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Endowment Effect and Housing Decisions

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Abstract

Endowment effect refers to the reported gaps between willingness to accept and willingness to pay. According to prospect theory, this is a result of the underweighting of opportunity costs. Given the high-stake in a typical housing transaction, one would expect that endowment effect to have a significant impact on housing decisions. In this paper, we develop a theoretical framework to study the presence of endowment effect and its role in housing decision-making process. Three hypotheses are derived and tested through a field experiment conducted in Beijing, China. Our empirical evidences show that endowment effect plays an important role in the formation of judgmental biases in housing decisions. Moreover, endowment effect interacts with housing cycles. As an application of prospect theory in housing market, our study not only extends existing theoretical and empirical works in this important sector, but also sheds light on consumers' behaviors in the emerging property market in China.

Key Words:

Prospect Theory; Behavioral Economics; Judgmental Bias; Field Experiment; China

JEL Classification: R31, D03

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Abstract

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Endowment Effect and Housing Decisions

1. Introduction

Ever since the publication of Kahneman & Tversky (1979)'s seminar work, prospect theory has been applied to a wide range of disciplines, from Finance to Managerial decisions, from economics to public administration (see, for example, Barberis, 2013; Goldfarb et al 2012; Wilson 2011). The theory has been used to provide explanation for an array of anomalies that cannot be explained or even modeled by standard economic theory (SET). The list is long – equity premium puzzle, disposition effect, endowment effect, house money effect, to name a few. Among all the puzzles studied, endowment effect is one of the most intensively investigated and most controversial anomalies.

Under the SET, the price of a good/service is determined by its hedonic characteristics and market equilibrium. Hence the price that a seller is willing to accept (WTA) equals the price that a buyer is willing to pay (WTP) for the same good/service. However, empirical evidences show that WTA is generally higher than WTP, sometimes with WTA as large as four times of the WTP for the same good/service (Kahneman et al, 1990). Thaler (1980) coined the term 'endowment effect' for this WTA/WTP gap, and describe the nature of this effect based on prospect theory.

There has been much debate on the nature of endowment effect. On the one hand, evidences show that experience, competition, and large stakes can effectively close the WTA/WTP gap (List, 2003; Levitt & List 2008; Hart, 2005); Plott & Zeiler (2005, 2007) also show that endowment effect might be due to mis-conception of subjects, and consequently won't be identified after experiments is designed to control for this factor. On the other hand, strong field evidence also suggests that loss aversion, the fundamental of endowment effect according to Thaler (1980), still presents even for professional golfers, who are experienced and playing in a highly competitive environment with large stake. Clearly further studies are needed in order to reach a consensus.

We aim to provide empirical evidence regarding endowment effect from an important sector, namely, the housing market. The gap between WTA and WTP between home- buyers and sellers will affect the liquidity of property transactions fundamentally. A good understanding of the nature and behavior of endowment effect in housing decisions will shed lights on the driving force of housing cycles, as well as consumer behaviors in this unique market.

Home purchase is one of the most important decisions in one's life. The stake, often measured as a percentage of home value in one's wealth portfolio, is high.

The implication could be two-folded. The high-stake associates with a transaction might force the owners to adjust their expectation rationally, and consequently form WTAs that are closer to WTPs, as suggested in the literature (List, 2003; Levitt & List 2008; Hart, 2005);. On the other hand, houses are not regular consumption goods. Sellers will be attached to their houses to certain extent. Therefore the loss aversion effect might be stronger than what is observed from transactions of any other goods/services.

To add complexity to the picture, most home buyers/sellers are not experienced enough. Statistics shows that people change homes four times on average in their lifetime. With so few transactions scattered far apart, one may suspect that the gap between WTA and WTP is substantial in property transactions. When it comes to competition, the picture is even blurrier. Housing market is characterized with cycles. Transaction prices and volumes are typically high during up markets, and just the opposite during market downturns. If we use transaction volume as an indicator of the level of competition, and take the position that competition interacts with endowment effect, the indication is that endowment effect in housing market, if any, should be examined with market sentiment in mind.

With the uniqueness of housing market in mind, we develop a theoretical framework to study the relationship between endowment effect and housing decisions. The theoretical model was tested using field experiment data from China. We conduct the experiment in China for two reasons. Firstly, the development of property market in China has been eye-catching. Given its great potential for capital growth and rental yield, here is a need for theoretical and empirical studies on this emerging market. Secondly, there is a lack of behavioral studies on this market. At the time of writing, we find only one related work by He & Asami (2014), in which they conduct a WTA-WTP experiment for land price in Beijing. There is a need to narrow the gap between the demand and supply of behavioral research into the property market in China.

The objective of this paper is to bridge the above-mentioned gaps in the literature. To ensure the ecological validity, we bring the experiments to the field, by interviewing potential homebuyers and sellers in branches of a local property agency in Beijing, China. To ensure the conceptual validity, we follow the experiment design in Paraschiv & Chenavaz (2011), which has been tested in the French property market. Our findings not only verify the presence of endowment effect in housing market, but also provide further evidence on the nature of endowment effect in this particular market. More specifically, we find that endowment effect plays an important role in the formation of judgmental bias in housing decisions, and this effect is not uniform under different market sentiment.

The remainder of this paper is organized as follows. In Section 2 the theoretical framework is presented and testable hypotheses are derived. The procedures to implement the theoretical model are given in Section 3. In Section 4 empirical findings are discussed, followed by conclusions in Section 5.

2. Theoretical Framework and Testable Hypotheses

The objective of this study is not only to verify the presence of endowment effect in housing market, but more importantly, to determine how endowment effect may shape housing decisions. To achieve this goal, we use Prospect Theory (PT) as a framework to model the effect of endowment effect in housing decision-making process.

PT improves the explanation power of SET by revisiting the assumptions of consumers being rational (Kahneman & Tversky, 1979). SET assumes that consumers aim to maximize a supposed utility function in making decisions. The assumption is consistent with, and enforces, a view of individuals as rational and purely self-interested in their preferences. In practice, consumers' behaviors deviate from SET's predictions as suggested by both laboratory experiments and field evidence (see, for example, (Baucells et al. 2011; Pope & Schweitzer, 2011)). PT introduces a reference point in the decision making process. More specifically, agents do not value their gains and losses based on global or globally available wealth, but rather take stock of these values in relation to an individually specific reference point. Without losing any generality, the relationship can be described with equation (1) and Figure 1a.

$$v(X) = \begin{cases} (X - r)^\alpha & X \geq r \\ -(r - X)^\beta & X < r \end{cases} \quad (1)$$

where $v(X)$ is the value function based on outcome X . r is the reference point. α and β capture the effects of both diminishing sensitivity and loss aversion. More specifically, $\beta > \alpha$ reflects that individuals' value function in the loss domain is steeper than that in the gain domain—in other words, they take greater risks to avoid losses than to secure gains; $\alpha < 1$ and $\beta < 1$ captures the diminishing sensitivity, which means that the marginal effect of gains and losses diminishes with the distance between X and r .

Loss aversion in PT has been used as the explanation of endowment effect. Because sellers need to give up the goods, which is essentially a loss of valuable possessions, it is only reasonable for them to demand compensation for such a loss (Kahneman et al., 1990). If the price of the product is m , seller is in the loss domain and her value function equals $-(r - m)^\beta$. In this case $|-(r - m)^\beta| > (m - r)^\alpha$ because $\beta > \alpha$. Sellers will demand a high price in order to reduce the loss.

However, the above explanation overlooks two important aspects in Prospect Theory. First of all, buyer and sellers do not necessarily have the same reference point r . The importance of reference point has been largely overlooked in the endowment effect literature, except for a few studies in the marketing research area (see, for example, Weaver & Frederick, 2012). In this study, we argue that the identification of reference point is the crucial first step to understand endowment effect. Only after the reference point is determined then one can decide whether the decision maker is in the loss domain or gain domain, and subsequently the nature of endowment effect can be determined. This is in line with the arguments in Weaver & Frederick (2012).

Our analysis starts from the definition of reference point as sellers'/buyers' WTA/WTP. It is found that consumers use expectations as reference points in their evaluations (Lattin & Bucklin, 1989; Spiegler, 2012; Ericson & Fuster, 2011). These expectations are essentially buyer/seller's reserved price, or WTP/WTA. For example, if a bid price is less than the seller's WTA, she will be in the loss domain and consequently be reluctant to transact. In contrast, a buyer will be more likely to agree to an asking price if it is below her WTP. The value function for buyers and sellers are mirror images as depicted in Figure 1b and Figure 1c. When buyers and sellers act as predicted in SET, both parties will arrive at the same price, which is the fair market price P . In this sense SET model is a special case of PT model where $WTA = WTP = P$.

However, PT predicts that decision makers have bounded rationality and form their own reference points to evaluate different prospects. This means that WTA/WTP does not necessarily equal P . Empirical evidences show that not only WTA/WTP deviated from P , but also the discrepancy differs between buyers and sellers (Paraschiv & Chenavaz, 2011). The relationship becomes more complex when market conditions are taken into account. A rich body of literature on reference point adaption suggest that buyers and sellers update their WTP/WTA by incorporating both historical and newly available market information (see, for example, Baucells et al 2011). To illustrate the dynamic between WTA/WTP and market conditions, we firstly define WTA and WTP as a weighted average of historical and recently available information. The definition is based on the well-established primacy and recency effect in psychology and neuroscience studies (Capitani et al., 1992; Cowan et al., 2002; Innocenti et al., 2013; Sikstrom, 2006). Baucells et al (2011) also shows that reference points are formed primarily based on the first and the last price of the time series. The relationship can be captured using the following equation.

$$WTA = \theta_s P_0 + (1 - \theta_s)P \quad (2)$$

$$WTP = \theta_b P_0 + (1 - \theta_b)P \quad (3)$$

where P_0 is the initial purchase price of the property, P is the market price of a

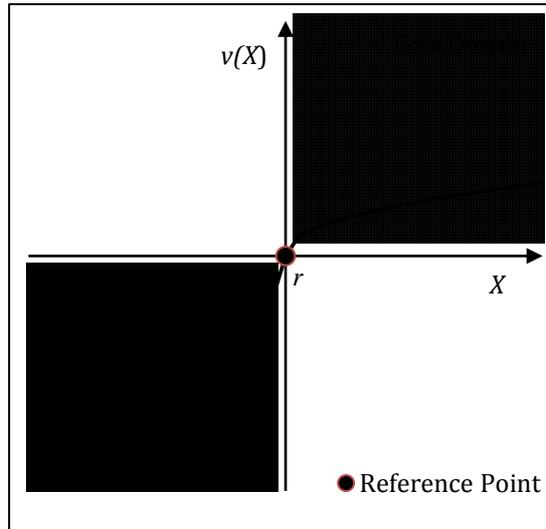
similar property, θ_s (θ_b) \in [0,1] is the weight placed on initial purchase prices by sellers (buyers). θ_s (θ_b) is determined by the degree of risk aversion. When there is a significant discrepancy between P_0 and P , agents who are in their loss domains will put more weight on P_0 , and the probability of transaction will be low because agents are reluctant to accept the market price, P . This is a risk seeking behavior that is typically found in the loss domain. As show in Figure 1b and 1c, buyers and sellers have different loss domains. More specifically, in an up market buyers are in their loss domain, and consequently will place more weight on P_0 . On the other hand, in a down market sellers are in their loss domain, and will weight P_0 heavier. To sum up, we assume that $\theta_s \geq \theta_b$ in down markets, and that $\theta_s \leq \theta_b$ in up markets.

Subtracting (3) from (2) we can calculate endowment effect as follows.

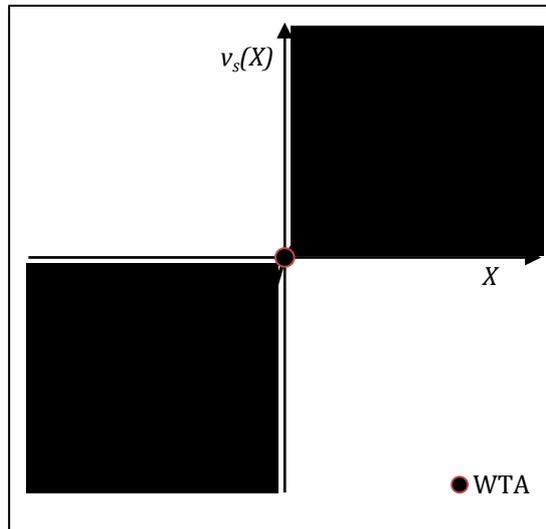
$$WTA - WTP = (\theta_s - \theta_b) \times (P_0 - P) \quad (4)$$

This expression suggests that endowment effect is determined by two elements, namely, market condition and risk preference. $P_0 - P$ is the market condition component. A positive value indicates a bear market, whilst a negative value suggests a bull market. $\theta_s - \theta_b$ measures the difference in the level of risk aversion between sellers and buyers. In down markets $P_0 - P > 0$. In the meanwhile $\theta_s - \theta_b > 0$ because sellers are in their loss domain, and consequently put more weights on initial purchase prices. As a result $WTA - WTP > 0$ and endowment effect will present. In up markets $P_0 - P < 0$ and $\theta_s - \theta_b < 0$ because buyers are in their loss domains and weight initial purchase prices heavier than sellers. Once again, $WTA - WTP > 0$ and endowment effect will present.

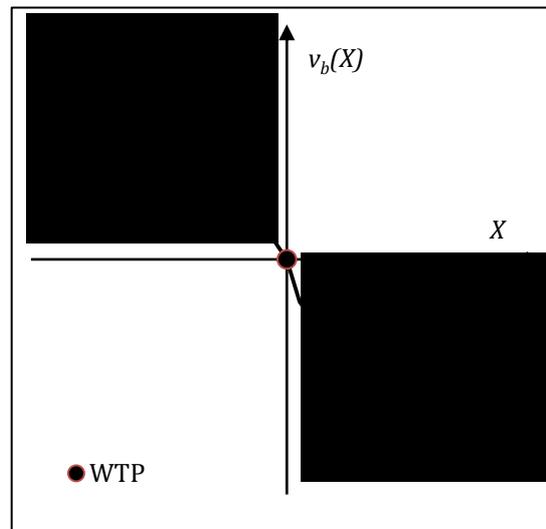
Equation (4) not only captures the composition of endowment effect, but also its dynamic nature. More specifically, based on equation (4) we do not expect endowment effect is constant. For example, $\theta_s - \theta_b$ should be different between up and down market. This is because although buyers are in their loss domain in an up market, their losses are ‘paper loss’ or ‘unrealized loss’ even if they accept a market price that is substantially higher than the initial purchase price P_0 . While sellers in their loss domain, the losses are essentially “realized loss”. All else being equal, the speed that buyers are easier to adjust their WTP to be close to the market price P_t may be different than that of sellers adjust their WTA. If the difference between $\theta_s - \theta_b$ is not statistically different from zero, $WTA - WTP \approx 0$. Consequently endowment effect could disappear. This offers an explanation of the puzzling findings in the literature (see, for example, Isoni et al, 2011; Plott & Zeiler, 2005).



(a) Standard value function



(b) Value function for sellers



(c) Value function for buyers

Figure 1: Value functions under PT

Another issue that worth noting is the role of market condition in the identification of endowment effect. As evident from equation (4), if $(P_0 - P)$ is overlooked, the underlying assumption is that $\theta_s - \theta_b$ is invariant to market conditions. This may result in failures of identifying WTA/WTP gap because the positive and negative effect of risk preference may cancel each other out.

We derive two conclusions from the above analysis. Firstly, because buyers and sellers process market information differently, it is rare that WTA and WTP can equal. Secondly, the relationship between WTA and WTP can be distinctively different in up and down market. If we denote the difference between WTA and current market price P as Δ_s and the difference between WTP and P as Δ_b , our conclusions can be summarized as $\Delta_s = WTA - P \neq 0$, $\Delta_b = WTP - P \neq 0$, and $\Delta_s \neq \Delta_b$. If $\Delta_s > \Delta_b$ or $\Delta_s - \Delta_b > 0$, then $WTA - WTP > 0$. This is essentially the endowment effect as defined in the literature (See, for example, He & Asami, 2014; Plott & Zeiler, 2011). If we stack Δ_s and Δ_b to form a column vector Δ , and place it in a difference-in-differences framework as shown in equation (5), the endowment effect can be identified by verifying if $\beta_1 > 0$.

$$\Delta = \beta_0 + \beta_1 D_p + \varepsilon \quad (5)$$

where D_p is a dummy variable that equals 1 for sellers and zero otherwise.

We use conditional mean difference between home seller and homebuyers' judgmental bias in order to control for other factors and capture a "net" endowment effect. In equation (5) the first level of difference is the deviation of reference point from market benchmark, which is often called the judgmental bias in the literature (see, for example, Paraschiv & Chenavaz, 2011). It is the dependent variable in our model. The second level of difference is the difference between sellers' and buyers' judgmental biases (i.e., $\Delta_s - \Delta_b$) and the effect is captured by introducing a dummy variable D_p . Because $\Delta_s - \Delta_b = (WTA - P) - (WTP - P) = WTA - WTP$, the corresponding coefficient β_1 can be used to verify if endowment effect presents.

Equation (5) is extended to enable the isolation of the net endowment effect. There has been ongoing debate on the equivalence of endowment effect and the WTA/WTP gap. Empirical evidences show that the WTA/WTP gap consists of other effects such as income effect and substitution effect as well (see, for example, He & Asami, 2014). Moreover, it is also found that endowment effect varies according to different social and cultural values (Apicilla et al, 2014; Lin & Lin, 2006; Maddux et al., 2010), and gender (Dommer & Swaminathan, 2012). Paraschiv & Chenavaz (2011) also note that the discrepancy between WTA/WTP and P changed under different market conditions (i.e., up and down market). To sum up, Δ is affected by at least three forces -endowment effect, moderators of endowment effect, and factors that other than endowment effect. The relationship can be described in equation (6).

$$\Delta = \beta_0 + \beta_1 D_p + \sum_{i=1}^k \alpha_i M_i + \sum_{j=1}^l \gamma_j X_j + \sum_{i=1}^k \theta_i (M_i \times D_p) + \sum_{j=1}^l \tau_j (X_j \times D_p) + \varepsilon \quad (6)$$

where M_i measures market conditions, X_j captures buyer/seller characteristics such as social and cultural values, $M_i \times D_p$ and $X_j \times D_p$ are interaction terms between D_p and the two above-mentioned groups of independent variables. β_1 measures the direct endowment effect, θ_i and τ_j measure the indirect endowment effect through those interaction terms, α_i and γ_j captures any other effects that can influence housing decisions.

The benefit of using model (6) is evident. First of all, it allows the isolation of the net endowment effect by including both the moderating and confounding factors in the same model. Secondly, and most importantly, it reflects the role of endowment effect in housing decision process. It is one of the forces that drive WTA/WTP away from P as predicted by SET. It is a general framework that incorporates various views regarding endowment effect in the literature. For example, if $\theta_i = \tau_j = \alpha_i = \gamma_j = 0$ and $\beta_1 > 0$ then it offers support to the conventional definition of endowment effect (i.e., endowment effect is the WTA and WTP gap). If X_j contains measurements of income and substitution effect and $\gamma_j \neq 0$ and $\beta_1 > 0$, it will give the same conclusions as in He & Asami (2014). If $\theta_i \neq 0$, it offers support to Paraschiv & Chenavaz (2011).

To answer these questions raised in the literature, we derive the following hypotheses from equation (6).

Hypothesis 1: Endowment effect presents in housing market

If this hypothesis is true, sellers' WTA will be higher than buyers' WTP. As a result Δ_s will be greater than Δ_b , or $\beta_1 > 0$ in equation (6).

Hypothesis 2: Endowment effect varies according to market conditions

This hypothesis predicts that endowment effect is different between up and down market. If $\theta_i \neq 0$, then there is sufficient evidence to say that buyers/sellers adapt their WTP/WTA differently in up and down market. The sign of this coefficient, if statistically significant, may also offer insights into the nature of such a pattern.

Hypothesis 3: Buyer/seller characteristics affect endowment effect.

We set up this hypothesis to verify some exiting findings regarding the moderating role of social, economic, and cultural characteristics on endowment effect. The hypothesis will be tested by checking if $\tau_j = 0$.

To verify the above hypotheses, we have conducted a survey to explore

homebuyers' WTP and sellers' WTA under given scenarios. In the next section, experimental design and data description will be presented.

3. Empirical Verification

The data used in this chapter are collected from a field experimental survey. Most, if not all, of the existing literature is built upon experiment evidences collected from classroom or laboratory settings (see, for example, Thaler, 1980; Kahneman et al, 1990). The instruments used in these experiences are mostly consumption goods that of small values (such as mugs and chocolates) and lottery. There are no established standards regarding the design of the experiment to test endowment effects. But the discussions between (Plott & Zeiler (2005, 2011) and Isoni et al. (2011) highlight the importance of incorporating training and practice sessions, anonymity, and an incentive-compatible device into experimental designs to reduce subject misconceptions. Our experiments are set up with these issues in mind.

It has been established that market knowledge is a confounding factor of endowment effect. Greater awareness of the market can reduce endowment effect (Bauer & Schmidt, 2008). Training and practice sessions are essential in lab experiences using undergraduates as subjects. It is an effective way to remove any cognitive bias caused by participants' misunderstanding of experiment procedures and the instruments (Plott & Zeiler, 2005). Our studies involve home purchase decisions. The instrument is substantially more complex than those used in early studies, and even more so is the decision making process. Multiple rounds of training and practice do not necessarily prepare inexperienced undergraduates for the experiments, because many of them might not be ready for home purchase decisions. To ensure that respondents are familiar with the experiment instruments (i.e., houses) and the experiment procedure (i.e., home purchase decisions), we move our experiment to the field. More specifically, we carry out the experiment by interviewing clients of a large real estate agent in Beijing, China. Our respondents are potential buyers and sellers who are knowledgeable of both the product and the market. In this sense training and practice sessions have already been done prior to the experiment through respondents' own research and experience.

The experiments are conducted in May 2013 by the Institute of Statistical Survey, Renmin University of China (ISS). A total of 20 interviewers were recruited and trained by the ISS, and the interviews were carried out at 10 local branches of Centaline Real Estate Brokerage across six main districts of Beijing. Firstly, interviews randomly selected clients who visited these branches on the day. Those who expressed intention to buy or sell a house were identified, and invited to the interview. Once agreed to participate, respondents were given instructions about how to complete the experiment, and information regarding the academic nature of the study. Each interview lasts around 10 minutes. After the subjects

have finished the questionnaire, they have been given small gifts. A total of 567 complete questionnaires are collected, with a response rate of 57%.

The interview questions are based on the questionnaire in Paraschiv and Chenavaz (2011), which is by far the only empirical study on judgmental biases in housing decisions. Based on two pilot studies, we revise their questionnaire in the following ways. Firstly, we interview buyers and sellers separately instead of restraining our sample to participants who are buyers and sellers at the same time. This is because the proportion of first time buyers is high in China. According to our sample statistics, about 50% of the respondents do not own a house². Therefore we decide not to restrict the interviews to clients who are on the 'property ladders' already, but to include first time buyers as well. This ensures sample representativeness and the correct estimation of endowment effect. Secondly, we change the prices in the questions to be close to the market prices at the time of the interviews in order to create realistic scenarios. The translation of the questionnaire from French to Chinese has also been tested in the two pilot studies to avoid any misunderstanding.

The questionnaire comprises two parts. In part one, the situation of a down market and an up market are created in separate scenarios. Initially, current market price is given. Historical information, such as the market price two years ago and four years ago, are introduced subsequently. Respondents are asked for their WTA or WTP each time when new information is provided. This is to ensure that respondents process all the information provided. The WTA/WTP reported at the final step is used in the analysis. We do not include prices reported from early steps in our model for two reasons. From a technical perspective, these prices (e.g., transaction prices two and four years ago) are highly correlated with current market price. Including all of them in the model may give rise to multi-collinearity issues. Secondly, and most importantly, a typical homebuyer will not evaluate these prices in isolation. Instead, all available information will be combined and processed to form a 'big picture' of the market environment, and decisions are made accordingly. To better capture the decision-making process in reality, we include a down/up market dummy variable created from a series of historical transaction prices, instead of the price series itself in the form of several separated variables (i.e., current price, price two years ago, and price four years ago). In these sense, historical transaction prices are considered in our model, albeit indirectly through the introduction of the down/up market dummy variable.

The second part of the questionnaire focuses on respondents' economic, social,

² Chinese citizens lived in state-owned properties until 1990s when the state opened the residential property market. Over the last three decades many households achieved homeownership by purchasing properties either from the open market or from their employers. However, given the rapid urbanization process in China, the proportion of first time buyers remains high. According to China Index Academy the percentage of first time buyers is 71.8% in major Chinese cities in 2012 (<http://www.fang.com/news/zt/201204/diaocha2012.html>).

and cultural background. These questions are included in an effort to control for any other factors that may affect the estimation of endowment effect. Existing evidences suggest that endowment effect is just one of the many factors that contribute to the gap. These factors include experience (Engelmann & Hollard, 2010; List, 2004; C. Plott & Zeiler, 2005; Sousa & Munro, 2012), income and substitute effect (He & Asami, 2014), social and cultural values (Maddux et al, 2010; Lin & Lin, 2006), and gender (Dommer & Swaminathan, 2012). This part of the questionnaire is designed with these factors in mind.

Variable definition and descriptive statistics can be found in Table 1. The dependent variable is the deviation of WTA/WTP from market benchmark prices. More specifically,

$$BIAS = \begin{cases} WTA - Market Benchmark & , \text{ if seller} \\ WTP - Market Benchmark & , \text{ if buyer} \end{cases}$$

The dummy variable D_p is created to capture endowment effect. If the corresponding coefficient estimate is positive and significant, an endowment effect is identified. The proportion of buyers and sellers is balanced in our sample, as indicated by a sample mean of 0.438 (See Table 1).

To control for market conditions, a dummy variable M is created, which equals one for up market and zero otherwise. As indicated by the descriptive statistics, the experiment is designed in a way that respondents are evenly and randomly distributed between the two types of market conditions to facilitate comparison. An interaction term is also created between M and D_p to determine if endowment effect varies between up and down market.

Three independent variables are included in our model to control for the effect of experience. We consider whether a respondent who has not made a house purchase previously (HOME=1), without postgraduate education (EDU=1), or younger than 30 (AGE=1). Overall we find that respondents are reasonably experienced. For example, 68% of the respondents have already purchased a house before; and over 20% of them should have investment knowledge/skills because of their postgraduate education background. We assume that age, education, and previous home purchase experience will help respondents to make more rational decisions, and consequently alleviate judgmental biases and endowment effect. The expected sign of these variables are positive.

We also consider the effect of affordability by asking respondents' monthly income level (INCOME), monthly housing expenses (SPENDING), and occupation (OCCP). Only about 15% of the respondents have a monthly income above the average monthly disposable income level in Beijing (i.e., 11,000RMB). 50% of the respondents are employed in the private sector. About 25% of the housing expense (mortgage or rent) is higher than the average monthly rental value in the

main districts (i.e., 3,000RMB).

The effect of social and cultural values is evaluated through variable SYMBOL, IMPORTANCE, RESIDENT and GENDER. Respondents are asked if they believe that homeownership is a symbol of success (SYMBOL) and if it is very important to own a house (IMPORTANCE). A good proportion of the respondents value homeownership greatly. The majority of our respondents are permanent residents of the city, who are likely to have greater social belongings. The gender distribution is well balanced in our sample (i.e., 53.8% of male respondents).

For each of the variables mentioned above, an interaction term is created with D_p to capture any moderating effect from the corresponding factor. A full list of variable names and descriptive statistics can be found in Table 1.

Table 1 Variable Definition and Descriptive Statistics

Variables	Variable Name	Definition	Mean	SD
Dependent Variable	<i>BIAS</i>	The deviation of WTA/WTP from market benchmark in 10,000 CNY (1 USD = 6.12 CNY)	19.514	73.415
Endowment Effect	<i>D_p</i>	=1 if seller, and 0 otherwise	0.438	0.496
Market condition	<i>M</i>	=1 if up market, and 0 otherwise	0.500	0.500
Buyer/seller characteristics	<i>HOME</i>	=1 if not a homeowner, and 0 otherwise	0.316	0.465
	<i>EDU</i>	=1 if without a postgraduate degree, and 0 otherwise	0.798	0.402
	<i>AGE</i>	=1 if under 30 years old, and 0 otherwise	0.409	0.492
	<i>INCOME</i>	=1 if income > 11,000 RMB, and 0 otherwise	0.147	0.355
	<i>SPENDING</i>	=1 if monthly housing expenses is more than 3,000RMB, and 0 otherwise	0.253	0.435
	<i>OCCP</i>	=1 if in fulltime employment in private sector, and 0 otherwise	0.511	0.500
	<i>SYMBOL</i>	=1 if subjects regard homeownership as a symbol of success, and 0 otherwise	0.587	0.493
	<i>IMPORTANCE</i>	=1 if subjects think homeownership is very important, and 0 otherwise.	0.275	0.446
	<i>RESIDENT</i>	=1 for permanent residents (i.e., registered residents who have been living in Beijing for at least 3 years), and 0 otherwise	0.871	0.335
	<i>GENDER</i>	=1 if male, and 0 otherwise	0.538	0.499

Notes: The original definition used in the experiment has more categories in each variable (e.g., Income has eight sub-categories ranging from less than 5000 to over 20,000RMB with a step value of 2000RMB). Preliminary regression analyses are conducted to empirically refine the variable classification, which is subsequently used in the benchmark and final models. Results of preliminary analyses are not shown here, but available upon request

4. Findings and Discussions

Three models are estimated to facilitate the testing of our hypotheses. The first model (denoted Model 1 in Table 2) does not include any interaction terms. This is the model that overlooks any moderators of endowment effect. The drawback of such a model specification is obvious in Table 2. The model has the lowest R square, and the endowment effect variable is not statistically significant. We then incorporate the moderating effect of market condition (Model 2), as well as buyer/seller characteristics (Model 3). Both models show significant improvement over Model 1. Model 3 consider both types of moderators of endowment effect with the highest adjusted R square. The discussions below are based on Model 3.

Table 2 Regression Results

	Category	Model 1	Model 2	Model 3	
		Coefficient	Coefficient	Coefficient	VIF
<i>C</i>	Intercept	-3.741	0.779	-2.129	---
<i>D_p</i>	Endowment effect	---	---	15.312*	3.484
<i>MKT</i>	Market condition	-10.614**	-19.653***	-19.653***	1.780
<i>HOME</i>	Experience	-10.884*	-10.884*	---	---
<i>EDU</i>		---	---	---	---
<i>AGE</i>		15.970***	15.970***	13.878***	1.238
<i>INCOME</i>	Affordability	26.857***	26.857***	40.871***	2.150
<i>SPENDING</i>		11.111**	11.111**	11.339**	1.130
<i>OCCP</i>		8.788**	8.788**	18.836***	1.931
<i>SYMBOL</i>	Social and Cultural Values	12.861***	12.861***	10.127**	1.086
<i>IMPORTANCE</i>		---	---	13.114***	1.093
<i>RESIDENT</i>		15.360**	15.360**	13.621**	1.142
<i>GENDER</i>		10.194**	10.194**	8.532**	1.044
<i>MKT*D_p</i>	Interaction terms	---	20.628**	20.628**	2.780
<i>EDU*D_p</i>		---	---	---	---
<i>INCOME*D_p</i>		---	---	-32.063***	2.206
<i>OCCP*D_p</i>		---	---	-23.070***	2.942
<i>IMPORTANCE*D_p</i>		---	---	---	---
Adj R²		0.065	0.069	0.087	
F (p-value)		8.578***	8.353***	7.965***	

Note: ***p<1%, **p<5%, *p<10%. All insignificant variables are omitted from the models.

First of all, we find strong support to the first hypothesis. The coefficient estimate of D_p is 15.312. This positive, significant coefficient loading indicates that the WTA/WTP gap is about 153,120 CNY, which is 3.75% of the market benchmark price used in the experiment. In our sample, the sample average WTA is 4,265,664 CNY and the sample average WTP is 4,140,140 CNY. This translates into a WTA/WTP gap equals 3.14% of the market benchmark. The regression coefficient estimate is consistent with the descriptive statistics. But this is an estimate of average WTA/WTP gap across all respondents. The complex determination process of endowment effect can only be understood by examining the significance and size of the interaction terms of D_p .

To verify whether endowment effect varies according to market conditions (i.e., Hypothesis 2), the coefficient estimate corresponding to $MKT * D_p$ offers useful information. It is significant at the 5% level, and the coefficient is 20.628. This implies that endowment effect is significantly greater in an up market, by a margin of over 200,000 CNY on average. In our experiment the price trend is controlled for by giving increases/decreases in prices for a fixed period of time. More specifically, the value of $P_0 - P$ is fixed for all respondents. But the values of $\theta_s - \theta_b$ is not directly observable, and will be captured indirectly by examining the size of the coefficient estimate of $M * P$. This large, positive coefficient estimate indicates that $|\theta_s - \theta_b|$ is larger in an up market. This suggests that buyers demonstrate a great level of risk seeking in up markets in China, and consequently widen the WTA/WTP gap.

We also include interaction terms between all other control variables and D_p to check if endowment effect varies among different types of agents. Results show that only affordability factors moderate endowment effect in our study. More specifically, endowment effect is weaker for respondents from higher affordability groups (i.e., with higher monthly income and stable jobs). This is consistent with previous findings regarding income effect, which means that payment capacity can lower WTP to be below its optimal level, and consequently increases the WTA/WTP gap. In our experiment design we use a 'generic' housing unit (i.e., a typical or average apartment in the local market) as the instrument and ask respondents to provide their WTA/WTP. Therefore substitute effect has been removed effectively. However, income effect cannot be easily controlled for in a similar way, as income constraints are often deeply rooted in respondents' mind and affect their decisions regardless of how experiment questions are constructed. This is evident in our findings. Although we ask respondents to provide their bid/offer prices without considering their financial constraints, we find that the coefficient loadings corresponding to $INCOME * D_p$ and $OCCP * D_p$ are significant and negative. Once again, our theoretical framework effectively captures the complex relationship between endowment effect and socio-economic factors.

Besides the variables used for hypotheses testing, all of the control variables in Model 3 are statistically significant with expected sign. For example, coefficient estimates of affordability and social/cultural indicators are positive and significant. This suggests that in China, richer and more social/cultural conscious individuals are more prone to judgmental biases in their housing decisions. Younger (or inexperienced) people are more likely to deviate from benchmark prices on average. Due to the large number of interaction terms used in our model, multi-collinearity is a concern. We adopt different model specifications and find that the results are robust. This is also supported by the VIF statistics that are reported in the last column of Table 2. The low VIF values indicate that the correlation among included independent variables is low. This is not serious variance inflation and biasness issues in our model.

In sum, we find sufficient evidence to support all three hypotheses derived based on the proposed theoretical model. Endowment effect does not only present, but also has a significant impact on judgmental bias in housing decision. This is true at least in China where the experiment is conducted.

4. Conclusions

In this paper we propose a theoretical framework to model endowment effect in housing decisions. We start from Prospect Theory in behavioral economics, but focus on the reference point formation aspect of endowment effect. This is different from approaches used in most existing studies, where loss aversion has been used as the explanation of endowment effect. Through this unique approach our model is capable of not only quantifying endowment effect but also investigating its role as a determinant of judgmental bias in home-purchase decisions. The framework facilitates the study of endowment effect in a more complex, yet more realistic, setting.

Through a field experiment conducted in China, we demonstrate how to empirically implement the theoretical framework in this paper, and how to capture and interpret the complex relationship between endowment effect and its moderators. Our findings are largely consistent with existing literatures, theories, and the nature of the study area. The applicability of the model can be further verified in other markets, and insights gained from similar studies will greatly enhance our understanding of endowment effect in property markets. This will eventually help homebuyers to make better decisions, and more importantly, to facilitate more effective housing policymaking.

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