1	224.1	207.0	207.0	224.1	197.9
			Session 3	150.0	80.0	100.0	255.0	208.0	215.0	213.0	174.4
			Session 4	223.0	76.0	223.0	160.0	101.0	207.5	224.5	173.6
	Buyer's earnings	HL	Session 1	22.5	14.5	106.2	73.9	36.8	27.3	43.9	46.4
			Session 2	44.3	14.7	106.4	74.7	37.2	45.4	43.9	52.4
			Session 3	25.0	13.9	31.4	58.6	32.5	42.9	40.3	35.0
			Session 4	41.3	10.8	54.6	64.3	37.2	46.4	39.9	42.1
		CC	Session 1	30.4	14.1	106.6	74.8	38.2	47.1	44.8	50.8
			Session 2	44.8	14.9	106.6	74.8	38.2	46.9	44.8	53.0
			Session 3	26.6	13.9	27.4	70.8	37.2	44.8	38.8	37.1
			Session 4	44.3	14.0	106.2	57.6	13.9	46.4	44.4	46.7
	Broker's earnings	HL	Session 1	1.2	0.1	0.2	0.9	0.3	0.2	0.9	0.5
			Session 2	0.2	0.1	0.2	0.1	1.0	0.1	0.9	0.4
			Session 3	0.3	0.2	0.6	0.9	4.1	2.6	0.3	1.3
			Session 4	0.8	0.5	0.8	0.3	1.0	0.8	4.9	1.3
CC		Session 1	0.3	0.4	0.0	0.0	0.0	0.1	0.0	0.1	
		Session 2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	
		Session 3	2.9	0.5	2.2	32.2	1	2.3	0.3	5.9	
		Session 4	0.2	1	0.2	3.7	0.7	0.5	0.4	1.0	
Competition index	Number of recommendations	HL	Session 1	25	12	26	12	13	12	12	16.0
			Session 2	11	25	16	17	36	12	18	19.3

(Continued...)

(Table 3 Continued)

Index system		Subjects	Sessions	Periods							Mean	
				1	2	3	4	5	6	7		
Competition index	Number of recommendations	HL	Session 3	6	5	8	4	7	7	10	6.7	
			Session 4	10	14	7	18	7	4	12	10.3	
		CC	Session 1	12	10	28	8	28	13	14	16.1	
			Session 2	11	10	18	13	11	9	13	12.1	
			Session 3	6	17	6	16	14	9	10	11.1	
			Session 4	19	7	15	8	7	7	6	9.9	
		Number of price competition	HL	Session 1	4	1	1	1	2	0	0	1.3
				Session 2	0	0	0	0	1	0	3	0.6
	Session 3			1	0	1	0	1	1	3	1.0	
	Session 4			2	1	1	4	1	0	1	1.4	
	CC		Session 1	1	0	11	0	5	4	2	3.3	
			Session 2	4	0	3	3	2	1	2	2.1	
			Session 3	0	0	0	1	0	0	1	0.3	
			Session 4	0	0	1	0	1	0	0	0.3	
	Number of attribute competition	HL	Session 1	21	11	25	11	11	12	12	14.7	
			Session 2	11	25	16	17	35	12	15	18.7	
			Session 3	5	5	7	4	6	6	7	5.7	
			Session 4	8	13	6	14	6	4	11	8.9	
		CC	Session 1	11	10	17	8	23	9	12	12.9	
			Session 2	7	10	15	10	9	8	11	10.0	
Session 3			6	17	6	15	14	9	9	10.9		
Session 4			19	7	14	8	6	7	6	9.6		
Matching index	Transaction house's actual attributes	HL	Session 1	4,3	10,6	9,1	10,1	3,1	4,3	10,1	-	
			Session 2	9,1	10,7	10,1	10,1	1,1	8,1	10,1	-	
			Session 3	9,3	10,5	9,4	9,2	4,1	8,1	5,1	-	

(Continued...)

(Table 3 Continued)

Index system		Subjects	Sessions	Periods							Mean
				1	2	3	4	5	6	7	
Matching index	Transaction house's actual attributes	HL	Session 4	2,1	4,4	1,2	5,1	1,1	2,1	10,1	-
		CC	Session 1	8,2	8,9	10,1	10,1	1,1	2,1	10,1	-
			Session 2	10,1	10,10	10,1	10,1	1,1	1,1	10,1	-
			Session 3	4,2	8,8	2,4	9,1	1,1	3,1	3,1	-
			Session 4	9,1	10,10	9,1	10,2	3,4	1,1	10,1	-
	Attributes of theoretical best house			10,1	10,10	10,1	10,1	1,1	2,1	10,1	-
	Euclidean distance	HL	Session 1	5.8	4.0	1.0	0.0	2.0	2.8	0.0	2.2
			Session 2	1.0	3.0	0.0	0.0	0.0	6.3	0.0	1.5
			Session 3	2.2	5.0	3.2	1.4	3.0	6.0	5.0	3.7
			Session 4	8.0	8.5	9.1	5.0	0.0	0.0	0.0	4.4
		CC	Session 1	2.2	2.2	0.0	0.0	0.0	0.0	0.0	0.6
			Session 2	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.1
Session 3			6.1	2.8	8.5	1.0	0.0	1.0	7.0	3.8	
Session 4			1.0	0.0	1.0	1.0	3.6	1.0	0.0	1.1	
Search time index	Search duration	HL	Session 1	158	243	156	147	300	100	155	179.9
			Session 2	209	153	246	94	106	131	94	147.6
			Session 3	112	73	118	77	97	98	133	101.1
			Session 4	127	132	78	172	70	63	130	110.3
	CC	Session 1	102	74	242	72	252	109	116	138.1	
		Session 2	103	81	152	117	118	71	89	104.4	
		Session 3	63	143	68	125	102	85	95	97.3	
		Session 4	167	77	160	80	70	62	60	96.6	

Note: : 1.HL and CC represent Home Link and Century21, China, respectively.

2.The theoretical result represents the level of the attributes of the theoretical best house.

Table 4 Experimental Results for Postgraduate Students

Index system		Subjects	Session	Period							Mean
				1	2	3	4	5	6	7	
Earnings index	Transaction price	TU	Session 1	145.2	75.0	156.0	156.4	110.5	116.8	220.1	140.0
			Session 2	224.2	75.1	224.1	224.1	207.0	210.3	224.1	198.4
			Session 3	224.1	75.2	224.3	225.0	210.0	222.9	89.0	181.5
			Session 4	224.5	78.5	224.2	226.0	207.2	207.2	207.2	196.4
		BCEAU	Session 1	224.2	73.9	224.2	224.2	207.0	210.3	224.2	198.3
			Session 2	224.1	78.3	140.0	224.1	207.1	212.8	224.2	187.2
			Session 3	95.0	150.8	217.0	220.1	207.2	122.4	225.0	176.8
			Session 4	224.2	58.0	224.2	224.1	207.0	207.0	224.1	195.5
	Buyer's earnings	TU	Session 1	28.8	13.5	57.6	61.2	12.5	27.7	42.1	34.8
			Session 2	44.8	15.0	54.6	74.8	38.7	47.0	44.7	45.6
			Session 3	44.8	14.8	106.4	73.9	35.2	45.0	15.9	48.0
			Session 4	44.4	14.7	106.5	72.9	38.0	46.7	37.7	51.6
		BCEAU	Session 1	44.7	14.6	106.5	74.7	38.2	47.1	44.7	52.9
			Session 2	44.7	14.9	106.6	74.8	38.2	47.1	44.8	53.0
			Session 3	11.1	57.6	64.3	35.5	46.7	22.1	43.9	40.2
			Session 4	44.7	14.9	106.5	74.8	38.2	46.9	44.8	53.0
	Broker's earnings	TU	Session 1	0.2	1.2	0.9	0.1	0.2	0.2	0.2	0.4
			Session 2	0.0	0.1	0.8	0.0	0.5	0.0	0.1	0.2
			Session 3	0.0	0.2	0.2	0.9	3.0	0.1	0.2	0.7
			Session 4	0.4	0.2	0.1	1.9	0.2	0.2	0.2	0.5
BCEAU		Session 1	0.1	0.1	0.2	0.1	0.0	0.0	0.1	0.1	
		Session 2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	
		Session 3	7.6	10.9	9.9	3.6	0.1	4.9	0.9	6.3	
		Session 4	0.1	3.3	0.2	0.0	0.0	0.0	0.0	0.5	
Competition index	Number of recommendations	TU	Session 1	12	16	9	14	7	21	10	12.7
			Session 2	10	32	11	9	11	10	19	14.6

(Continued...)

(Table 4 Continued)

Index system		Subjects	Session	Period							Mean	
				1	2	3	4	5	6	7		
Competition index	Number of recommendations	TU	Session 3	14	12	9	6	5	12	10	9.7	
			Session 4	8	16	16	10	6	8	9	10.4	
		BCEAU	Session 1	21	10	16	8	14	8	18	13.6	
			Session 2	27	20	4	17	9	21	13	15.9	
			Session 3	3	5	8	7	6	5	6	5.7	
			Session 4	5	11	7	11	10	7	8	8.4	
		Number of Price competition	TU	Session 1	1	0	0	1	1	0	0	0.4
				Session 2	0	2	0	1	2	0	0	0.7
	Session 3			3	3	1	0	0	2	1	1.4	
	Session 4			0	3	1	1	0	0	0	0.7	
	BCEAU		Session 1	0	0	0	0	0	0	0	0.0	
			Session 2	2	0	0	0	0	3	0	0.7	
			Session 3	0	0	0	0	0	0	0	0.0	
			Session 4	0	0	0	1	0	2	0	0.4	
	Number of attribute competition	TU	Session 1	11	16	9	13	6	21	10	12.3	
			Session 2	10	30	11	8	9	10	19	13.9	
			Session 3	11	9	8	6	5	10	9	8.3	
			Session 4	8	13	15	9	6	8	9	9.7	
		BCEAU	Session 1	21	10	16	8	14	8	18	13.6	
			Session 2	25	20	4	17	9	18	13	15.1	
Session 3			3	5	8	7	6	5	6	5.7		
Session 4			5	11	7	10	10	5	8	8.0		
Matching index	Actual attributes of transaction house	TU	Session 1	10,1	9,10	10,1	10,1	1,1	2,1	10,1	-	
			Session 2	10,1	10,9	1,2	10,1	1,1	3,1	10,1	-	

(Continued...)

(Table 4 Continued)

Index system		Subjects	Session	Period							Mean		
				1	2	3	4	5	6	7			
Matching index	Actual attributes of transaction house	TU	Session 3	10,1	10,10	10,1	10,1	1,1	9,1	7,6	-		
			Session 4	10,1	10,9	10,1	10,1	1,1	1,1	1,1	-		
		BCEAU	Session 1	3,2	9,10	9,2	10,2	9,4	3,3	7,1	-		
			Session 2	10,1	10,10	10,1	10,1	1,1	2,1	10,1	-		
			Session 3	5,5	6,2	5,1	7,1	1,1	6,3	10,1	-		
			Session 4	10,1	1,10	10,1	10,1	1,1	1,1	10,1	-		
		Attributes of theoretical best house				10,1	10,10	10,1	10,1	1,1	2,1	10,1	-
		Euclidean distance	TU	Session 1	7.1	1.0	1.4	1.0	8.5	2.2	3.0	3.5	
	Session 2			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Session 3			0.0	0.0	0.0	0.0	0.0	7.0	6.0	1.9		
	Session 4			0.0	1.0	0.0	0.0	0.0	1.0	9.0	1.6		
	BCEAU		Session 1	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.1		
			Session 2	0.0	1.0	9.1	0.0	0.0	1.0	0.0	1.6		
			Session 3	6.4	8.9	5.0	3.0	0.0	4.5	0.0	4.0		
Session 4			0.0	9.0	0.0	0.0	0.0	1.0	0.0	1.4			
Search time index	Search duration	TU	Session 1	107	89	53	84	47	97	63	77.1		
			Session 2	89	231	96	66	84	112	122	114.3		
			Session 3	195	83	129	69	122	81	130	115.6		
			Session 4	262	107	123	139	75	164	104	139.1		
		BCEAU	Session 1	36	41	43	46	44	53	43	43.7		
			Session 2	41	90	40	60	84	38	53	58.0		
			Session 3	172	202	262	210	272	188	245	221.6		
			Session 4	271	129	264	294	276	248	238	245.7		

Note: TU and BCEAU represent Tsinghua University and the Beijing Civil Engineering and Architecture University, respectively.

Table 5 Impact of Demand Specification and Search Patience on Earnings, Matching, and Search Duration

Variable	Subject	Earnings index		Matching index	Search time index
		Ratio of earnings of buyer	Ratio of earnings of broker	Euclidean distance	Ratio of search duration
Demand specification	Professionals	w=708 p=0.139	w=708 p=0.139	w=692 p=0.071	w=751.5 p=0.446
	Postgraduate Students	w=602.5 p=0.001	w=602.5 p=0.001	w=633.5 p=0.002	w=761.5 p=0.546
Search patience	Professionals	w=520 p=0.000	w=520 p=0.000	w=616 p=0.002	w=639 p=0.009
	Postgraduate Students	w=788.5 p=0.876	w=788.5 p=0.876	w=782 p=0.766	w=572.5 p=0.000

- Notes:* 1. The left-hand column represents the measured variable.
 2. “w” is the rank-sum test statistic and “p” is the p-value.
 3. The ratio of the earnings of the buyer= (Buyer reservation price-trading price)/(Buyer reservation price-Seller reserve price).
 4. The ratio of the earnings of the broker= (trading price-Seller reservation price)/(Buyer reservation price-Seller reserve price).
 5. The ratio of search duration is the percentage of the period time divided by search duration.

Table 6 reports the results associated with the three components of the competition index for both samples. For professionals, the three components of the competition index are unaffected by the demand specification of the buyer. When buyer patience is high, the result is a significant increase in the number of broker recommendations and attribute competition, but no change in price competition.

Table 6 Impact of Demand Specification and Search Patience on Competition

Variable	Subject	Competition index		
		Number of recommendations from broker	Number of price competition	Number of attribute competition
Demand specification	Professionals	w=770 p=0.645	w=786.5 p=0.842	w=774.5 p=0.699
	Postgraduate students	w=632.5 p=0.007	w=766 p=0.594	w=593 p=0.001
Search patience	Professionals	w=561.5 p=0.000	w=691 p=0.064	w=567 p=0.000
	Postgraduate students	w=764 p=0.577	w=707 p=0.130	w=798 p=1.000

- Notes:* 1. The left-hand column represents the measured variable.

2. “w” is the rank-sum test statistic and “p” is the p-value.

For students, a clear demand specification is associated with significantly fewer overall broker recommendations, fewer attribute recommendations, but no change in pricing competition. The three components of the competition index are unaffected by the search patience of the buyer.

By comparing the results of the professionals to the postgraduates, we find that the demand specification of the buyer has no significant influence on the behavior of the professionals, whereas the search patience of the buyer has a significant influence on the earnings of the buyer and broker, matching degree and the number of broker recommendations. In contrast, when we consider postgraduates, the demand specification of the buyer has a significant influence on the earnings of the buyer and broker, matching degree, and number of broker recommendations and attribute competition at the 99% significant level, whereas the search patience of the buyer has almost no significant influence on student behavior, except for the search duration.

7. Conclusions

We utilize an experimental method to examine the effects of the demand specification and search patience of buyers on the home buying process in China’s resale housing market. We conclude that there are no significant effects of demand specification on the behavior of brokers and search results. When the search patience of a buyer is higher, the earnings of the buyer are greater, matching degree is higher, search duration is longer, number of broker recommendations is greater, and attribute competition is fiercer.

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Appendix

Experimental Instruction 1 (Session 1)

I. General Instructions

Welcome! This is an experiment with regards to transactions in China's resale housing market. The National Nature Science Foundation of China has provided funds for this research. The instructions are simple, and if you make the proper decisions, you can earn a considerable amount of money. We will pay you in cash at the end of the experiment.

II. Market Organization

There is one buyer and four brokers in this experiment. All of you are playing the broker role, whereas the buyer is represented by the computer. You can recommend houses to the buyer. Other than a time constraint, you are free to recommend houses at any time.

All houses in the experimental market meet the basic requirements of the buyer. All of the attributes of the house are the same except for Attributes A and B. Attributes A and B may represent any characteristic of the home that you deem important, such as size, school district, etc. The quality of Attributes A and B range from one (low) to 10 (high). There are 10 periods in our experiment; the first three periods are practice periods, while the last seven periods are formal trading periods. Each period will last 5 minutes.

III. Market Institution

In the experiment, you should clearly mark the house price as well as the levels of Attributes A and B when recommending a house to a buyer. The buyer will tell you which house is the current "best house" based on its price and levels of Attributes A and B. You can adjust your strategy and recommend a new house to the buyer according to the response of the buyer.

The buyer search process will be stopped when one of the following conditions is satisfied. First, the buyer will stop searching if no newly recommended house replaces it for 60 seconds. Secondly, if no house can satisfy the first condition within a 5 minute period, the buyer will buy the current "best house" at the end of the period.

IV. Incentive Mechanism

Your earnings consist of two parts: a basic salary and reward. The basic salary is 50 CNY. Conditional on your participation, you will receive a basic salary. Rewards are determined based on your experimental performance. At the end of the experiment, you can exchange the experimental currency (points) into CNY, at the rate of one to one. The more points that you earn, the more cash you will receive at the end of the experiment.

V. Computer Interface

You will use the computer interface to get information and submit recommendations. A screen capture of the computer interface is shown in Figure 1. The computer interface consists of five boxes. The upper box shows the remaining time in the current period. Two boxes in the middle and lower-right-hand sides are the recommending boxes. You should key in the house price as well as levels of Attributes A and B into the text boxes which are entitled “Price”, “A,” and “B,” respectively. You can then calculate your earnings by clicking the “CALCULATE” button and recommend a house by clicking the “RECOMMEND” button. The price and attribute information of the recommended house will be listed in the upper left-hand side box and sorted in chronological order. When the recommended house is the current “best house,” the house information and the name of the broker who recommended it will be displayed in the upper right-hand side box. A 60 second countdown will be also displayed in the upper-right-hand side box. The countdown will be ended if no new recommended house replaces the current “best house” within 60 seconds or restarted if the new recommended house replaces the current “best house” within 60 seconds. The left-bottom box displays the information of the reservation price of the seller. You can use this information to modify previous recommendations to try to replace the current “best house”.

VI. Notice

You will now play in three practice periods. Your actions in the three practice periods do not count towards your earnings and do not affect your position later in the seven formal periods. The goal of the practice periods is to help you become familiar with the computer interface. Please make sure you understand how to use the computer interface before the end of the practice periods.

It is important that you do not talk or communicate with other people during the experiment. If you have any questions, please raise your hand. Are there any questions?

Experimental Instruction (Sessions 2, 3, and 4)

The contents of the experimental instruction 1, 2, 3, and 4 are identical except for the disclosure of the reservation price information of the buyer and the length of the countdown. In the experiment, the reservation price information of the buyer of the recommended house was provided to the broker who recommends it in Sessions 2 and 4, but not provided in Sessions 1 and 3. In Sessions 1 and 2, the buyer would buy the current “best house” if no new recommended house replaces it after 60 seconds. In Sessions 3 and 4, we changed the 60 seconds to 30 seconds. Finally, the basic salary was changed to 200 CNY when we used the professional sample.