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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 effect is a result of the underweighting of opportunity costs. Given the high stake involved in a typical housing transaction, endowment effect is expected to have a significant influence on housing decisions. 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 results show that endowment effect plays an important role in the formation of judgmental biases in housing decisions. Moreover, endowment effect interacts with housing cycles. Our study highlights the application of prospect theory in the housing market; thus, it not only extends existing theoretical and empirical works in this important sector, but also clarifies consumer behavior in the emerging property market of China.

KEYWORDS: Prospect theory; Behavioral economics; Judgmental bias; Field experiment; China

1. INTRODUCTION

Since the publication of the seminal work of Kahneman and Tversky (1979), prospect theory has been applied to a wide range of disciplines, from finance to managerial decision making and from economics to public administration (see Barberis 2013; Goldfarb *et al.* 2012; Wilson 2011). The theory has been used to explain an array of anomalies that cannot be explained or even modeled using standard economic theory (SET). The long list of anomalies includes equity premium puzzle, disposition effect, endowment effect, and 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 SET, the price of a product 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 product. However, empirical results show that WTA is generally higher than WTP, sometimes with as large as four times of WTP for the same product (Kahneman *et al.* 1990). Thaler (1980) coined the term "endowment effect" for this WTA-WTP gap[1], and describe the nature of this effect based on prospect theory.

The nature of endowment effect has been a topic of debates. On the one hand, evidence shows that experience, competition, and large stakes can effectively close the WTA-WTP gap (List 2003; Levitt, List 2008; Hart 2005). Plott and Zeiler (2005, 2007) show that WTA-WTP gap might be attributed to the misconception of subjects, and consequently would not be identified after the experiments are designed to control for this factor. On the other hand, strong field evidence suggests that loss aversion, the foundation of endowment effect according to Thaler (1980), affects even professional golfers, who are experienced and play in a highly competitive environment with large stakes. Clearly, further studies are necessary to reach a consensus.

We aim to provide empirical evidence regarding endowment effect from an important sector, the housing market. The gap between home buyers' WTP and sellers' WTA affects the liquidity of

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[1] WTA-WTP gap is one of the most robust measurements of endowment effect (Ericson, Fuster 2014). It is also a general term to refer to endowment effect in the literature. Consequently we use WTA-WTP gap as the measurement of endowment effect, and use the two terms interchangeably in this paper.

property transactions fundamentally. A good understanding of the nature and behavior of endowment effect in housing decisions will reveal the driving force of housing cycles, as well as consumer behavior in this unique market.

Home purchase is one of the most important life decisions. The stake, often measured as a percentage of home value in one's wealth portfolio, is high. The implication could be twofold. 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). By contrast, houses are not regular consumption goods. Sellers will be attached to their houses to a certain extent. Therefore, loss aversion effect might be stronger in transactions involving houses than in transactions involving other products.

To add complexity to the picture, most home buyers/sellers are generally inexperienced. Statistics show that people change homes in their lifetime four times on average. Transactions are few and far between; thus, one may suspect that the gap between WTA and WTP in property transactions is substantial. In the aspect of competition, the picture is even more undefined. The housing market is characterized by cycles. Transaction prices and volumes are typically high during up markets and just the opposite is true 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, then the endowment effect in the housing market, if any, should be examined by considering the market sentiment.

Given the uniqueness of the housing market, we develop a theoretical framework to study the relationship between endowment effect and housing decisions. The theoretical model is tested using field experiment data from China. We conduct the experiment in China for two reasons. First, the development of the property market in China has been remarkable. Given its great potential for capital growth and rental yield, theoretical and empirical studies on this emerging market are necessary. Second, behavioral studies on this market are scarce. At the time of writing, we only find one related work, a study by He and Asami (2014), in which they conduct a WTA-WTP experiment for land price in Beijing. Thus, narrowing the gap between the demand and supply of behavioral research in relation to the property market in China is essential.

The objective of this paper is to bridge the gaps in the literature. To ensure ecological validity, we bring the experiments to the field, by interviewing potential home buyers and sellers engaged with the branches of a local property agency in Beijing, China. To ensure conceptual validity, we follow the experiment design of Paraschiv and 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, an effect that is not uniform under different market sentiments.

The reminder of this paper is organized as follows. Section 2 presents the theoretical framework and the testable hypotheses. Section 3 explains the procedures used to implement the theoretical model. Section 4 discusses the empirical findings. Section 5 presents the conclusions.

2. THEORETICAL FRAMEWORK AND TESTABLE HYPOTHESES

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

PT improves the explanation power of SET by revisiting the assumptions on the rationality of consumers (Kahneman, Tversky 1979). SET assumes that consumers are rational utility maximizers. The assumption is consistent with and enforces the view that individuals are rational and purely self-interested in their preferences. In practice, consumer behaviors deviate from SET predictions as suggested by evidence from both laboratory and field experiments (see 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 consider these values in relation to an individually specific reference point. Without losing any generality, the relationship can be described using equation (1) and Figure 1a.

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

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

Loss aversion in PT has been used to explain the endowment effect. Sellers demanding compensation for a loss of valuable possession is reasonable because they have to surrender the goods (Kahneman *et al.* 1990). If the price of the product is *m*, seller is in the loss domain and the value function equals $-(r-m)^{\beta}$. In this case, $\left|-(r-m)^{\beta}\right| > (m-r)^{\alpha}$ because $\beta > \alpha$. Sellers will demand a high price to reduce the loss.

However, the above explanation overlooks two important aspects of PT. First, buyers and sellers do not necessarily have the same reference point *r*. Except for a few studies in the marketing research area (see Weave, Frederick 2012), reference point has been largely overlooked in the endowment effect literature, which emphasizes the lack of focus on the importance of reference point. In this study, we argue that the identification of a reference point is the crucial first step to understand endowment effect. Only after the determination of the reference point can one decide whether the decision maker is in the loss or gain domain, and subsequently determine the nature of endowment effect. This argument is consistent with that of Weaver and Frederick (2012).

Our analysis begins from the definition of reference points as seller/buyer WTA/WTP. Consumers use expectations as reference points in their evaluations (Lattin, Bucklin 1989; Spiegler 2012; Ericson, Fuster 2011). These expectations are essentially the reserved price or WTA/WTP of seller/buyer. For example, if the market fair price is less than the WTA of the seller, then the seller will be in the loss domain, and consequently becomes reluctant to transact. By contrast, a buyer will more likely agree to a price if it is below his or her WTP. The value functions of buyers and sellers are mirror images, as depicted in Figures 1b and 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*. 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, implying that WTA/WTP does not necessarily equal P. Empirical evidence shows that not only WTA/WTP deviates from P, but the discrepancy differs between buyers and sellers as well (Paraschiv, Chenavaz 2011). The relationship becomes more complex when market conditions are considered. A rich body of literature on reference point adaption suggests that buyers and sellers update their WTP/WTA by incorporting both historical and newly available market information (see Baucells *et al.* 2011). To illustrate the dynamics between WTA/WTP and market conditions, we first define WTA and WTP as the weighted average of historical and recently available information. The definition is based on the well-established primacy and recency effects in psychology and neuroscience studies (Capitani *et al.* 1992; Cowan *et al.* 2002; Innocenti *et al.* 2013; Sikström 2006). Baucells *et al.* (2011) showed that reference points are formed primarily based on the first and last prices of the time series. The relationship can be captured using the following equation:

$$WTA = \theta_s P_0 + (1-\theta_s) P; \tag{2}$$

$$WTP = \theta_b P_0 + (1-\theta_b) P, \tag{3}$$

where: P_0 is the initial purchase price of the property; P is the market price of a similar property, and $\theta_s(\theta_b) \in [0,1]$ is the weight placed on initial purchase prices by sellers (buyers). $\theta_s(\theta_b)$ is determined by the degree of risk aversion. When a significant discrepancy exists 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 risk seeking behavior is typically found in the loss domain. As shown in Figures 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. By contrast, sellers are in their loss domain during downturn, and will place heavier weight on P_0 heavier. Thus, we assume that $\theta_s \geq \theta_b$ in down markets and $\theta_s \leq \theta_b$ in up markets.

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

$$WTA - WTP = (\theta_s - \theta_b) \times (P_0 - P). \tag{4}$$

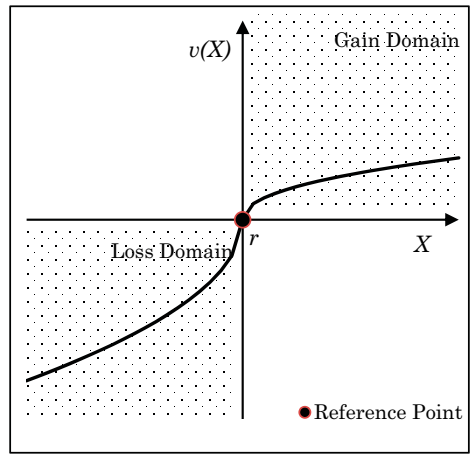
This equation suggests that endowment effect is determined by two elements, namely, market condition and risk preference. $P_0 - P$ is the

market condition component. A positive value indicates a bear market, whereas 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[2], $P_0 - P > 0$. Moreover, $\theta_s - \theta_b > 0$ because sellers are in their loss domain; consequently, they put more weight on initial purchase price. As a result, $WTA - WTP > 0$ and endowment effect is present. In up markets, $P_0 - P < 0$ and $\theta_s - \theta_b < 0$ because buyers are in their loss domains and put heavier weight on initial purchase prices compared with sellers. Once again, $WTA - WTP > 0$ and endowment effect is present.

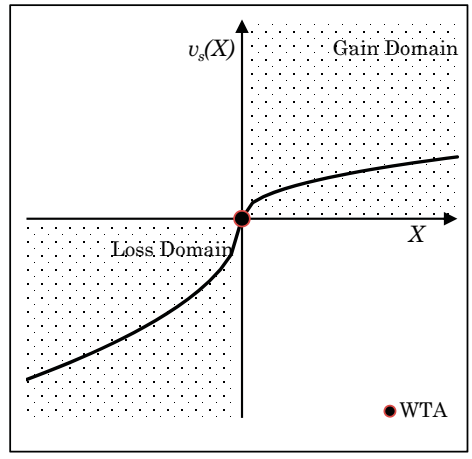
Equation (4) not only captures the composition of endowment effect, but also its dynamic nature. More specifically, based on equation (4) we do not expect endowment effect to be constant. For example, $\theta_s - \theta_b$ should be different between up and down markets because although buyers are in 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. Although sellers are in their loss domain, the losses are essentially "realized loss". All else being equal, the speed that buyers can adjust their WTP close to the market price results in P_t, which may be different from those of sellers who adjust their WTA. If the difference between $\theta_s - \theta_b$ is not statistically different from zero, $WTA - WTP \approx 0$. Consequently, the endowment effect could disappear. This result offers an explanation to the puzzling findings in the literature (see Isoni *et al.* 2011; Plott, Zeiler 2005).

Another notable issue is the role of market condition in the identification of endowment effect. As shown in equation (4), if $(P_0 - P)$ is overlooked, then the underlying assumption is that $\theta_s - \theta_b$ is invariant to market conditions, which may result in the failure to identify the WTA-WTP gap because the positive and negative effects of risk preference may cancel each other out.

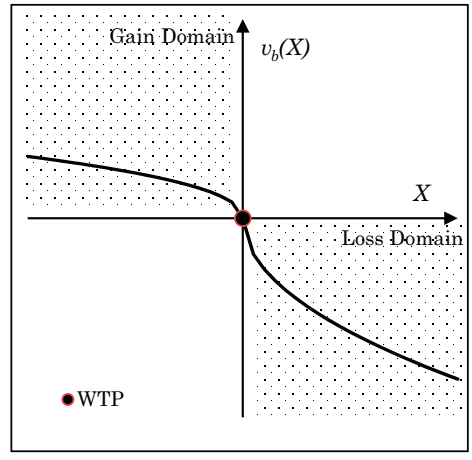
We derive two conclusions from the above analysis. First, WTA and WTP being equal is rare because buyers and sellers process market information differently. Second, the relationship between WTA and WTP can be distinctively different in the up and down markets. If we denote the difference between WTA 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 result is essentially the endowment effect as defined in the literature (see 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



(a) Standard value function



(b) Value function for sellers



(c) Value function for buyers

Fig. 1. Value functions under PT

[2] Without losing any generality, we define down markets as situations when current market price of a property falls below its initial purchase price, i.e., $P_0 > P$ or $P_0 - P > 0$. Similarly, up markets are defined as $P_0 - P < 0$.

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 is equal to 1 for sellers and zero otherwise.

We use conditional mean difference in the judgmental bias between home seller and home buyer 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 Paraschiv, Chenavaz 2011). The judgmental bias is the dependent variable in our model**.** The second level of difference is the difference in the judgmental bias between seller and buyer (i.e., $\Delta_s - \Delta_b$), and the effect is captured by introducing a dummy variable D_p. When $\Delta_s - \Delta_b = (WTA - P) - (WTP - P) = WTA - WTP$, then the corresponding coefficient β_1 can be used to verify if endowment effect is present.

Equation (5) is extended to enable the isolation of the net endowment effect. The debate on the equivalence of endowment effect and the WTA-WTP gap is ongoing. Empirical evidence shows that the WTA-WTP gap consists of other effects such as income effect and substitution effect (see He, Asami 2014). Moreover, endowment effect varies according to different social and cultural values (Apicilla *et al.* 2014; C.-H. Lin, H.-M. Lin 2006; Maddux *et al.* 2010), as well as gender (Dommer, Swaminathan 2012) a phenomenon called the endowment effect. Loss aversion has typically accounted for the endowment effect, but an alternative explanation suggests that ownership creates an association between the item and the self, and this possession-self link increases the value of the good. To test the ownership account, this research examines three moderators that theory suggests should affect the possession-self link and consequently the endowment effect: self-threat, identity associations of a good, and gender. After a social self- threat, the endowment effect is strengthened for in-group goods among both men and women but is eliminated for out-group goods among men (but not women). Paraschiv and Chenavaz (2011) noted that the discrepancy between WTA/WTP and P changes under different market conditions (i.e., up and down markets). To sum up, Δ is affected by at least three forces, namely, endowment effect, moderators of endowment effect, and factors other than endowment effect. The relationship can be described in equation (6).

$$\Delta = \beta_0 + \beta_1 D_p + \sum_{i=1}^{k} \alpha_i M_i + \sum_{j=1}^{l} \gamma_i X_i + \sum_{i=1}^{k} \theta_i \left(M_i \times D_p \right) + \sum_{j=1}^{l} \tau_i \left(X_i \times D_p \right) + \varepsilon , \quad (6)$$

where: M_i measures market conditions; X_i captures buyer/seller characteristics, such as social and cultural values; and $M_i \times D_p$ and $X_i \times D_p$ are interaction terms between D_p and the two abovementioned groups of independent variables. β_1 measures the direct endowment effect, θ_i and τ_i measure the indirect endowment effect through those interaction terms, and α_i and γ_i capture any other effects that can influence housing decisions.

The benefit of using model (6) is evident. First, it allows the isolation of the net endowment effect by including both the moderating and confounding factors in the same model. Second, it reflects the role of endowment effect in housing decision process. The effect is one of the forces that drive WTA/WTP away from P as predicted by SET. The model is a general framework that incorporates various views regarding endowment effect in the literature. For example, if $\theta_i = \tau_i = \alpha_i = \gamma_i = 0$ 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_i contains measurements of income and substitution effect and $\gamma_i \neq 0$ and $\beta_1 > 0$, then the same conclusions as those of He and Asami (2014) will be obtained. If $\theta_i \neq 0$, then the conclusions of Paraschiv and Chenavaz (2011) are supported.

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

Hypothesis 1: Endowment effect is present in the housing market.

If this hypothesis is true, then 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 markets. If $\theta_i \neq 0$, then evidence is sufficient to indicate that buyers/sellers adapt their WTP/WTA differently in up and down markets. The sign of this coefficient, if statistically significant, may also offer insights into the nature of such pattern.

Hypothesis 3: Buyer/seller characteristics affect endowment effect.

We formulate this hypothesis to verify some exciting findings regarding the moderating role of social, economic, and cultural characteristics on endowment effect. The hypothesis is tested by checking if $\tau_i = 0$.

To verify the above hypotheses, we conduct a survey to explore home buyers' WTP and sellers' WTA under given scenarios. In the next section, experimental design and data description are 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 developed based on experimental evidence collected from classroom or laboratory settings (see Thaler 1980; Kahneman *et al.* 1990). The instruments used in these experiences are mostly consumption goods with small values (such as mugs and chocolates) and lottery. The data used in housing studies are not restricted to lab evidence. Hanson and Hawley (2011, 2014) conduct a field experiment involving landlords as subjects. The design of the experiment used to test endowment effects has no established standards. Nevertheless, the discussions between Plott and 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.

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 experiments using undergraduates as subjects. Sessions like these are an effective way to remove any cognitive bias caused by participants' misunderstanding of experiment procedures and the instruments (Plott, Zeiler 2005). Our study involves home purchase decisions. The instrument is substantially more complex than those used in early studies, and even more so in 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 about the product and the market. In this sense, the training and practice sessions have already been conducted prior to the experiment through the research conducted by and the experiences of the respondents.

Beijing property market

We choose Beijing for two reasons. First, the property market in Beijing is one of the most active and liquid markets in China. Recruiting participants for the experiments is easy. Second, Beijing is one of the most expensive cities in China. Home purchase decisions might be significantly influenced by endowment effect given the large stake involved. Therefore, a good understanding of the role of endowment effect, if any, in this market is important to all stakeholders.

The secondary property market in Beijing boomed during the last decade (see Fig. 2). Despite few minor setbacks in 2009 and 2012, the secondary property market in Beijing shows a strong upward trend in general. The price index has shown rapid increase from 1,000 points in 2005 to nearly 6,000 points in 2015. The house price to income ratio is estimated as 10.2 at the national level and 19.1 in Beijing, both of which are significantly higher than those in western countries[3]. Housing in Beijing is not affordable by international standard.

An official survey conducted by China Index Academy in April 2013 provides useful insights into the characteristics of Beijing housing market. According to Table 1, almost two-thirds of the home buyers in Beijing plan to purchase a house within a year. Among the respondents, 56.3% are

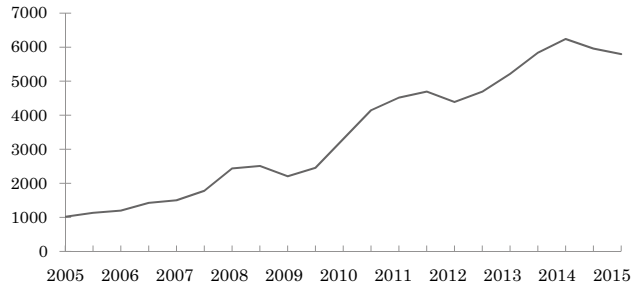


Fig. 2. Secondary property price index (Beijing, 2005–2015)[4]

[3] E-house China R&D Institute (http://www.yiju.org/). See also the news report at http://politics.people.com.cn/n/2014/0527/c1001–25070210.html.

[4] China Real Estate Index System (http://fdc.fang.com/index/ErShouFangIndex.html). The index is set as equal to 1,000 in the base period (December 2005).

first-time buyers, whereas 41.7% already own a house. Among the home buyers, 97.6% believe that they can afford a house that is priced below RMB 5 million. Male and female housing consumers are evenly distributed in this market. More than two-thirds of the respondents are permanent residents in Beijing. The market is dominated by home buyers who are 30 years-old or older (73.3%).

Table 1. Beijing housing market[5]

Plan-to-buy within one year	60.9%
First-time buyer	56.3%
Homeownership	41.7%
Male	50.6%
Permanent resident in Beijing	68.8%
Young home buyer (30 years old or younger)	26.7%
Education (university degree or below)	82.5%

Experiment implementation

The experiments were conducted in May 2013 by the Institute of Statistical Survey (ISS) of Renmin University of China. A total of 20 interviewers were recruited and trained by ISS, and the interviews were carried out at 10 local branches of Centaline Real Estate Brokerage across the six main districts of Beijing. Interviewers randomly selected clients who visited these branches on a specific day. Those who expressed their intention to purchase or sell a house were identified, and invited to the interview. Upon agreement to participate, the respondents were instructed about how to complete the experiment and provided with information regarding the academic nature of the study. Each interview lasted approximately 10 min. After the subjects completed the questionnaire, they were given token gifts. A total of 567 complete questionnaires were collected; thus, the response rate was 57%.

The interview questions were based on the questionnaire in the study of Paraschiv and Chenavaz (2011), which is by far the only empirical study on judgmental biases in housing decisions. Based on two pilot studies, we revised their questionnaire in the following ways. First, we interviewed buyers and sellers separately instead of restraining our sample to participants who are buyers and sellers at the same time because the proportion of first time buyers is high in China. According to our sample statistics, approximately 50% of the respondents do not own a house[6]. This finding is consistent with existing findings from other surveys (see Table 1). Therefore, we decided not to restrict the interviews to clients who are on the "property ladders" already, but included first time buyers as well. This inclusion ensured sample representativeness and the correct estimation of endowment effect. Second, we changed the prices in the questions to be close to the market prices at the time of the interviews to create realistic scenarios. The translation of the questionnaire from French to Chinese was tested in the two pilot studies to avoid any misunderstanding.

The questionnaire comprises two parts. The first part of the questionnaire focuses on the respondents' economic, social, and cultural background. These questions are included to control for any other factors that may affect the estimation of endowment effect. Existing evidence suggests that endowment effect is merely one of the many factors that contribute to the gap. These factors include experience (Engelmann, Hollard 2010; List 2004; Plott, Zeiler 2005; De Sousa, Munro 2012), income and substitute effect (He, Asami 2014), social and cultural values (Maddux *et al.* 2010; C.-H. Lin, H.-M. Lin 2006), and gender (Dommer, Swaminathan 2012) a phenomenon called the endowment effect. Loss aversion has typically accounted for the endowment effect, but an alternative explanation suggests that ownership creates an association between the item and the self, and this possession-self link increases the value of the good. To test the ownership account, this research examines three moderators that theory suggests should affect the possession-self link and consequently the endowment effect: self-threat, identity associations of a good, and gender. After a social self- threat, the endowment effect is strengthened for in-group goods among both men and women but is eliminated for out-group goods among men (but not women. This part of the questionnaire is designed with these factors in mind.

In the second part of the questionnaire, the situations of down and up markets are created in separate scenarios. Initially, the current market price is given. Historical information such as the market prices two and four years ago, are introduced

[5] Statistics in this table are from a survey conducted by the China Index Academy (http://fdc.fang.com/zt/201304/2013xqdc01.html).

[6] 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.

subsequently. An alternative offer is given in the last question of this part. The respondents are asked about their WTA or WTP each time new information is provided. The descriptions of the questions and corresponding summary statistics are found in Table 2.

Both home sellers and buyers are given the current market price (i.e., Questions S1a and B1a), which is presented as a range (i.e., "*You want to sell [buy] an apartment. The apartment is currently being valued at a price between RMB 2.7 and 3.3 million. What is the lowest [highest] price that you are willing to accept [pay]*?"). With the average market at RMB 3.0 million, the average values of WTA of home sellers and WTP of buyers are RMB 3.020 million and RMB 2.814 million, respectively. The average WTP of home buyers is statistically significantly different from the average market price (p-value <0.001), implying that home buyers do not want to pay the average market price. Although this conclusion is inconsistent with the prediction of standard economic theory, which states that rational home buyers refer to market fair price, this finding is consistent with the results obtained by Paraschiv and Chenavaz (2011). The opposite is true for home sellers. The average reported WTA is not statistically significantly different from the average market price (p-value = 0.270). Home sellers refer to the average market price in their decision-making process, implying that sellers in this field experiment are rational. Similar questions are repeated in Questions S2a and B2a with the measurement unit changed between RMB 3.8 million and RMB 4.2 million. The unit is modified as a robustness check. The above conclusions regarding the respondents' reference point formation remain true.

Subsequently, initial purchase price is introduced in the second step in the home sellers' questionnaire ("*Four years ago, you bought the apartment for RMB 2.4 million. Now, what is the lowest price that you are willing to accept*?") and home buyers' questionnaire ("*You find out that the seller bought the apartment four years ago at the price of RMB 3.6 million. Now, what is the highest price that you are willing to pay*?"). These are marked as Questions S1b, S2b, B1b, and B2b in Table 2[7]. Our findings suggest that both home sellers and buyers adapt their reference points after new information (i.e., initial purchase price) is introduced. This result is confirmed by the significance of t-test that compares WTA and WTP before and after the introduction of the initial prices (p-value <0.001). The role of initial purchase price in reference point formation is consistent and robust across home buyers and sellers, and in both up and down markets.

Third, historical information (i.e., the market price two years ago) is given to form a market trend. More specifically, up and down market scenarios are established based on the position of the price two years ago relative to the initial purchase price and current market price. For example, home sellers are placed in an up market in the first scenario (Question S1c) when they are asked "*If you find out that the apartment you are selling was priced at RMB 2.7 million. Now, what is the highest price that you are willing to accept*?" Market evolution affects sellers' WTA in both up (p-value = 0.012) and down markets (p-value <0.001), which is consistent with that of Paraschiv and Chenavaz (2011). However, home buyers in the up market have not statistically significantly adapted their WTA (p-value = 0.894).

In the final step, home sellers and buyers are given an alternative offer. For example, in Question S1d, home buyers are asked, "*You just learned that another buyer made an offer of RMB 3.3 million for the apartment. Now, what is the highest price that you are willing to pay?*" We find that both buyers and sellers adjust their WTA and WTP according to alternative offers. The pattern is significant in both up and down markets. This pattern is consistent with that of Paraschiv and Chenavaz (2011).

We repeated the experiment of Paraschiv and Chenavaz (2011) to check the validity and reliability of these questions in a distinctively different market. Our findings are largely consistent with the empirical evidence obtained from the French market. By asking these questions in a stepwise and repetitive manner, we provided respondents the opportunity to practice. This approach addresses the concern about training and practice by respondents as raised by Plott and Zeiler (2005, 2011). In our subsequent analysis, we used the responses to Questions S1C, S2C, B1C, and B2C as basis. These are WTA and WTP formed after market trend is established. Questions from the last step are not used because the information (alternative offers) is not directly relevant in our studies.

[7] Question S2b and B2b are set up to establish and reinforce market trend (i.e., up or down markets). This is designed to reliably frame respondents in specific market conditions. The reported WTA/WTP in S2b/B2b is "intermediate" in the sense that it is formed before the market trend is fully established. Consequently results from these questions are not used in our final estimation of equation (6).

Table 2. Questionnaire design and summary statistics

Panel A: Home sellers' WTA				
Scenarios	Question No.	Information	Mean of WTA	p-value (two-tail)
Up market	Question S1a	Current market price: RMB 2.7–3.3 million	3.020	0.270
	Question S1b	Initial purchase price four years ago: RMB 2.4 million	3.300	0.000
	Question S1c	Market trend two years ago: RMB 2.7 million	3.207	0.012
	Question S1d	Alternative offer: RMB 3.3 million	3.266	0.016
Down market	Question S2a	Current market price: RMB 3.8–4.2 million	4.017	0.128
	Question S2b	Initial purchase price four years ago: RMB 4.4 million	4.670	0.000
	Question S2c	Market trend two years ago: RMB 4.2 million	4.278	0.000
	Question S2d	Alternative offer: RMB 4.0 million	4.137	0.000
Panel B: Home buyers' WTP				
Scenarios	Question No.	Label	Mean of WTP	p-value (two-tail)
Down market	Question B1a	Current market price: RMB 2.7–3.3 million	2.814	0.000
	Question B1b	Initial purchase price four years ago: RMB 3.6 million	3.419	0.000
	Question B1c	Market trend two years ago: RMB 3.3 million	3.179	0.000
	Question B1d	Alternative offer: RMB 2.7 million	2.824	0.000
Up market	Question B2a	Current market price: RMB 3.8–4.2 million	3.891	0.000
	Question B2b	Initial purchase price four years ago: RMB 3.6 million	4.029	0.002
	Question B2c	Market trend two years ago: RMB 3.8 million	4.032	0.894
	Question B2d	Alternative offer: RMB4.2 million	4.170	0.000

Note: 1. p-values of Questions S1a, S2a, B1a, and B2a are one-sample t-test results between corresponding reported WTA/WTP and average market price. 2. p-values of Questions S1b–S1d, S2b–S2d, B1b–B1d, and B2b–B2d are paired-sample t-test results between corresponding reported WTA/WTP and the reported WTA/WTP from prior one.

These questions are included in our experiments only as a part of the validity and reliability check as mentioned above.

Variable definition and descriptive statistics are shown in Table 3. The dependent variable is the deviation of WTA/WTP from market benchmark prices. More specifically:

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

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 3).

To control for market conditions, a dummy variable MKT 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 MKT and D_p to determine if endowment effect varies between up and down markets.

Two independent variables are included in our model to control for the effect of experience. We consider whether a respondent who has not purchased a house previously (*HOME* = 1) or younger than 30 (*AGE* = 1). Overall, we find that respondents are reasonably experienced. For example, 68% of the respondents have purchased a house before. We assume that age 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 is positive.

We also consider the effect of affordability by asking the respondents' monthly income level (*INCOME*), monthly housing expenses (*SPENDING*), and occupation (*OCCP*). Only 15% of the respondents have a monthly income above the average monthly disposable income level in Beijing (i.e., RMB 11,000). Half (50%) of the respondents are employed in the private sector. Approximately 25% of the housing expense (mortgage or rent) is higher than the average monthly rental value in the main districts (i.e., RMB 3,000).

The effect of social and cultural values is evaluated through the variables, *SYMBOL, IMPORTANCE, RESIDENT,* and *GENDER*. The 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

Table 3. Variable definition and descriptive statistics

Variables	Variable name	Definition	Mean	SD
Dependent variable	*BIAS*	The deviation of WTA/WTP from market benchmark of RMB 10,000 (1 USD = 6.12 RMB)	19.514	73.415
Endowment effect	D_p	= 1 if seller, and 0 otherwise	0.438	0.496
Market condition	*M*	= 1 if up market, and 0 otherwise	0.500	0.500
Buyer/seller characteristics	*HOME*	= 1 if not a homeowner, and 0 otherwise	0.316	0.465
	AGE	= 1 if under 30 years old, and 0 otherwise	0.409	0.492
	INCOME	= 1 if income > RMB 11,000, and 0 otherwise	0.147	0.355
	SPENDING	= 1 if monthly housing expenses is more than RMB 3,000, and 0 otherwise	0.253	0.435
	OCCP	= 1 if in fulltime employment in private sector, and 0 otherwise	0.511	0.500
	SYMBOL	= 1 if subjects regard homeownership as a symbol of success, and 0 otherwise	0.587	0.493
	IMPORTANCE	= 1 if subjects think homeownership is very important and 0 otherwise.	0.275	0.446
	RESIDENT	= 1 for permanent residents (i.e., registered residents who have been living in Beijing for at least three years), and 0 otherwise	0.871	0.335
	GENDER	= 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 subcategories ranging from less than RMB 5000 to more than RMB 20,000 with a step value of RMB 2000). Preliminary regression analyses are conducted to refine the variable classification empirically, which is subsequently used in the benchmark and final models. The results of preliminary analyses are not shown here, but are available upon request.

value homeownership greatly. The majority of our respondents are permanent residents of the city, who are likely to have greater social integration. The gender distribution is also balanced in our sample (i.e., 53.8% are 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 is presented in Table 3.

4. FINDINGS AND DISCUSSIONS

Three models are estimated to test our hypotheses. The first model (Model 1 in Table 4) does not include any interaction terms. This model ignores any moderator of endowment effect. The drawback of such a model specification is obvious, as shown in Table 4. The model has the lowest R square, and the endowment effect is only significant at the 10% level. Subsequently, we incorporate the moderating effect of market condition (Model 2), as well as buyer/seller characteristics (Model 3). Both models show significant improvement compared with Model 1. Model 3 considers both types of moderators of endowment effect with the highest adjusted R square. The discussions below are based on Model 3.

Results support the first hypothesis. The coefficient estimate of D_p is 34.364. This positive, significant coefficient loading indicates that the WTA-WTP gap is approximately RMB 343,640, which is 8.59% of the market benchmark price used in the experiment. In our sample, the sample average WTA is RMB 4,265,664 and the sample average WTP is RMB 4,140,140, which translates into a WTA-WTP gap that is equal to 3.14% of the market benchmark. The regression coefficient estimate differs from the descriptive statistics because this value is an estimate of the 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. The coefficient estimate of 20.628 is significant at 5% level, implying that endowment effect is significantly greater in an up market by a margin of more than RMB 200,000 on average. In our experiment, the price trend is controlled for by increasing/decreasing the prices for a fixed period of time. More specifically, the value of $P_0 - P$ is fixed for all respondents. However, the

Table 4. Regression results

	Category	Model 1	Model 2	Model 3	
		Coefficient	Coefficient	Coefficient	VIF
C	Intercept	–5.529	–1.009	–17.462**	NA
D_p	Endowment effect	8.357*	–1.957	34.364***	6.845
MKT	Market condition	–10.614**	–19.653***	–19.653***	1.780
HOME	Experience	–10.092*	–10.092*	–6.562	2.021
AGE		15.083***	15.083***	18.615***	2.071
INCOME	Affordability	26.736***	26.736***	40.517***	2.203
SPENDING		11.183**	11.183**	18.787***	2.004
OCCP		8.796**	8.796**	18.197***	2.010
SYMBOL	Social and cultural values	9.617**	9.617**	14.365**	1.913
IMPORTANCE		13.846***	13.846***	20.451***	1.813
RESIDENT		–15.392**	–15.392**	–17.840**	1.572
GENDER		9.274**	9.274**	9.745*	1.890
*MKT** D_p	Interaction terms		20.628**	20.628**	2.780
*HOME** D_p				–9.982	1.471
*AGE** D_p				–11.237	2.643
*INCOME** D_p				–32.633**	2.456
*SPENDING** D_p				–12.925	2.421
*OCCP** D_p				–21.356**	3.168
*SYMBOL** D_p				–9.683	3.553
IMPORTANCE D_p				–18.869*	2.158
*RESIDENT** D_p				11.597	1.603
*GENDER** D_p				–2.123	3.139
Adj R^2		0.080	0.084	0.107	
F-statistic		8.547	8.351	6.121	

Note: ***p < 1%, **p < 5%, *p < 10.

values of $\theta_s - \theta_b$ is not directly observable, and can only be captured indirectly by examining the size of the coefficient estimate of *MKT** D_p. This large, positive coefficient estimate indicates that $|\theta_s - \theta_b|$ is larger in an up market, suggesting that buyers demonstrate a high level of risk in 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 verify if endowment effect varies among different types of agents. Our results show that only *INCOME, OCCP,* and *IMPORTANCE* moderate endowment effect. More specifically, endowment effect is weaker for respondents from higher affordability groups (i.e., with higher monthly income and stable jobs). This result is consistent with previous findings regarding income effect, implying that payment capacity reduces WTP 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 is removed effectively. However, income effect cannot be easily controlled in a similar way, as income constraints are often deeply rooted in the minds of the respondents and affect their decisions regardless of how experiment questions are constructed. This constraint 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 $P_0 > P$ are significant and negative. Once again, our theoretical framework effectively captures the complex relationship between endowment effect and socioeconomic factors.

Aside from the variables used in hypotheses testing, nine out of ten control variables in Model 3 are statistically significant, and show the expected sign. For example, coefficient estimates

for *INCOME, SPENDING, OCCP, SYMBOL, IMPORTANCE,* and *GENDER* are positive and significant, suggesting that wealthier and more socially/culturally conscious individuals in China are more prone to judgmental biases in their housing decisions. Younger (or inexperienced) people are more likely to deviate from benchmark prices on average. By contrast, permanent residents are less prone to bias partly because they are more familiar with the local market than the non-permanent residents. Multicollinearity is a concern because of the large number of interaction terms used in our model. We adopt different model specifications and find that the results are robust. This result is also supported by VIF statistics that are reported in the last column of Table 4. All VIF statistics are less than 10, indicating that the correlation among included independent variables is low. No serious variance inflation and biasness issues exist in our model.

In sum, we find sufficient evidence that supports the three hypotheses based on the proposed theoretical model. Firstly, endowment effect does not only present, but also play an important role in housing decisions. Secondly, the effect varies according to market conditions. Thirdly, we also identify some consumer characteristics (e.g., income and occupation) as mediators of endowment effect. Our findings highlight the importance and complexity of endowment effect in housing markets.

5. CONCLUSIONS

We propose a theoretical framework to model endowment effect in housing decisions. We utilize PT, a theory in behavioral economics, but focus on the reference point formation aspect of endowment effect. This approach is different from those used in most existing studies, in which loss aversion is used to explain the endowment effect. Through this unique approach, our model not only quantifies endowment effect, but also investigates its role as a determinant of judgmental bias in home purchase decisions. The framework facilitates the study of endowment effect in a more complex, but more realistic setting.

Through a field experiment conducted in China, we demonstrate how to implement empirically the theoretical framework in this paper, and how to capture and interpret the complex relationship between endowment effect and its moderators. Our findings are highly consistent with the results and stipulations of the existing literature, 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 initiative will eventually help home buyers make better decisions, and more importantly, facilitate a more effective housing policy-making process.

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