What Drives the WTA-WTP Disparity in Real Estate Markets? Endowment Effect, Information Asymmetry and Housing Decisions

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Abstract

The disparity between sellers' willingness to accept (WTA) and buyers' willingness to pay (WTP) has been widely observed in the economic experiments. Such experiment usually involves instruments of trivial values and college students. Without assuming any wealth effect and transaction cost, results show that the WTA-WTP gap can be interpreted as endowment effect. According to prospect theory, this is an evidence of reference dependence and loss aversion. However, given the high level of information asymmetry and high stake involved in housing transactions, this paper tends to investigate the disparity between sellers' WTA and buyers' WTP in the housing market and decompose the driving forces of WTA-WTP gap into two components: market frictions and psychological bias. Results from field experiments carried out in Beijing, China show that both the endowment effect and information asymmetry contribute to the WTA-WTP disparity. The information asymmetry effect can be reduced by introducing information disclosure laws, whereas the endowment effect is caused by sellers' loss aversion. This study not only extends the application of behavioral economics in housing, but also offers a better understanding of housing consumer behavior in the real estate market of China.

Key Words:

Prospect theory; WTA-WTP disparity; Endowment effect; Loss aversion; Information asymmetry; Housing market

JEL Classification: D03, D81, D82, R3

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1. Introduction

Trading happens every day as a part of human economic activities. As the fabric of an efficient market, frequent trading activities are essential to the generation of wealth as well as in supporting the growth of global economies. Take a simple trade involving the exchange of a given product and cash between two counterparties for an example, a trade deal is struck when two counterparties can reach an agreement on the price. Specifically, a certain market transaction can only occur when the buyer's willingness-to-pay (WTP, or the highest reservation price that the buyer subscribes to the traded product) is higher than or equal to the willingness-to-accept (WTA, or the lowest reservation price that the seller subscribes to the trade product) of the seller. According to the standard economic theories (SET), market participants are assumed to be rational. If there is limited income effect (i.e., buyers do not have any income constrain to buy the product), sellers and buyers are usually capable of correctly setting their WTA and WTP at the market fair price of the goods (Willig, 1976), the price at which supply is equal to demand, and hence sealing the deal.

However, it has been widely observed from empirical evidences that a disparity between the seller's WTA and the buyer's WTP exists (see Horowitz & Mcconnell, 2002; Sayman & Öncüler, 2005; Tunçel & Hammitt, 2014 for reviews). The WTA-WTP ratio can be as large as 100 when the trade goods are some specific environmental assets. This ratio is too large to be explained by the income effect alone and demands alternative explanations. The WTA–WTP disparity is a violation of the predictions of SET. Such disparity prevents deals from being struck smoothly, undermines market efficiency and poses direct implications to market liquidity. Therefore, the WTA–WTP disparity has attracted a lot of attention from the academic community and the industry for decades as people try to understand what is causing the disparity and how does the disparity interact with the transaction volume and the market liquidity of traded goods.

Behavioural economists suggest that the endowment effect is a major driving force behind this observed WTA-WTP disparity. The concept of endowment effect, which is usually considered sellers' decision bias, is coined by Thaler (1980) to interpret the phenomenon that sellers ascribe additional value to the goods being traded due to their physical ownership. Based on prospect theory (PT, Kahneman & Tversky, 1979) in behavioural economics, sellers' loss aversion has been the leading and the most robust explanation to the endowment effect (Ericson & Fuster, 2014). Specifically, sellers' ownership experience induces their emotional attachment to the underlying goods. By sacrificing their ownership, sellers parting with their belongings and fall into the loss domain. Sellers who are more averse to losses are likely to demand a larger amount of compensation. As a result, sellers' loss aversion causes them to subscribe extra value to their belongings due the mechanism described above, and thereby contributing to the endowment effect and enlarging the WTA–WTP disparity. However, the nature of such a decision bias has been subjected to many debates. Evidence shows that experience, competition, and large stakes can effectively extinguish the

decision bias such as endowment effect or loss aversion (Hart, 2005; Levitt & List, 2008; List, 2003). By contrast, strong field evidence suggests that loss aversion affects even professional golfers who are experienced in playing in a highly competitive environment with large stakes (Pope & Schweitzer, 2011). These contradicting findings clearly indicate that further studies are necessary.

Previous scholars also attempt to understand the WTA–WTP disparity based on the deviations of market environment from the underlying assumptions of SET. One of the deviations proposed in these studies is information asymmetry, which is a key feature that is always present in a transaction (Casey, 1995). Glosten & Milgrom (1985) and Dupont & Lee (2002) establish theoretical models to show that information asymmetry can lead to a gap between sellers' WTA and buyers' WTP, which is considered a rational explanation of the WTA–WTP disparity without invoking human psychology. This rational explanation derived from the theoretical models corroborates the uncertainty hypothesis in previous studies that sellers or buyers may mis-specify their WTA or WTP when they are uncertain about the value or characteristics of the traded items (Casey, 1995; Shefrin & Caldwell, 2001). However, the information asymmetry explanation has yet been directly tested by empirical data since most of the previous experiments on the WTA-WTP disparity are designed to rule out the effect of information asymmetry between two counterparties.

Experimental economists have suggested that the observed WTA–WTP disparity comes from the mis-specified experiment designs. Plott & Zeiler (2005, 2007) among others argue that the observed WTA–WTP gap in previous laboratory experiments is caused by subjects' misconceptions. For example, sellers and buyers may not fully understand the pricing and auction mechanism in the experiment, and thus inappropriately employing the "sell-high buy-low" strategy (Ericson & Fuster, 2014). Plott & Zeiler (2005) introduce the paid practice round into the experiment design to familiarize participants with the pricing mechanism and to remove any misconception of the subjects. After several rounds of practice, the WTA–WTP gap disappears. Although the paid practice rounds are designed with good motives, their applicability is limited. This is because people's willingness to trade changes with the probability of trading, according to the reference-dependence model of Koszegi & Rabin (2006). The endowment effect (or the WTA–WTP gap) exists when participants' ex-ante expectation of the trading probability is none or small, and the disparity may be extinguished when the trading probability gets larger. As a result, the phenomenon of the insignificant WTA-WTP disparity may be attributed to the continuous increase in the participants' ex-ante expectation of the trading probability during the practice rounds instead of the familiarity with the pricing mechanism per se. Essentially, additional studies are necessary to clarify the design and implementation of experiments on the WTA–WTP disparity.

However, none of the preceding explanations have been tested in the unique and important housing market. With housing being one of the largest components in a typical household's investment portfolio, the housing market however tends to be much less active and liquid than the other asset or private goods markets. In housing markets, the disparity between home sellers' WTA and buyers' WTP affects the liquidity of property transactions fundamentally. In Fisher et al (2003)'s discussion on market liquidity and how it interacts with home sellers and buyers' reservation prices, the authors clarify that a trade deal is struck if the sellers' and buyers' reservation prices overlap. A relationship can thus be established as such that the greater the gap between sellers' WTA and buyers' WTP is, the

lower the probability that transactions occur and trades complete successfully (Fisher et al, 2003). If sellers' WTAs are well above buyers' WTPs and the sellers are not flexible with their WTAs, property prices can increase and propeties can sit in the market for a long time since sellers and buyers may take a long time in negotiation until the final settlement (Genesove & Mayer, 2001). Therefore, relatively small transaction volumes and low market liquidity in housing markets can be associated with a large WTA-WTP disparity. It is necessary to understand the factors that prevent home sellers and buyers from closing deals.

With this background in mind, this study revolves around the study of human behaviors in decision making. In SET, economists assume that market participants are rational "economists" and examine how they would behave in an abstract economy instead of normal people (i.e., "humans") in the real marketplace (Thaler, 2016). Had all market players followed rationality of economists, the market could be as ideal as the standard theories have predicted. However, the real marketplace does not subscribe to a single theory, and its players are far from rational. To make things work, behavioural economists introduced the concept of "libertarian paternalism," which aims to examine "Human" behaviours and nudge "humans" to make choices as closely as "ideal" economists would using non-forced ways. The ultimate goal was to enhance market efficiency and improve the process of policymaking. This paper is designed with this ultimate goal in mind.

The objective of this paper is to investgate and identify the market/economic and psychological driving forces of the WTA–WTP disparity. Specifically, how do housing consumers (i.e., homebuyers and sellers) form and update their WTA or WTP? Does the WTA–WTP disparity exist in the housing market? If yes, what are the driving forces of the WTA–WTP disparity? Most importantly, is there any non-forced way of psychological intervention that can be used to reduce the WTA–WTP disparity and nudge people to close deals in this market? By answering these questions, this paper contributes to the literatures by bridging the research gap and investigating the driving forces behind the WTA-WTP disparity and market participants' housing decisions in the real estate market. This research facilitates the understanding of what is preventing home sellers and buyers from closing deals and in which ways can home buyers make better decisions, thereby reducing the WTA–WTP disparity and enhancing housing market efficiency.

Given that sellers' WTAs and buyers' WTPs are usually unobservable, using ex-post data can be insufficient to answer the questions listed above. To fully address the issues, multiple field experiments in the housing market are conducted, and the data used in this paper come from these field experiments. The use of field experiment in economic literature has become a growing trend in recent years. Floyd & List (2016) provide general descriptions on the scope of field experiments and the benefits of using field experiment evidence The study also offers a "user's guide" on how to effectively implement field experiments and analyse the collected experimental data.

Field experiments combine controls and realism in experimentation methodologies, aspects that laboratory or natural experiments usually lack (Floyd & List, 2016). Specifically, in contrast to laboratory experiments conducted in a classroom setting, field experiments are usually implemented in field settings, such as marketplaces and organizations. Additionally, unlike natural experiments in which experiment participants are usually not aware that they are in the experiment, field

experiments offer researchers more control over the experiment scenarios and the participants. Therefore, field experiments can accomplish the tasks that both laboratory and natural experiments find difficult.

Nevertheless, field experiments can offer great opportunities to uncover causal relationships and gain economic insights if and only if the experiments are carefully designed to make economic and practical sense. To ensure efficiency and robustness of the experiment results, special attention should be paid to the power of the designs and procedures of the experiments (Floyd & List, 2016). For example, market characteristics or organization dynamics should always be considered when designing field experiments. Both internal validity (e.g., the extent to which bias is eliminated in a causal relationship) and external validity (e.g., the extent to which the experiment results can be generalized to other people) of the experiments need to be fulfilled. Replicability of previously reported key results is important in understanding specific scientific and economic phenomena, and should be checked using different experiment participants at different times. Therefore, conducting a pilot study is good practice. Floyd and List (2016) also suggest that experiment evidence without any underlying theories could be a coincidence and only provide limited information. Thus, theories and experimental evidence should be examined and understood together. The experiments conducted in this study are designed following these guidelines from Floyd and List (2016). Prior to the field experiments, a meta-analytical review of previous studies on the WTA–WTP disparity was performed. By analysing 525 data points from 124 studies, general guidelines in the design of my field experiments on the WTA-WTP disparity in housing markets were obtained.

Conducting field experiments in the housing market that are both representative and capable of producing reliable first hand data is important. The secondary housing market of Beijing, China offers me such an ideal testing ground to conduct field experiments for the following reasons: First, China has yet to enact a "seller information disclosure" law such as that in the United States nor is China providing any official "local land charge and search" service to buyers such as that offered in the United Kingdom. Information asymmetry is likely to remain un-mitigated in the property market in China compared with that in the United Kingdom and the United States. As a result of this, experiments can be conducted on scenarios before and after private information disclosure; the responses of decision makers (i.e., WTA or WTP) and their decision-making process with/without information asymmetry can thus be observed in controlled experiment settings. This allows the impact of information asymmetry to be better tested. Second, the growth of home prices in Beijing is relatively stable over the past years; the good return generated on house purchases in Beijing encourage people to participate in this market. Due to the high absolute level of trading volume, Beijing housing market is relatively competitive. Home purchase decisions may be influenced by the endowment effect provided with the large stake and competition involved. Therefore, a good understanding of the endowment effect in this market can assist scholars to clarify the previous contradicting findings. Last but not the least, Beijing has one of the most active property markets in China. The substantial market size ensures the ease of recruiting participants for the experiments.

The remainder of this paper is organized as follows. Section 2 presents the theoretical background and research framework. Literature review and the testable hypotheses are given in Section 3. Two experiments are conducted to test the hypotheses. The design and implementation of these

experiments are illustrated in Section 4. Section 5 explains empirical findings and Section 6 concludes.

2. Theoretical background and research framework

Suppose that an agent makes decisions by maximizing the following utility function form $U_{\boldsymbol{x}}$: $R_+^n \longrightarrow R$.

$$U_{\boldsymbol{x}}(\boldsymbol{y}) = \sum_{i=1}^{n} u_i(y_i - x_i) \quad (1)$$

where the agents' initial entitlement is non-negative n-vector **x**, and for each *i*, the utility function $u_i(y_i - x_i)$ is continuous and strictly increasing. Without losing any generality, according to the prospect theory in behavioral economics (Kahneman & Tversky, 1979), $u_i(y_i - x_i)$ in Equation (1) can be described with Equation (2) and illustrated with Figure 1.

$$u_i(y_i - x_i) = \begin{cases} (y_i - x_i)^{\alpha} & y_i - x_i \geq 0 \\ -\lambda(x_i - y_i)^{\beta} & y_i - x_i < 0 \end{cases} \quad (2)$$

where the prospect theory-based utility function u_i is defined based on an outcome y_i, and the utility function satisfies the following properties:

a) Reference dependence. x_i, which is an agents' initial entitlement, can be considered as his/her reference point. When the outcome y_i is greater than x_i, individuals enter the gain domain; otherwise, they fall into the loss domain.

b) Loss aversion. λ is the loss aversion coefficient. $\lambda > 1$ reflects that individuals' utility function in the loss domain is steeper than that in the gain domain. Individuals take greater risks to avoid losses than to secure gains. Specifically, if $y_i - x_i \neq 0$, then $u_i(y_i - x_i) < -u_i(x_i - y_i)$. If $y_i - x_i = 0$, then $u_i(y_i - x_i) = 0$.

c) Diminishing sensitivity. α and β are diminishing sensitivity coefficient in the gain and loss domains, respectively. $\alpha < 1$ and $\beta < 1$ indicate that the marginal gains and losses diminish with the distance between y_i and x_i. The prospect theory-based utility function $u_i(y_i - x_i)$ is concave in the gain domain while convex in the loss domain.

Consider a typical trade where money and a single item are involved, an agent's endowment (i.e., the non-negative vector **x**) has two components: wealth and entitlement (Masatlioglu & Ok, 2013). Hence the endowment can be described as $X = I * \{0,1\}$, where *I* is denoted as the wealth and $\{0,1\}$ captures the state of entitlement. Specifically, let e_0 as each agent's initial monetary endowment, and a as the amount of money that an agent possess to the item with both e_0 and a being positive numbers, then $I \in [e_0, e_0 + a]$. A pair $(e_0 + a, 0)$ in X can be interpreted as a buyer who has $(e_0 + a)$ as his/her total wealth but does not own the item, whereas a pair $(e_0, 1)$ indicates that a seller has some initial monetary endowment e_0 and owns the item. Each agent (i.e., buyer or seller)

makes choice (denote as **c**) on $C(X)$. For example, if a seller makes a choice to sell the item, his/her endowment changes from $(e_0, 1)$ to $(e_0 + a, 0)$, vise versa.

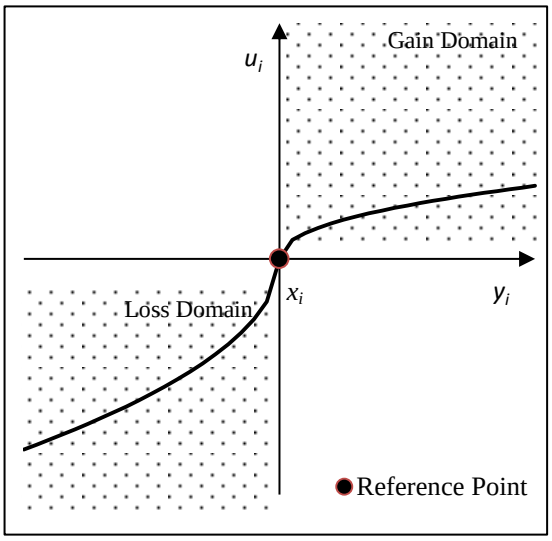


Figure 1. Prospect theory-based utility function

Subsequently, this paper considers sellers' WTA as the following equation:

$$WTA(\boldsymbol{c}) = \inf\{a \geq 0: u_1(e_0 + a - e_0) + u_2(0 - 1) \geq 0\} \quad (3)$$

Similarly, buyers' WTP can be described with Equation (4) as follows:

$$WTP(\boldsymbol{c}) = \sup\{e_0 \geq a \geq 0: u_1(e_0 - (e_0 + a)) + u_2(1 - 0) \geq 0\} \quad (4)$$

Equation (3) can be re-arranged as below and since the prospect theory-based utility function is continuous and strictly increasing,

$$WTA(\boldsymbol{c}) = \inf\{a \geq 0: u_1(a) + u_2(-1) \geq 0\} = u_1(0) + u_2(-1) \quad (5)$$

As $u_1(0) = 0$,

$$u(WTA(\boldsymbol{c})) = -u_2(-1) \quad (6)$$

Similarly,

$$WTP(\boldsymbol{c}) = \sup\{e_0 \geq a \geq 0: u_1(-a) + u_2(1) \geq 0\} = u_1(0) + u_2(1) \quad (7)$$

Hence

$$u\big(WTP(\boldsymbol{c})\big) = u_2(1) \tag{8}$$

Since the prospect theory-based utility function u_i satisfies the property of loss aversion and follows the inequality $u_2(1) < -u_2(-1)$, $u\big(WTP(\boldsymbol{c})\big) < u\big(WTA(\boldsymbol{c})\big)$. Because u_i is continuous and strictly increasing, $WTA(\boldsymbol{c}) > WTP(\boldsymbol{c})$. Based on this theoretical framework, it can be concluded that the WTA–WTP disparity, which is usually considered a measurement of endowment effect (Thaler, 1980), is subject to the loss aversion effect. This study attempts to decompose the driving forces of WTA-WTP disparity into information asymmetry effect and the endowment effect, as well as minimise any bias caused by subject misconception. The research design is illustrated in Figure 2. Experiment 1 starts with a benchmark WTA-WTP disparity. This is obtained by conducting field experiments in the housing market, in which the WTA of sellers and WTP of buyers are elicited and their differences calculated (i.e. the WTA-WTP gap) explicitly. Subsequently, scenarios containing information asymmetry materials are introduced in the experiment, and the impact of information asymmetry on the WTA-WTP gap is tested. The resulted gap value can be broken down and explained respectively by the endowment effect (E.E.), the information asymmetry (I.A.) and potentially the mis-specifications (M.S.) in the experiment design (i.e., E.E. with I.A. and M.S. in Figure 2). This is followed by the information disclosure scenario, which clarifies the information asymmetry introduced in the previous step with the aim to eliminate its effect. Experiment 2 replaces buyers participating in the experiment with real estate agents. This is done in order to eliminate the potential "sell-high, buy-low" tendency. Sellers and agents share the same position in selling, in which their profit increases should the transaction price rise. The only difference between the two parties is that the sellers have ownership of the property while the agents do not. If there is any disparity between sellers' WTA and agents' evaluations, the difference should be independent of the mis-specification issues (i.e., E.E with I.A. in Figure 2). Therefore, by providing the information disclosure signals to both sellers and agents, the resulted gap between WTA and agents' evaluations should be the isolated endowment effect. The relationship between sellers' loss aversion (L.A.) and the endowment effect can then be identified.

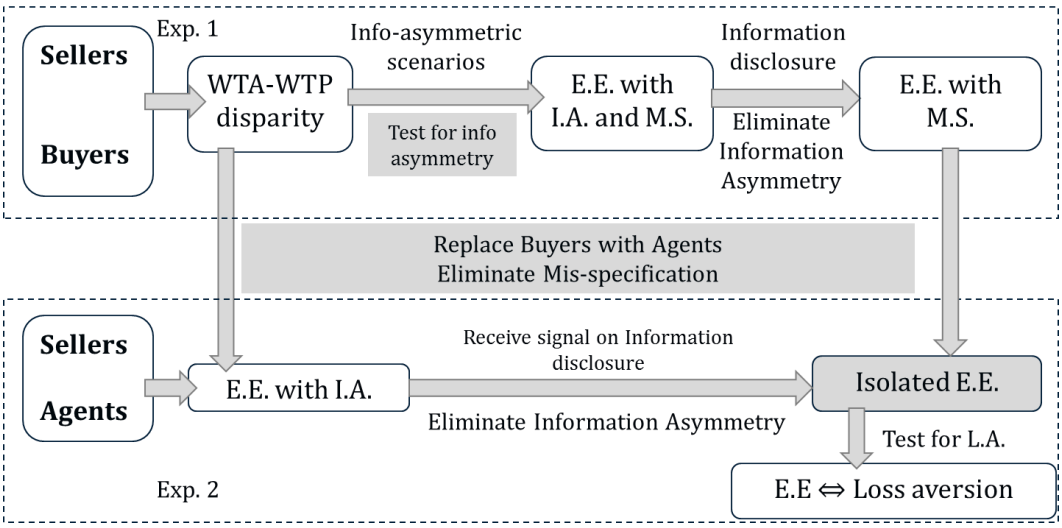


Figure 2. Research framework

3. Literature review and testable hypotheses

Experimental evidence obtained in the past 50 years also confirms that sellers' WTA is higher than buyers' WTP for the same good. The WTA–WTP ratio obtained from previous experiments ranges from less than 5 to more than 100 (Tunçel & Hammitt 2014 for a meta-analytic review on the WTA–WTP disparity). The instrument utilized in these experiments covers ordinary private goods (Brown & Cohen 2015; Kahneman et al. 1990; Morrison 1997), environment assets (Bishop et al. 1983; Shefrin & Caldwell 2001), time (Ortona & Scacciati 1992), health- and safety-related goods (Chapman & Johnson 1995; Gerking et al. 1988), lottery (Eisenberger & Weber 1995; Peters et al. 2003; Nash & Rosenthal 2014), and other public or non-market goods (Garbacz & Thayer 1983). Horowitz & Mcconnell (2002) and Tunçel & Hammitt (2014) conclude that the WTA–WTP ratio is small when the instrument used in the experiment is close to ordinary private goods with all other conditions being equal.

However, real estate, which is a unique but important type of instrument, is overlooked and under-researched by previous experimental studies. A good understanding of the disparity between home sellers' WTA and home buyers' WTP is essential because it can explain the property transaction volume movement, liquidity of property transactions, and underlying housing cycles. At the time of writing this paper, only a few experiments have asked respondents about their WTA or WTP through a real estate-related instrument. Paraschiv & Chenavaz (2011) are the first to apply experimental techniques to the housing market and elicit respondents' evaluations on secondary housing. However, their work does not comprehensively discuss the WTA–WTP disparity. He & Asami (2014) and Bao & Gong (2016) conduct WTA–WTP experiments on land price and secondary housing in Beijing, respectively, and confirm the existence of the WTA–WTP disparity in land and secondary housing markets. However, the instruments (i.e., land and houses) used in these studies are generic and hypothetical. Sayman & Öncüler (2005) indicate that the WTA–WTP ratio is larger when participants have physical ownership of the instrument than when participants are only provided with hypothetical ownership. Consequently, considering the external validity of the experiments, this study re-confirms whether or not the WTA–WTP disparity exists in the housing market using real houses on the market, house owners, and potential home buyers.

Hypothesis 1: The WTA–WTP disparity exists in the housing market.

SET predicts that in the case of a limited income effect, sellers' WTA and buyers' WTP are generally identical for the same product (Willig, 1976). However, the WTA–WTP disparity observed in previous experiments is considerably large to be explained by the income effect. Previous studies seek alternative explanations for such disparities from different perspectives. Based on psychology and behavioral economics, Thaler (1980) coined the term "endowment effect" to explain why sellers' WTA usually exceeds buyers' WTP. Although the endowment effect explanation contradicts the Coase theorem, laboratory experimental evidence confirms the presence of the endowment effect when the income effect and transaction costs are absent. This finding is evidence of reference dependence and loss aversion according to the theoretical framework introduced previously. These psychological factors are considered the most robust explanation for the WTA–WTP disparity from the behavioral aspect (see Ericson & Fuster 2014 for a review).

Information asymmetry acts as friction in the free market. A typical transaction is usually accompanied by asymmetric information among agents (Casey, 1995). This scenario is not a concern in previous studies because most, if not all, of the experiments distribute exactly the same information on goods to the participants, assuming that information asymmetry does not exist. However, such an assumption is strong for a real estate-related instrument. Given that properties have heterogeneous characteristics (i.e., structural, locational, and neighborhood characteristics), sellers usually have more information on their own house than buyers do (Wong et al. 2012; Pope, 2008). The issue of information asymmetry in the housing market and its effect on liquidity (Wong et al., 2012) and house price movements (Kurlat & Stroebel, 2015) are discussed in previous studies. However, none of these studies establish a direct link between information asymmetry and home seller's WTA (or buyers' WTP) and capture the manner by which information asymmetry affects the WTA–WTP disparity in the housing market. With these considerations in mind and by taking note of the internal validity of experiments, this study determines whether or not the observed WTA–WTP disparity in a market with heterogeneous assets and differentially informed parties is driven by information asymmetry.

Hypothesis 2: Information asymmetry affects the WTA–WTP disparity in the housing market.

Information disclosure is a potential means to address information asymmetry in the housing market. The US housing market has become an ideal "laboratory" for event study and for investigating changes in house values after information disclosure because of the implementation of seller disclosure laws by each state government (e.g., in North Carolina, the law is known as the "Residential Property Disclosure Act"). For example, Pope (2008a; 2008b) notes a decline in house values after information on environmental dis-amenities is disclosed to the public. Fiva & Kirkebøen (2011) reveal a short-term response to the disclosure of information on school quality; buyers increase their WTP to a high level shortly after the release of information. Overall, the average house sales price has increased after the proliferation of seller disclosure laws (Nanda & Ross 2012). The housing market in the United States benefits from such information disclosure laws. Market efficiency has improved, and the marketplace has become stable because price volatility is significantly reduced (Zhang et al. 2015). Other indicators, such as high market liquidity, narrow bid–ask spreads, small WTA–WTP gap, can also enhance market efficiency (Chordia, Roll, & Subrahmanyam, 2008; Chung & Hrazdil, 2010). However, none of the studies establish the relationship between information disclosure and market efficiency along this direction. Consequently, this study investigates the response of individual housing consumers to information disclosure in transactions and determined whether or not information disclosure reduces the WTA–WTP gap in housing transactions, thereby nudging home buyers and sellers to close deals.

Hypothesis 3: The WTA–WTP disparity can be reduced after information disclosure.

The above hypotheses can be tested by the traditional valuation paradigms of the WTA–WTP disparity experiment, whereas the findings obtained from have been challenged in recent years. One of the challenges comes from the internal validity of the experiment designs. For example, Plott & Zeiler (2005) argue that the observed WTA–WTP gap in the previous laboratory experiment is

attributed to the misconception of the subjects. Specifically, sellers and buyers may not fully understand the pricing mechanism in the experiment, and thus they inappropriately use the "sell-high, buy-low" strategy (Ericson & Fuster, 2014), which leads to an extensive gap between WTA and WTP.

An early experiment by Kahneman et al. (1990) offered some insights to address the abovementioned issues. The experiment involves a group of "choosers" who are asked to choose, at certain prices, if they would like to take the instrument or cash. If the difference between WTA and choosers' evaluation is significantly greater than zero, evidence exists to show the endowment effect. Although the original experiment of Kahneman et al. (1990) is designed to eliminate the income effect, the experiment can exclude the effect caused by the sell-high, buy-low asymmetry because choosers and sellers share the identical position and face the same decision problem (Brown, 2005; Kahneman et al. 1990). The only difference between the two groups is that the assignment of a mug provides sellers a physical ownership, whereas choosers do not share such ownership experience. Thus, chooser' evaluations avoid any loss aversion effect. If choosers' evaluations lie between WTAs and WTPs, the gap between WTAs and choosers' evaluations, if any, can be considered an isolated endowment effect. If a WTA–WTP gap exists but WTAs are insignificantly higher than choosers' evaluations, no sufficient evidence exists to show the endowment effect (Casey, 1995).

Table 1 Summary of selected literatures that involve "choosers"

Papers	Instruments	Key findings or arguments
Kahneman et al. (1990)	Mug	Endowment effect exists
Casey (1995)	Lottery	WTA-WTP gap exists but no evidence of endowment effect
Loomis et al. (1998)	Wildlife art print	Chooser reference point can avoid any loss aversion or endowment effect
Shu & Peck (2011)	Pen	Endowment effect exists
Irmak et al. (2013)	Mug	The study uses choosers instead of buyers to control wealth effect. Endowment effect exists
Kleber et al. (2013)	Lottery	The study uses choosers instead of buyers to control wealth effect. Endowment effect exists

The experiment has been replicated in later years. The instrument used in the experiment covers ordinary private goods, such as mug and pens (e.g., Irmak, Wakslak, & Trope, 2013; Shu & Peck, 2011) and risky objects such as lottery (e.g., Casey, 1995; Kleber, Dickert, & Betsch, 2013). A brief summary of the papers is presented in Table 1. However, none of the above studies use real estate-related instruments. Conducting a similar experiment in the real estate market is necessary, which aims to determine whether or not the endowment effect can be isolated from the "sell-high, buy-low" tendency by using real estate agents as the third-party group in the experiment. Consequently, the experiment procedure proposed by Kahneman et al. (1990) is adapted to the housing market.

Hypothesis 4: Sellers' WTAs are significantly higher than real estate agents' evaluations (denoted as AE).

If Hypotheses 2 and 4 cannot be rejected, this study further improves the experiment by considering

the characteristics of the housing market. For example, if information asymmetry has been confirmed to contribute to the disparity between WTA and WTP, the investigation of the endowment effect in the housing market should not only eliminate the "sell-high, buy-low" tendency but also the effect of information asymmetry. Consequently, this study determines whether or not sellers' WTAs are significantly higher than the evaluations of real estate agents after ruling out the information asymmetry effect.

Hypothesis 5: After ruling out the information asymmetry effect, sellers' WTAs are significantly higher than AE.

Sellers' loss aversion has long been the leading explanation to the endowment effect, offering the most robust explanation (Ericson & Fuster, 2014). Specifically, sellers' ownership experience induces a sense of endowment and promotes emotional attachment to the underlying belongings. By sacrificing their ownership (e.g., sellers' endowment changes from $(e_0, 1)$ to $(e_0 + a, 0)$), sellers parting with their belongings and fall into the loss domain. Sellers who are more averse to losses are likely to demand a larger amount of compensation. Essentially, loss aversion causes sellers to subscribe extra value to these belongings, thereby contributing to the endowment effect as the theoretical framework suggests.

Previous studies use experiment data to demonstrate the existence of the endowment effect/WTA–WTP gap on ordinary private goods and lottery, among others. However, they mostly only allude to the link between the endowment effect and loss aversion. A separate set of experiments focuses only on loss aversion. Majority of the loss aversion experiments have not divided the participants into sellers and buyers; thus, these experiments cannot obtain the endowment effect (e.g., Bateman, Day, Jones, & Jude, 2009; Schmidt & Traub, 2002; Thaler, Tversky, Kahneman, & Schwartz, 1997). Only a few studies have linked the WTA–WTP gap to sellers' risk aversion, a proxy for their loss aversion (Georgantzis & Navarro-Martnez, 2010). The lack of a study that makes a direct connection between the endowment effect and sellers' loss aversion makes it necessary to use empirical evidence to test whether a relationship between them exist; while the relationship can be established if and only if the obtained endowment effect is independent of the other noises. Consequently, if the isolated endowment effect indeed exists, this study determines whether sellers' loss aversion affects this isolated endowment effect[2] (i.e., gap between WTA and AE).

Hypothesis 6: Sellers' loss aversion affects the gap between sellers' WTA and agents' AE.

2 Theoretical framework suggests that the WTA–WTP disparity is subject to the loss aversion. $WTA(\boldsymbol{c}) - WTP(\boldsymbol{c}) = (WTA(\boldsymbol{c}) - AE) - (WTP(\boldsymbol{c}) - AE)$. By assuming that $WTP(\boldsymbol{c}) - AE$ does not affected by sellers' loss aversion, it can be derived that $WTA(\boldsymbol{c}) - AE$ is subject to sellers' loss aversion.

Table 2 Testable hypotheses

Hypotheses	
H1	The WTA–WTP disparity exists in the housing market
H2	Information asymmetry affects the WTA–WTP disparity in the housing market
H3	The WTA–WTP disparity can be reduced after information disclosure
H4	Sellers' WTAs are significantly higher than real estate agents' evaluations
H5	After ruling out the information asymmetry effect, sellers' WTAs are significantly higher than AE
H6	Sellers' loss aversion affects the gap between sellers' WTA and agents' AE

4. Experiment

The experimental setting of this study is different from those of previous studies. An online field experiment that makes use of 'big data' on the Chinese secondary housing market is conducted in this study, instead of a face-to-face interview. Online or internet-based experiments have attracted much attention in recent years. Extensively used internet-based methods of recruitment and experiment include Amazon MTurk (Keuschnigg, Bader, & Bracher, 2016; Eriksson & Simpson, 2010; Suri & Watts, 2011, 3), Qualtrics.com (Christensen et al. 2013; Higgs et al. 2008), and online forums (Paraschiv & Chenavaz, 2011), among others. The benefits of using internet-based experiments have been recognized by previous literatures. First, internet-based experiments enable researchers to approach a more diverse population and a substantial variety of participants (Casler, Bickel, & Hackett, 2013). Second, anonymity makes participants feel more comfortable than face-to-face interviews or classroom experiments (Joinson, Woodley, & Reips, 2007). Third, the hidden "manipulation check" during the online experiment can ensure that online participants are focused on the tests (Oppenheimer, Meyvis, & Davidenko, 2009). Lastly and most importantly, the results obtained from online experiments are consistent with those obtained from traditional laboratory experiments.

The online field experiments are conducted on my behalf by China Index Academy, which is one of the largest real estate databanks in China. The experiment participants are homeowners and potential home buyers in Beijing who have indicated interest to sell or buy secondary properties by registering in a public platform belonging to China Index Academy. This platform is the same one used by China Index Academy to conduct official surveys and collect official statistics on Chinese housing consumers.

Experiment 1 is designed based on the one described in Bao & Gong (2016) to test the first three hypotheses but with the following adjustments: First, given the external validity of the field experiment, the experiments in this study uses real houses on the market as the stimuli and real house owners and potential home buyers as the experiment participants, instead of providing the participants with a hypothetical ownership in Bao & Gong (2016). Second, the participants are assigned with the up or down market conditions based on their own market expectations in this study, instead of using current and historical hypothetical information (i.e., price, increase rate, and others) in the up or down market scenario. This step is conducted to provide genuine price information and realistic scenarios in the experiment to ensure its ecological validity. Third,

homeowners and potential home buyers are provided with "imbalanced" questionnaires as information asymmetry materials are incorporated in Experiment 1. The design of the information asymmetry materials and the experiment is based on the following three assumptions:

1) Home buyers are always less informed than home sellers.
2) Home buyers are unaware of undesirable housing characteristics. Desirable housing characteristics are well advertised by either homeowners or real estate agencies for marketing purpose. Therefore, desirable housing characteristics are considered public information.
3) Locational characteristics (i.e., distance to the nearest metro station, bus stop, park, and others) and neighborhood characteristics (i.e., demographic information, school quality, and others) are considered public information as these characteristics are publicly available from either social media websites or government official statistics. Private information only comes from structural characteristics, for example, latent problems (Wong et al., 2012).

Experiment 2 involves third-party participants, who are neither home sellers nor home buyers, in the housing transactions to test Hypotheses 4 to 6. The experimental design is different from those of previous studies that introduce choosers as the third-party in the WTA–WTP gap studies. In the real estate market, it makes little sense to use people who are neither homeowners nor potential home buyers as choosers and ask to choose between a property and cash. As a result, choosers are replaced with real estate agents to ensure the external and ecological validity of the experiment. The real estate agents are recruited by China Index Academy from more than 10 active real estate agencies in Beijing. The invitations were sent out by text message. The instruments used in the field experiment in this study are the properties obtained from the field experiment described in Experiment 1. The experiment design is based on the following two assumptions:

1) Real estate agents and sellers are at strictly identical positions of selling the property and earning profits from the transaction.
2) The between-subject design of the experiment can effectively rule out the influence of transaction costs in this experiment. Transaction costs usually cover agency commission fee, which is charged with a certain percentage of the total property price. Both sellers and real estate agents already take the fees into consideration when they formulate WTAs/evaluations. Therefore, the between-subject design can effectively remove any form of the effect caused by transaction costs.

Each real estate agent is asked to evaluate one property only to avoid any learning effect during the experiment. If a participant is asked to repeat the experiment procedure to evaluate more than one property, it is unavoidable that he/she gains experiment experience and becomes familiar with the experiment setup and sequence of the designed experiment scenarios. It is impossible to prevent them from anticipating the questions and producing evaluations that are biased based on these anticipations. For a similar reason, experiment participants are also required not to discuss with their colleagues about the experiment materials before completing the questionnaires to prevent a priori knowledge of experiment procedure.

Prior to the experiment, the experiment procedures and questionnaires were tested in a pilot study to

avoid any mis-implementation and misunderstanding. The pilot study was conducted in January to February 2016. The properties collected from the pilot study covered only three administrative districts, namely, Chaoyang, Haidian, and Fengtai, out of 17 (see Figure 2). The three districts are selected because they are the most popular and representative metropolitan areas in urban Beijing. After removing the outliers, 348 completed questionnaires were collected in the pilot study; 111 were from home sellers and 237 were from buyers. The results obtained from the pilot study are as expected.

Figure 3. Selected administrative districts in the field experiment

4.1 Experiment Features and Designs

The experiments are designed and implemented in three sequential stages to target home sellers, buyers and real estate agents in the housing market. The instruments utilized in these experiments are real properties that homeowners intend to sell. **Stage one (sellers' experiment)** is designed for home sellers; information on the properties that sellers intend to sell (i.e., listed price, location, lot size, etc.) is collected. This stage is followed by **Stage two (buyers' experiment)** and **Stage three (agents' experiment)** which are designed for buyers and real estate agents who are randomly assigned with one real property on the market obtained from Stage one. In all stages, the experiment participants (i.e., homeowners, potential home buyers and agents) are asked to complete a three-part questionnaire. **Parts A, B, and C** provide data on identification, scenarios, and background information, respectively. The experimental procedures are provided in Figure 4.

Part A, which is labeled "identification," constitutes the first component of experiments. Part A in Stage one (sellers' experiment) has 15 questions, which aim to identify whether or not a participant is a potential seller and to collect basic information on the property that he or she intends to sell (see Table 3). Specifically, the experiment in Stage one (sellers' experiment) is terminated when the participants do not meet the established criteria in this study (e.g., if property owners indicate that they do not have any plans of selling their properties in the near future, if the property for sale is not

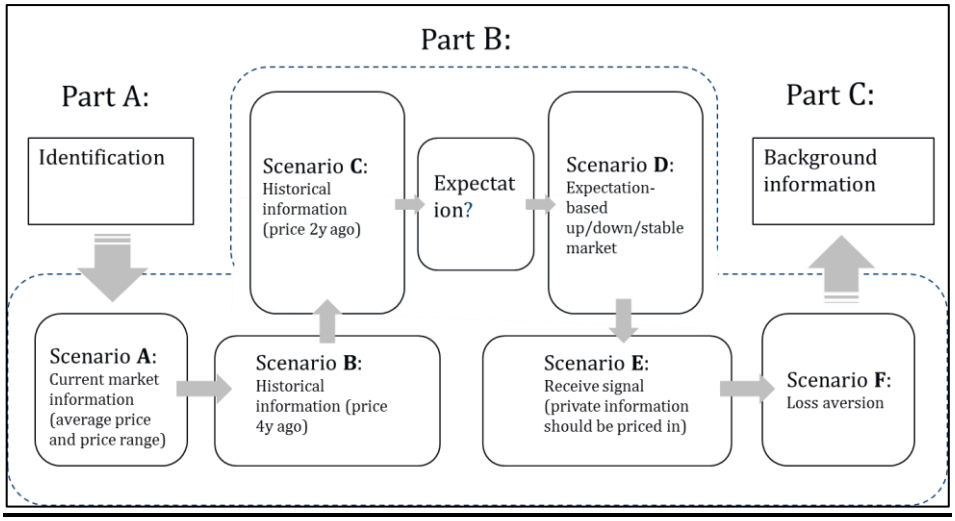
located in the areas covered by the experiment, if the property that an owner holds is a villa or an affordable home, etc.). Part A in Stage two (buyers' experiment) presents 10 questions to identify whether or not a participant is a potential buyer who meets the criteria established in this study. For example, the experiment will not proceed if a participant does not have any plan to buy a secondary property in the near future, if he or she already owns more than two properties[3], if he or she does not have the *Hukou* of Beijing and has paid for tax and/or social securities in Beijing for less than five years, or is not looking for a property located in the areas covered by the experiment. Part A in Stage three (agents' experiment) has four questions that aim to check the identity of an agent. For example, the participants are asked if they have experience in dealing with secondary properties in Beijing and which real estate agency do they work for. Each participant is then randomly assigned 10 real properties in the market obtained from the sellers' experiment and asked to select one to commence with Part B of the questionnaire. Additionally, several "check points" have been established to check the consistency of the participants' responses and to further confirm the ecological validity of the experiment. For example, the experiment will also terminate if a participant provides conflicting answers during the experiment. All participants who meet the established criteria in this study and pass all the consistency checks are guided to answer Part B of the questionnaire.

Table 3. Number of questions for each participant in each part

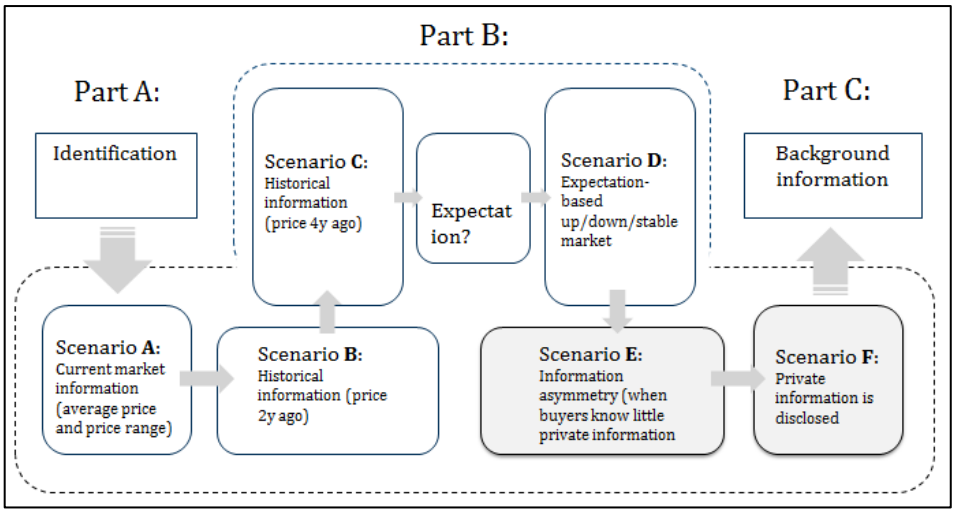
	Part A – "identification"	**Part B** – "scenarios"	**Part C** – "background information"
Stage one (Sellers' experiment)	15	7	11
Stage two (Buyers' experiment)	10	7	11
Stage three (Agents' experiment)	4	6	6

Part B, which is labeled "scenarios," requires participants to follow a sequence of scenarios detailing the current market price, historical information, market expectations, information asymmetry materials, and others. The reference points (i.e., WTA or WTP) of the participants are elicited from their responses. Scenarios in Part B of the real estate agents' experiment are similar to the ones outlined in the sellers' experiment. Specifically, scenarios in this part detail the current market price, historical information, market expectations, and information asymmetry materials, among others. The first four scenarios (i.e., Agent-Scenarios A–D; refer to Figure 4) used in the real estate agents' experiments are similar to those used in the sellers and buyers' experiments. However, in the case of Stage 3, real estate agents' evaluation on the property is asked and recorded. All scenarios can be found in the Appendix.

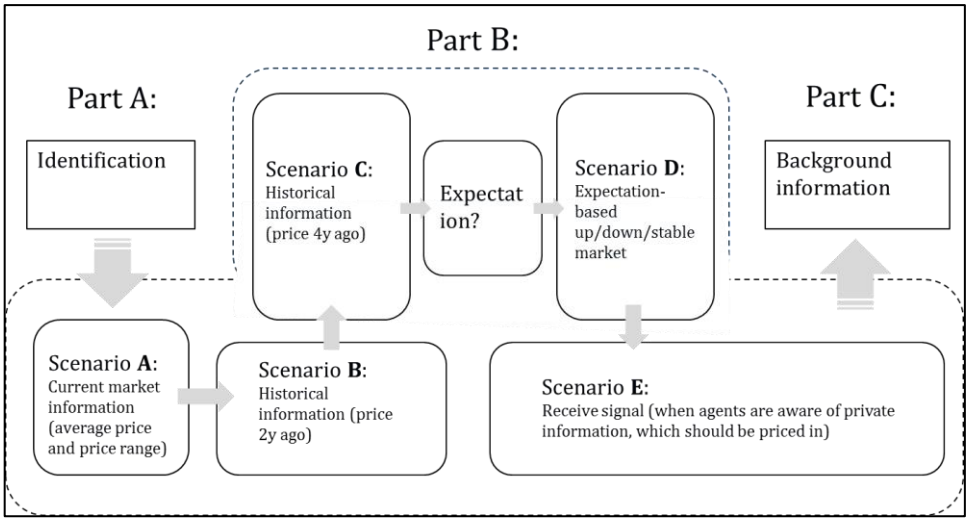
[3] According to home-purchase restrictions in Beijing, housing consumers who already own more than two properties are not eligible to purchase another property.



(a). Procedures of Stage one (sellers' experiment)



(b). Procedures of Stage two (buyers' experiment)



(c). Procedures of Stage three (Agents' experiment)

Figure 4. Experimental procedures

Part C of the questionnaire is labeled "background information." The questions in Sellers and Buyers' experiments include those on social and cultural values (Lin & Lin, 2006; Maddux et al., 2010), educational level/experience (Bao & Gong, 2016; List, 2004; Plott & Zeiler, 2005), income effect (He & Asami, 2014), and gender (Dommer & Swaminathan, 2012). The questions in Agents' experiment include those on real estate agents' age, gender, educational level, work experience (i.e., how many years they have worked as a real estate agent), social and cultural values (i.e., whether the newly introduced housing policies affect their performance). All information obtained from Part C is used as control variables in the subsequent data analysis. In addition, the participants' risk preferences are determined by asking them to participate in a mock "speed lottery" task (question shown below). The design of this question, which aims to obtain the participants' risk preferences, is based on Hanaoka et al. (2014). A participant is more risk seeking (risk-averse) if he/she spends more (less) on this "speed lottery."

> *Q. Risk preference: Suppose that you have a chance to buy "speed lottery." This lottery gives you a 50% chance of winning RMB 1,000. If you win, you will receive the prize right away. If you lose, you will receive nothing. How much will you spend to buy a ticket for this lottery?*

○ *RMB 1*
○ *RMB 20*
○ *RMB 40*
○ *RMB 80*
○ *RMB 150*
○ *RMB 250*
○ *RMB 350*
○ *RMB 500*

4.2 Calculations of the WTA–WTP gaps and WTA–AE Gaps

First three hypotheses are tested by comparing sellers' WTA and buyers' WTP obtained from different scenarios. For example, Hypothesis 1 is tested using the WTA obtained from Seller-Scenario D and the WTP obtained from Buyer-Scenario D. The gap is labeled "WTA-WTP Gap 1: information asymmetry is not considered," which is similar to that in the previous typical WTA–WTP gap experiment and served as a benchmark WTA-WTP disparity in this study. Subsequently, WTA-WTP Gap 2 is calculated by subtracting WTP of Buyer-Scenario E from WTA of Seller-Scenario D, which is essentially the E.E. with I.A. and M.S. This is the case where home sellers have information advantages while buyers have little private information. WTA-WTP Gap 2 is the one that can be observed from the market if high level of information asymmetry exists. WTA-WTP Gap 3 is the case when home sellers receive the signal to consider the discounting factor of structural defects. In the meantime, part of the private information is disclosed to home buyers (see Table 4 for details).

Table 4. Calculation of the WTA-WTP gaps and WTA–AE Gaps

Calculation	Label	H1	H2	H3	H4	H5	H6
Seller-Scenario D minus Buyer-Scenario D	WTA-WTP Gap 1: Information asymmetry is not considered **(Benchmark WTA-WTP disparity)**	×	×				
Seller-Scenario D minus Buyer-Scenario E	WTA-WTP Gap 2: High level of information asymmetry **(E.E. with I.A. and M.S.)**		×	×			
Seller-Scenario E minus Buyer-Scenario F	WTA-WTP Gap 3: Private information is disclosed **(E.E. with M.S.)**			×			
Seller-Scenario D minus Agent-Scenario D	WTA-AE Gap 1: The benchmark gap between seller's WTA and agent's evaluation. **(E.E. with I.A.)**				×		
Seller-Scenario E minus Agent-Scenario E	WTA-AE Gap 2: The isolated gap between seller's WTA and agent's evaluation after the effect of information asymmetry is ruled out **(Isolated E.E.)**					×	×

Similar to the calculation of the WTA–WTP gaps, Hypotheses 4 to 6 are tested by comparing sellers' WTA (obtained from the sellers' experiment) and real estate agents' evaluation from different scenarios. For example, Hypothesis 4 is tested using sellers' WTA obtained from Seller-Scenario D and AE obtained from Agent-Scenario D. The gap is labeled "WTA-AE Gap 1", which is essentially a replication of the previous experiments by (Casey, 1995; Kahneman et al. 1990). WTA-AE Gap 1 is considered the baseline in Experiment 2. WTA-AE Gap 2, which is the gap after the information asymmetry effect is reduced, is used to facilitate the testing of Hypothesis 5. WTA-AE Gap 2 is calculated by subtracting AE obtained from Agent-Scenario E from sellers' WTA obtained from Seller-Scenario E. Furthermore, if Hypothesis 5 is not rejected, WTA-AE Gap 2 will be used to check if sellers' loss aversion is the driving force of such a gap.

5 Data Analysis

5.1 Data Description

Experiment 1 was conducted from April to May 2016. After removing the outliers, 490 completed questionnaires are obtained from the online field experiment in Experiment 1. Among these questionnaires, 105 are from home sellers and 385 are from buyers.

The properties obtained from the experiment cover eight administrative districts (e.g., Chaoyang, Haidian, Fengtai, and Shijingshan, among others) out of 17 (see Figure 3 for details). These administrative districts constitute almost 80% of the transaction volume in Beijing. Chaoyang accommodates the majority of foreign embassies and 18.2% of residents, and thus it is the largest administrative district in urban Beijing. With more than 20% of the gross domestic product (GDP) of Beijing being generated in Chaoyang, this district has the largest transaction volume among all administrative districts (see Table 5). Haidian is the second largest administrative district in urban

Beijing with regard to population and size. Most of the universities in Beijing and several decent primary and secondary schools are located in this administrative district. The disposable income of Haidian residents ranks first among all administrative districts in Beijing. Trading volumes in Haidian and Fengtai are approximately the same, accounting for 11.7% and 9.4% of the total transaction volume in Beijing, respectively.

Table 5. Summary of the statistics of Beijing and the selected administrative areas[4]

	Population (10,000)	**GDP** (Billion)	**Disposable income** (RMB)	**Transaction volume**[5]
Beijing	2114.8	1950.06	40,321	16,583
Chaoyang	384.1	396.36	41,035	4,636
Haidian	357.6	383.52	45,953	2,049
Fengtai	226.1	100.78	37,886	1,685
Shijingshan	64.4	36.52	38,657	433
Changping	188.9	55.72	32,495	1,579
Daxing	150.7	43.16	34,128	895
Fangshan	101	48.18	32,886	726
Shunyi	98.3	123.22	33,329	922

The distribution of the properties obtained from the experiment (see Figure 4) is roughly consistent with that of transaction volumes in Beijing (refer to the last column of Table 5).

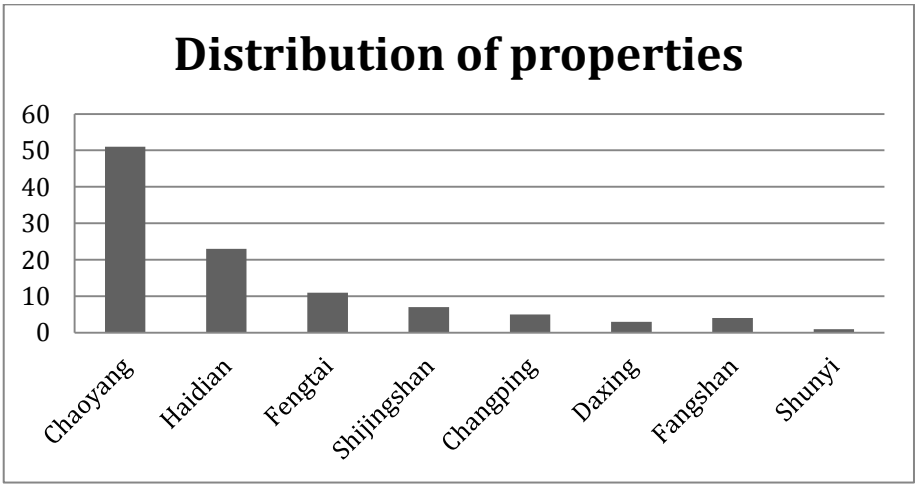


Figure 5. Distribution of properties collected from the experiment

The buyer/seller ratio of each property is not fixed. The ratio ranges from 0 to more than 7 (see Figure 6), which indicates that the properties are not equally popular. The average buyer/seller ratio is 3.66. More than 85% of the properties are selected by at least one buyer.

[4] Source: http://www.bjstats.gov.cn/nj/qxnj/2014/zk/indexch.htm

[5] The data on transaction volume is provided by China Index Academy. It is based on official statistics before the experiment is conducted.

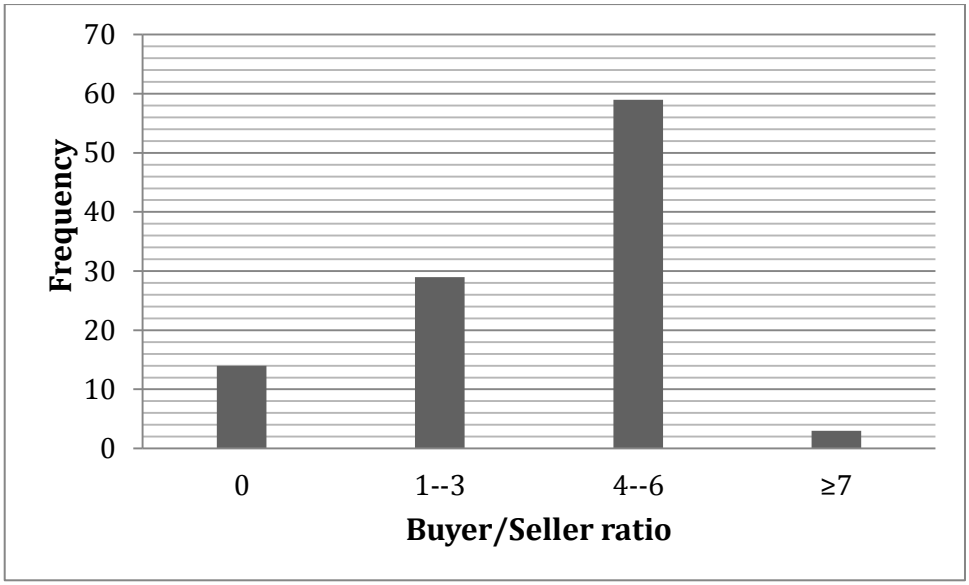


Figure 6. Buyer/Seller ratio

An official survey conducted by China Index Academy in April 2016 provides useful insights into the characteristics of potential home buyers in Beijing. For example, the market is dominated by home buyers who are 20–50 years old. Male housing consumers outnumber the female consumers in this market. More than half of the potential home buyers in this market aim to upgrade to a better property. In the buyers' sample collected from the experiment, female participants are less than the males. More than 90% of the participants are in their 20s–40s. Approximately 60% of home buyers recruited in the field experiment indicate that they are upgrading to a better property (with or without selling the current one). These consistencies indicate that the samples collected are representative.

The experiment participants in Experiment 2 are real estate agents from more than 10 of the largest real estate agencies in China[6]. The field experiment was conducted in July 2016. After removing the outliers, 310 completed questionnaires are obtained from the online field experiment. The number of participants recruited from each real estate agency is shown in Figure 7. A number that is less than five is not shown in the figure for clarity. Approximately 60% of the recruited real estate agents are from the largest real estate agency in China (i.e., Fang).

[6] These real estate agencies are:
1) Fang;
2) Lianjia Real Estate;
3) 5i5j;
4) Maitian Real estate agency Co;
5) ijia Real Estate;
6) Beijing Jinse Shiguang Real Estate Manager Co;
7) Centaline Property Agency;
8) iwjw Real Estate;
9) Xingshang Real Estate;
10) Yige Real Estate;
11) Others.

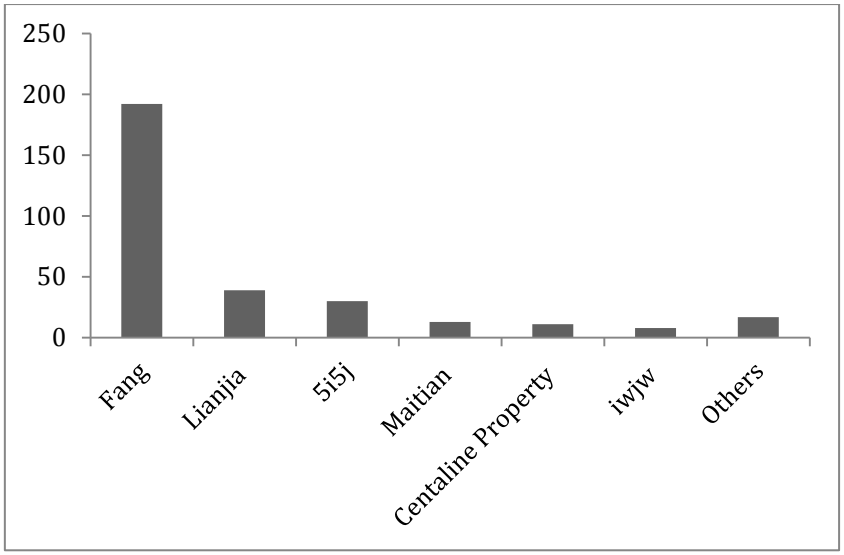


Figure 7. Number of participants from each real estate agency (numbers < 5 are not shown for clarity)

Approximately 39% of the recruited 310 real estate agents are less than 28 years old (see Table 6). Male real estate agents outnumber the females in this experiment. Approximately two-thirds of the real estate agents have an educational level that below bachelor's degree. Only 7 participants hold postgraduate degrees or higher. More than half of the participants work as a real estate agent for two to five years. A few of them have more than 10 years' work experience in this sector. Around 80% of the real estate agents believe that the newly introduced policies have affected their performance.

Table 6 Characteristics of the recruited real estate agents

	Percentage
Age (< 28 years old)	39%
Female	28%
Education (below bachelor degree)	66%
Work experience (2–5 years)	63%

Each property is randomly assigned to at least one of these real estate agents for evaluation. The agent–property ratio ranges from 1 to 6[7] (see Figure 8). The random assignment is conducted to eliminate the cognitive or judgmental bias (if any), such as personal preference, bad emotion, etc., caused by each individual real estate agent. Randomization also assures that the evaluations on each property are fair and do not come from any of the single real estate agency.

[7] Only the properties that have at least one potential buyer are included in the experiment in this study.

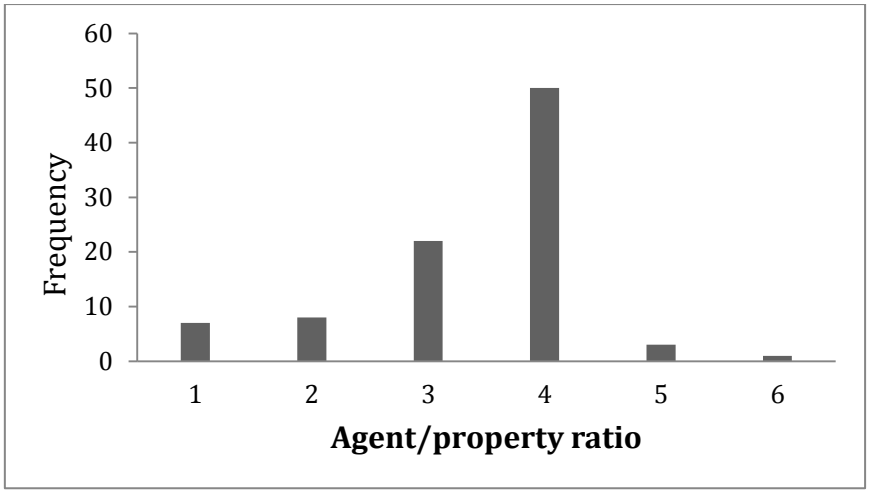


Figure 8. Agent–property ratio

5.2 Empirical findings

5.2.1 WTA–WTP gaps

All WTAs and WTPs are standardized to a base of RMB 1 million. Two sample t-tests are conducted to examine how home sellers and buyers form and update their WTAs and WTPs (i.e., reference points). The results are as expected.[8] The WTAs obtained from Seller-Scenario D and WTPs obtained from Buyer-Scenario D are stacked to form a column vector and put in a difference-in-

[8] In the subsequent analysis, the calculation of WTA–WTP gaps is based on the responses from Scenarios D to F. These calculations are the WTAs and WTPs formed after market expectations are established. Scenarios A to C are included in the experiments as part of the validity and reliability checks.

Table 7. Variable definition and regression results for H1

Variable	Definition	Mean	Coefficient	VIF
C	Constant	---	95.863***	---
PARTICIPANT	=1 if seller; 0 if otherwise	0.214	6.301***	1.313
MKT	=1 if participant has a down-market expectation; 0 if otherwise	0.035	-10.129***	1.137
INCOME	=1 if participant's household income>20,000 RMB; 0 if otherwise	0.539	-0.205	1.136
POLICY	=1 if participant's housing decision will be affected by the recently introduced policies; 0 if otherwise	0.629	-5.874***	1.163
AGE	=1 if participant is under 28 years old; 0 if otherwise	0.078	-3.942	1.144
GENDER	=1 if participant is female; 0 if otherwise	0.331	-0.096	1.333
EDU	=1 if participant has a bachelor's degree or above; 0 if otherwise	0.827	2.075	1.348
OCCP	=1 if participant is in the real estate sector; 0 if otherwise	0.049	-2.338	1.100
IMPORTANCE	=1 if participant thinks homeownership is very important; 0 if otherwise	0.800	2.219	1.156
HOLDING	=1 if participant holds the property for less than 5 years; 0 if otherwise	0.439	1.442	1.317
HAIDIAN	=1 if property is in Haidian; 0 if otherwise	0.220	-4.956**	2.019
CHAOYANG	=1 if property is in Chaoyang; 0 if otherwise	0.522	-2.889	2.288
SCHOOL	=1 if property is in the school catchment area; 0 if otherwise	0.445	1.342	1.189
FLOOR	=1 if the property is at lower floor; 0 if otherwise	0.190	6.032***	1.187
ORIENTATION	=1 if the property is facing south; 0 if otherwise	0.820	2.811	1.176
Adj R^2	8.695%			
F-statistic	4.104			

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

differences model to facilitate the testing of Hypothesis 1. A dummy variable *PARTICIPANT* is included as an independent variable, which is equal to 1 for sellers and 0 if otherwise. *MKT* is included to control for participants' market expectations.

Eight independent variables are included in the model to control for the participants' demographic background and social and cultural values (i.e., *AGE*, *GENDER*, *EDU*, etc.). Properties' hedonic characteristics are evaluated by including locational characteristics (e.g., *HAIDIAN* and *CHAOYANG*), neighborhood characteristics (e.g., *SCHOOL*), and structural characteristics (e.g., *FLOOR* and *ORIENTATION*). After controlling for the participants' market expectation, demographic background, social and cultural values, and properties' hedonic characteristics, the coefficient estimation of *PARTICIPANT* is statistically significantly greater than 0 (see Table 7). All estimations of the coefficients are based on White heteroskedasticity-consistent standard errors and covariance. The model passes the Ramsey RESET Test (F-stat = 1.210), thereby suggesting that the model does not suffer from omitted variable bias. All VIF statistics are less than 5, which indicate that the correlation among the included independent variables is low. No serious variance inflation and biasness issues exist in the model. The results support the first hypothesis and confirm that the WTA–WTP gap exists in the housing market.

5.2.2 Information asymmetry

The sellers and buyers are then paired up according to their properties to obtain the WTA–WTP gap of each individual property. As indicated in Table 4, two gaps calculated from different scenarios (i.e., WTA-WTP Gap 1 and Gap 2) are stacked to form a column vector (*GAPS*) and then placed in a difference-in-differences model using as the dependent variable in the regression analysis to facilitate the testing for Hypothesis 2. The list of variable definitions and regression results is provided in Tables 8 and 9, respectively.

Three models are estimated to test the hypotheses. Model 1 in Table 9 includes only the basic driving forces (e.g., information asymmetry, psychological forces, market expectations, and income effect). The limitation of such a model is obvious: the model has the lowest adjusted R square. Subsequently, confounding factors (i.e., participants' demographic background, social and cultural values, and properties' hedonic characteristics) are controlled in Model 2 and the interaction terms are included in Model 3 (see Table 9). Both Models 2 and 3 in Table 9 show an improvement of Model 1 with regard to the explanation power. Model 3 includes the confounding and moderating factors of psychological forces with the largest adjusted R square. Therefore, the discussions below are based on Model 3.

The WTA–WTP gap is larger when buyers do not know any private information than that of the benchmark scenario. Information asymmetry persistently causes the WTA–WTP gap to be RMB 80,550 larger than that in any other case. In addition, the gap enlarges when sellers have a high degree of loss aversion. Sellers are reluctant to sell if they are sensitive to potential losses. The loss aversion effect is indirectly obtained in Model 3 when I further consider the mediators of psychological force. The mediate effect is evaluated by adding a series of interaction terms between *LOSS_AVERSION* and the control variables and hedonic characteristics. For example, experience can

moderate the effect of psychological force, which is confirmed by the negative loading of the coefficient estimation of *EDU_S*LOSS_AVERSION*. This finding is consistent with that of List (2003; 2004). The negative loading of *HOLDING*LOSS_AVERSION* indicates that a long holding period (i.e., more than five years) amplifies the effect of *LOSS_AVERSION*. In addition, the WTA–WTP gap of the properties in *CHAOYANG* and *HAIDIAN* widens when homeowners are loss-averse. All estimations of coefficients in Table 9 are based on White heteroskedasticity-consistent standard errors and covariance. All VIF statistics are less than 10. In summary, the regression results support the second hypothesis in this study, which states that when all other conditions are equal, information asymmetry affects the WTA–WTP gap in the housing market.

5.2.3 Information disclosure

The effect of information asymmetry on the WTA–WTP disparity in the housing market is significant because of market frictions. However, information disclosure can effectively reduce the effect of information asymmetry. Hypothesis 3 is tested by stacking Gap 2 and Gap 3 and forming a column vector (*GAPS*) to place in a difference-in-differences model. The independent variables (see Model 1 in Table 10) are the same as the ones I use in section 5.2.2. After controlling for the confounding factors, participants' demographic background, properties' hedonic characteristics, and interaction terms, the WTA–WTP gap is reduced by RMB 90,810 after private information is disclosed. The model passes the Ramsey RESET Test (F-stat = 1.664) and VIF test. This evidence supports the last hypothesis in this study, which states that the WTA–WTP gap is reduced after private information is disclosed. Information disclosure can nudge people to close deals and may shorten the time on the market, thereby resulting in improved market liquidity and enhanced market efficiency.

Adding to the complexity of this study, the interaction between information disclosure and psychological forces is examined by including an interaction term between *INFOR_DIS* and *LOSS_AVERSION* (see Model 2 in Table 10). The significant and positive loading of the coefficient estimation of *INFOR_DIS* LOSS_AVERSION* suggests that the effect of loss aversion remains even after information asymmetry is addressed. This finding will be further confirmed and discussed in the following sections.

Table 8. Variable definitions and descriptive statistics (H2 & H3)[9]

Category	Variable	Definition	Mean	
			H2	H3
Dependent variable	*GAPS*	=WTA–WTP gaps from different scenarios	109,240 RMB	104,110 RMB
Information asymmetry	*FULL_IA*	=1 if the gap is in a high level of information asymmetry scenario; 0 if otherwise	0.500	---
	INFOR_DIS	=1 if the gap is obtained from the scenario after private information is disclosed; 0 if otherwise	---	0.500
Psychological forces	*LOSS_AVERSION*	=1 if seller is loss averse; 0 if otherwise	0.506	
Market expectations	*MKTS*	=1 if seller has a down-market expectation; 0 if otherwise	0.016	
	MKTB	=1 if buyer has a down-market expectation; 0 if otherwise	0.039	
Income effect	*INCOME_S*	=1 if seller' income>20,000 RMB; 0 if otherwise	0.584	
	AFFORDABILITY	Maximum amount that homebuyers can afford	4,754,620 RMB	
Policies	*POLICY_S*	=1 if seller's housing decision will be affected by the recently introduced policies; 0 if otherwise	0.403	
	POLICY_B	=1 if buyer's housing decision will be affected by the recently introduced policies; 0 if otherwise	0.681	
Control variables	*AGE_S*	=1 if seller is under 28 years old; 0 if otherwise	0.075	
	AGE_B	=1 if buyer is under 28 years old; 0 if otherwise	0.083	
	GENDER_S	=1 if seller is female; 0 if otherwise	0.223	
	GENDER_B	=1 if buyer is female; 0 if otherwise	0.358	
	EDU_S	=1 if seller has a bachelor's degree or above; 0 if otherwise	0.823	
	EDU_B	=1 if buyer has a bachelor's degree or above; 0 if otherwise	0.826	
	OCCP_S	=1 if seller is in the real estate sector; 0 if otherwise	0.049	
	OCCP_B	=1 if buyer is in the real estate sector; 0 if otherwise	0.049	
	IMPORTANCE_S	=1 if seller thinks homeownership is very important; 0 if otherwise	0.839	
	IMPORTANCE_B	=1 if buyer thinks homeownership is very important; 0 if otherwise	0.787	

[9] Properties' hedonic characteristics are not included in this table.

Table 9. Regression results (H2)

Variable	Category	Model 1	Model 2	Model 3	
		Coefficient	Coefficient	Coefficient	VIF
C	Constant	4.237**	-0.315	3.356	---
FULL_IA	Information asymmetry	8.055***	8.055***	8.055***	1.074
LOSS_AVERSION	Psychological force	2.454*	5.931***	---[10]	---
MKTS	Market expectations	-8.673***	-12.059***	-7.776*	2.032
MKTB		15.586***	16.605***	16.125***	1.252
INCOME_S	Income effect	1.629	-0.048	-0.597	3.944
AFFORDABILITY		0.000	0.002	0.003	2.059
POLICY_S	Policies		-5.468***	-4.970***	3.077
POLICY_B			-1.996	-1.706	1.500
AGE_S	Control variables		-3.694*	0.287	3.423
AGE_B			5.260**	4.065*	1.141
GENDER_S			-6.031***	-7.004***	2.571
GENDER_B			0.299	0.544	1.259
EDU_S			6.031***	8.363***	2.665
EDU_B			-1.987	-1.220	1.455
OCCP_S			2.490	-5.927	4.172
OCCP_B			2.642	3.638	1.235
IMPORTANCE_S			7.937***	5.275***	2.505
IMPORTANCE_B			-1.307	-0.841	1.243
HOLDING			1.237	2.900*	3.191
HAIDIAN	Hedonic characteristics		2.901	-2.387	4.019
CHAOYANG			-4.266***	-7.958***	5.169
SCHOOL			2.302*	2.757	3.159
FLOOR			7.460***	5.334***	2.297
ORIENTATION			-3.822**	-5.401***	1.839
*INCOME_S*LOSS_AVERSION*	Interaction terms			3.490	5.682
*POLICY_S*LOSS_AVERSION*				-2.171	5.794
*AGE_S*LOSS_AVERSION*				-10.271**	4.120
*GENDER_S*LOSS_AVERSION*				4.385	4.352
*EDU_S*LOSS_AVERSION*				-5.967*	9.509
*OCCP_S*LOSS_AVERSION*				12.804	4.028
*HOLDING*LOSS_AVERSION*				-4.539*	5.690
*HAIDIAN*LOSS_AVERSION*				16.734***	3.941
*CHAOYANG*LOSS_AVERSION*				7.738***	8.656
*SCHOOL*LOSS_AVERSION*				1.664	4.608
*FLOOR*LOSS_AVERSION*				-0.013	3.807
*ORIENTATION*LOSS_AVERSION*				3.266	9.351
Adj R^2		8.863%	19.406%	21.753%	
F-statistic		13.464	8.715	7.108	

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

[10] *LOSS_AVERSION* is highly correlated with the interaction terms, making the VIF of *LOSS_AVERSION* higher than 20. Hence it is removed from Model 3 in Table 7. The effect of *LOSS_AVERSION* is indirectly captured by its interaction terms with control variables.

Table 10. Regression results (H3)

Variable	Category	Model 1		Model 2	
		Coefficient	VIF	Coefficient	VIF
C	Constant	9.539**	---	9.583**	---
INFOR_DIS	Information asymmetry	-9.081***	1.059	-11.570***	1.921
MKTS	Market expectations	-12.119***	2.356	-12.338***	2.360
MKTB		12.905***	1.239	12.760***	1.241
INCOME_S	Income effect	-3.020	4.218	-2.902	4.248
AFFORDABILITY		-0.002	2.030	-0.003	2.087
POLICY_S	Policies	-4.268**	3.480	-4.201**	3.493
POLICY_B		-1.348	1.519	-1.390	1.527
AGE_S	Control variables	3.060	4.225	3.201	4.387
AGE_B		4.564**	1.125	4.662**	1.129
GENDER_S		-2.675	2.980	-2.527	3.063
GENDER_B		0.420	1.360	0.417	1.369
EDU_S		4.547*	2.688	4.946**	2.721
EDU_B		0.251	1.370	0.212	1.397
OCCP_S		-2.186	5.303	-2.014	5.263
OCCP_B		3.439	1.232	3.430	1.242
IMPORTANCE_S		6.299***	2.633	6.507***	2.651
IMPORTANCE_B		0.037	1.215	0.031	1.218
HOLDING		2.852	3.680	3.063	3.771
HAIDIAN	Hedonic characteristics	-0.588	4.250	-0.110	4.438
CHAOYANG		-3.602	5.972	-3.192	6.117
SCHOOL		-0.499	3.108	-0.471	3.107
FLOOR		5.543***	2.251	5.742***	2.308
ORIENTATION		-3.685**	1.918	-3.372*	1.968
*INCOME_S*LOSS_AVERSION*	Interaction terms	6.556**	5.917	6.228**	5.988
*POLICY_S*LOSS_AVERSION*		1.541	5.837	1.556	5.961
*AGE_S*LOSS_AVERSION*		-9.760*	4.654	-9.526*	4.833
*GENDER_S*LOSS_AVERSION*		-3.144	4.799	-3.578	4.890
*EDU_S*LOSS_AVERSION*		-0.673	9.052	-1.341	9.315
*OCCP_S*LOSS_AVERSION*		13.052	5.073	12.660	5.099
*HOLDING*LOSS_AVERSION*		-4.456	5.830	-4.766	5.965
*HAIDIAN*LOSS_AVERSION*		7.816	3.906	6.966	4.018
*CHAOYANG*LOSS_AVERSION*		0.884	8.485	0.152	8.718
*SCHOOL*LOSS_AVERSION*		3.037	4.696	2.922	4.742
*FLOOR*LOSS_AVERSION*		2.299	3.797	2.140	3.831
*ORIENTATION*LOSS_AVERSION*		4.393	7.679	3.507	7.863
INFOR_DIS LOSS_AVERSION*				4.914**	3.347
Adj R^2		19.267%		19.658%	
F-statistic		6.243		6.227	

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

5.2.4 WTA–AE gap and Isolated WTA–AE gap

All AEs are standardized to the base of RMB 1 million[11]. As demonstrated in Table 4, sellers' WTAs obtained from Seller-Scenario D and AEs obtained from Agent-Scenario D are used to facilitate the testing of Hypothesis 4. Sellers' WTAs are generally higher than agents' AEs by approximately 6%. Figure 9 shows that a WTA–AE gap exists in all administrative districts.

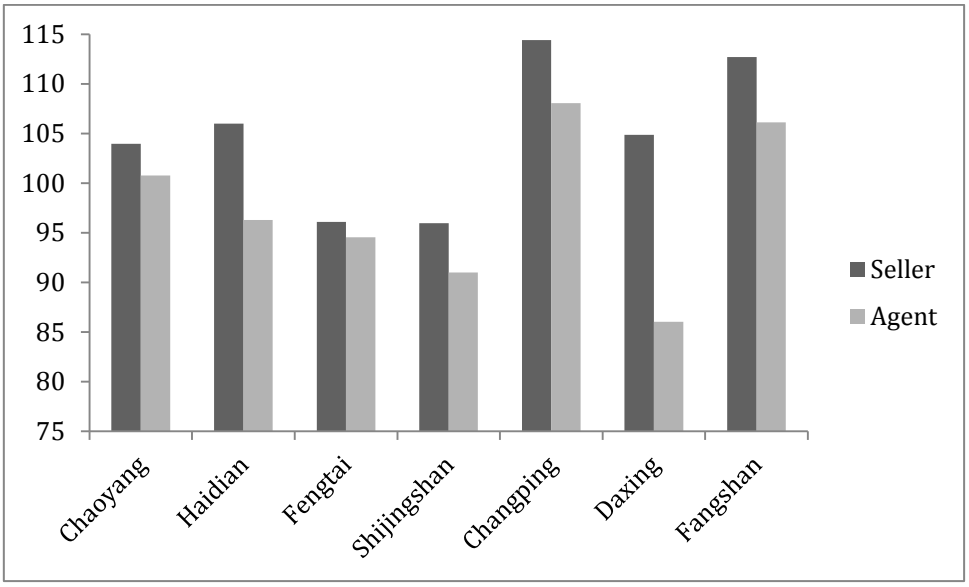


Figure 9. Sellers' WTA vs. AE (Scenario D)[12]

Subsequently, WTAs and AEs are stacked to form a column vector and are placed in a difference-in-differences model to check if the WTA–AE gap still exists when participants' characteristics and properties' hedonic characteristics are controlled. The gap is obtained by a dummy variable *PARTICIPANT,* which is equal to 1 for sellers and 0 if otherwise. Other control variables include participants' market expectations (i.e., *MKT*), participants' characteristics (i.e., *AGE, GENDER, EDU, OCCP,* and *HOLDING*), and properties' hedonic characteristics (i.e., *HAIDIAN, CHAOYANG, SCHOOL, FLOOR,* and *ORIENTATION*). *INCOME* and *IMPORTANCE* are excluded from the model specification because these two variables are irrelevant in the real estate agents' experiment.

After controlling for the participants' market expectations, participants' characteristics, and properties' hedonic characteristics, the coefficient estimation of *PARTICIPANT* is statistically significantly greater than 0 (see Model 1 in Table 11). Therefore, sellers' WTAs are significantly higher on average than real estate agents' evaluations. All coefficient estimations are based on White heteroskedasticity-consistent standard errors and covariance. The model passes the Ramsey RESET Test (F-stat = 1.019), thereby suggesting that the model does not suffer from omitted variable bias.

[11] To make sure that sellers' WTAs and agents' AEs are directly comparable at base line, standardizations of all WTAs and AEs are based on the market price.
[12] Shunyi has only one data point, thus, it is not included in the figure.

Table 11 Regression results (H4 and H5)

Variable	**Model 1** (WTA-AE gap)		**Model 2** (isolated WTA-AE gap)	
	Coefficient	**VIF**	**Coefficient**	**VIF**
C	97.112***	---	84.847***	---
PARTICIPANT	7.532***	3.627	11.405***	3.629
MKT	-10.232***	1.091	-6.599***	1.075
POLICY	-6.727***	1.592	-4.268***	1.411
AGE	-0.823	1.588	0.399	1.444
GENDER	-3.930**	1.127	-2.495*	1.162
EDU	-0.732	1.209	-4.483***	1.230
OCCP	6.464***	2.842	9.384***	3.019
HOLDING	-1.763	1.290	-1.089	1.343
HAIDIAN	-0.792	1.562	-0.755	1.764
CHAOYANG	0.375	1.470	2.539*	1.753
SCHOOL	4.125***	1.161	1.460	1.134
FLOOR	4.390**	1.155	4.764***	1.253
ORIENTATION	2.207	1.142	4.944***	1.133
Adj R^2	8.924%		8.771%	
F-statistic	5.666		5.578	

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

All VIF statistics is less than 5, which indicates that the correlation among all the included independent variables is low. No serious variance inflation and biasness issues exist in the model. The results support the first hypothesis in this study. The experiment design removes the effect of "sell-high, buy-low" tendency. Sellers and real estate agents assume the same role of selling properties and deriving profits from successful transactions; therefore they share an identical position in the trade. The only difference between sellers and agents is that the former has physical ownership of the properties whereas the latter does not. Physical ownership promotes the emotional attachment to belongings and induces a sense of endowment. The existence of both WTA–WTP gap and WTA–AE gap confirms that the endowment effect experiment and the results of Kahneman et al. (1990) can be replicated in the housing market.

The preceding model specification is repeated, and the dependent variable is replaced with sellers' WTAs and AEs obtained from Scenario E to facilitate the testing of Hypothesis 5. These evaluations are formulated after excluding the effect of information asymmetry. The significant and positive loading of the coefficient estimation of *PARTICIPANT* in Model 2 in Table 11 indicates that an isolated WTA–AE gap exists in this particular market. Sellers' WTAs are significantly higher than real estate agents' evaluations on average by RMB 114,050. The coefficient estimation of *PARTICIPANT* in Model 2 is higher than that in Model 1. The change in magnitude in this coefficient estimation implies that real estate agents discount the properties with undesirable characteristics (i.e., structural defects in this case) more than owners of these properties do.

By improving the experiment design of Kahneman et al. (1990), the results of a significant isolated WTA–AE gap further reduce the effect of information asymmetry, thereby confirming that the isolated endowment effect exists in the housing market. The findings confirm that even after

addressing information asymmetry, the endowment effect remains. The findings also suggest that investigating the endowment effect in the housing market should not only eliminate the "sell-high, buy-low" bias but also the information asymmetry effect. Consequently, the test of Hypothesis 6 is based on the isolated WTA–AE gap.

Table 12 Variable definitions (H6)[13]

Category	Variable	Definition
Market expectations	*MKTA*	= 1 if the agent has a down-market expectation; 0 if otherwise
Policy	*POLICY_A*	= 1 if the agent think his/her performance has been affected (both favorably and negatively) by the recently introduced policies; 0 if otherwise
Real estate agent's characteristics	*AGE_A*	= 1 if the agent is under 28 years old; 0 if otherwise
	EDU_A	= 1 if the agent has a bachelor's degree or above; 0 if otherwise
	GEDNER_A	= 1 if the agent is female; 0 if otherwise
	WORK_YEARS	Years that the participant has been working as a real estate agent.

5.2.5 Sellers' loss Aversion and Isolated WTA-AE Gap

Sellers and agents are paired up according to the property code to obtain the isolated WTA–AE gap of each individual property. The value of the isolated WTA–AE gap is considered the magnitude of the endowment effect in the housing market, which is used as the dependent variable in the following regression analysis. The independent variables include sellers' *LOSS_AVERSION,* participants' market expectations, policy (e.g., whether or not the newly introduced policies have affected participants' housing decisions/performance), properties' hedonic characteristics, seller's characteristics, and agents' characteristics (see variable definition in Table 12). Agents' occupation is not included in the agents' characteristics variables as all agents are in the same sector.

Four models are estimated to test Hypotheses 6. Model 1 in Table 13 is considered a base model in this section. The independent variables include only the basic driving forces (i.e., sellers' *LOSS_AVERSION*, participants' market expectations, and influence of policy) and properties' hedonic characteristics. As an improvement over Model 1, Models 2 to 4 control for seller's characteristics, real estate agents' characteristics, and both, respectively. A significant and positive loading of the coefficient estimation of *LOSS_AVERSION* can be observed in all models. Specifically, the magnitude of the endowment effect (i.e., isolated WTA–AE gap) increases by approximately RMB 90,000 RMB if the seller is loss averse. All models pass the VIF test. The results support the last hypothesis in this study, that is, sellers' loss aversion affects the gap between sellers' WTA and real estate agents' evaluation (i.e., the isolated endowment effect). This finding is consistent with those in previous studies claiming that loss aversion can be used to explain the

[13] The definition of sellers' loss aversion, sellers' market expectations, sellers' characteristics and properties' hedonic characteristics are the same as that in Tables 7-8, thus not included in this table.

Table 13 Regression results (H6)

Category	Variable	Model 1		Model 2		Model 3		Model 4	
		Coefficient	**VIF**	**Coefficient**	**VIF**	**Coefficient**	**VIF**	**Coefficient**	**VIF**
Constant	*C*	-8.278**	---	-9.915*	---	-9.246*	---	-12.702**	---
Loss aversion	*LOSS_AVERSION*	9.297***	1.381	8.700***	1.845	9.117***	1.451	8.612***	1.881
Market expectations	*MKTS*	-18.253***	1.920	-15.819***	2.581	-21.063***	1.769	-17.782***	2.273
	MKTA	1.740	1.171	1.119	1.154	2.413	1.261	1.657	1.203
Policy	*POLICY_S*	-2.635	1.269	-2.657	1.603	-2.978	1.298	-3.037	1.676
	POLICY_A	5.653*	1.504	5.659*	1.622	4.790	1.551	4.912	1.642
Hedonic characteristics	*HAIDIAN*	-0.940	1.704	-4.071	2.233	-0.998	1.830	-4.062	2.246
	CHAOYANG	-2.816	1.824	-5.729*	2.886	-4.006	1.874	-6.735**	2.838
	SCHOOL	-3.098	1.309	-3.340	1.608	-2.730	1.400	-2.987	1.669
	FLOOR	10.099***	1.175	11.443***	1.565	10.078***	1.237	11.453***	1.582
	ORIENTATION	4.419	1.287	4.400	1.476	4.461	1.296	4.501	1.455
Seller's characteristics	*AGE_S*			6.963*	1.631			6.979*	1.546
	GENDER_S			-4.188	2.021			-3.682	1.966
	EDU_S			-3.047	1.708			-2.499	1.880
	OCCP_S			5.565	2.189			5.879	2.350
	INCOME_S			3.210	1.622			3.303	1.588
	IMPORTANCE_S			3.332	2.535			4.232	2.373
	HOLDING			4.064*	1.585			4.089*	1.608
Real estate agent's characteristics	*AGE_A*					-1.341	1.420	-0.863	1.514
	EDU_A					3.257	1.121	2.729	1.239
	GEDNER_A					5.655***	1.149	5.993***	1.210
	WORK_YEARS					0.047	1.410	0.059	1.422
Adj-R^2		11.651%		12.629%		13.250%		14.144%	
F-statistic		5.075		3.627		4.371		3.424	

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

endowment effect (e.g., Ericson & Fuster, 2014; Georgantzis & Navarro-Martnez, 2010). However, the current study obtains the relationship between the isolated endowment effect and sellers' loss aversion by utilizing the field experiment evidence in the housing market.

Besides, the endowment effect is small for the homeowners in *CHAOYANG*, and the effect is large for the properties on the lower floor. Sellers' age and properties' holding period also interact with the endowment effect. Real estate agents' age, educational level, and work experience do not affect their evaluations. However, female real estate agents are likely to provide low evaluations.

To summarize, WTA-WTP disparity exists in the housing market. The gap is as large as RMB 63,010 per RMB 1 million. Information asymmetry effect can enlarge the gap by RMB 143,560 whereas the gap can be reduced by RMB 52,750 when private information is disclosed to home buyers. The WTA-AE gap is RMB 75,320 per RMB 1 million, which is greater than the benchmark WTA-WTP disparity. This is because there are keen buyers in certain administrative areas, resulting in higher WTP overall. Everything else being equal, the isolated endowment effect is RMB 114,050, which is larger than the WTA-AE gap. This is because real estate agents discount structural defects more than homeowners do. Sellers' loss aversion positive affect the endowment effect. The isolated endowment effect increases RMB 86,120 when sellers' loss aversion increases 1 unit.

Table 14 Hypotheses tested and results

Hypotheses	**Results** (per RMB 1 million)
H1: WTA-WTP disparity	The benchmark gap is RMB 63,010
H2: Information asymmetry	The effect of information asymmetry enlarges the gap by RMB 143,560
H3: Information disclosure	Information disclosure can reduce the gap by RMB 52,750
H4: WTA-AE gap	The WTA-AE gap is RMB 75,320
H5: Isolated endowment effect	The isolated endowment effect is RMB 114,050
H6: Sellers' loss aversion and Isolated endowment effect	The isolated endowment effect increases RMB 86,120 when sellers' loss aversion increases 1 unit

5.3 Discussions

5.3.1 Income Effect

All WTA-WTP disparities obtained in this study is independent of income effect. In the field experiment, a property is not assigned to the potential home buyer if its listing price is higher than the amount that he/she can afford. Consequently, this effect has been effectively ruled out by the design of the experiment. This conclusion is confirmed by the insignificant coefficient estimation of *AFFORDABILITY* (see Model 3 in Table 9 and Model 1 in Table 10 for details).

5.3.2 Administrative Districts and Policy Implications

Prior to this field experiment, the People's Bank of China lowered its bank interest rate, deposit reserve requirement, and down payment rate. The effect of government policies is also considered in this study. These policies affect home sellers and buyers in different ways (see Table 10 for details). The pattern is also inconsistent across all administrative districts. The inconsistency becomes prominent when the interaction terms between locational characteristics (i.e., *CHAOYANG, HAIDIAN*) and *POLICY_S/POLICY_B* are added to Model 1 in Table 10. Using *HAIDIAN* and *CHAOYANG* as examples, the WTA–WTP gap is significantly reduced in areas such as *HAIDIAN* when buyers' housing decisions are affected by these policies. However, properties become unattractive to home buyers in *CHAOYANG* as buyers who are affected by these policies display a substantial WTA–WTP gap in *CHAOYANG* (see Model 2 in Table 15). This pattern is consistent with the official statistics on transaction volume from February to June 2016. The percentage of transaction volume in *CHAOYANG* is significantly reduced, whereas the percentage increases in *HAIDIAN* (see Figure 10).

Table 15. Regression results (Administrative districts and policy implications)[14]

Variable	Model 1	Model 2	Model 3	Model 4
POLICY_S HAIDIAN*	3.600		5.663	
POLICY_B HAIDIAN*	-8.418***		-6.030*	
POLICY_S CHAOYANG*		-1.696		-1.494
POLICY_B CHAOYANG*		5.028**		4.437*
*SCHOOL*HAIDIAN*			16.555***	
*SCHOOL*CHAOYANG*				-5.681*
Adj R^2	19.888%	19.487%	21.948%	19.780%

[14] Other independent variables are omitted from the Table.

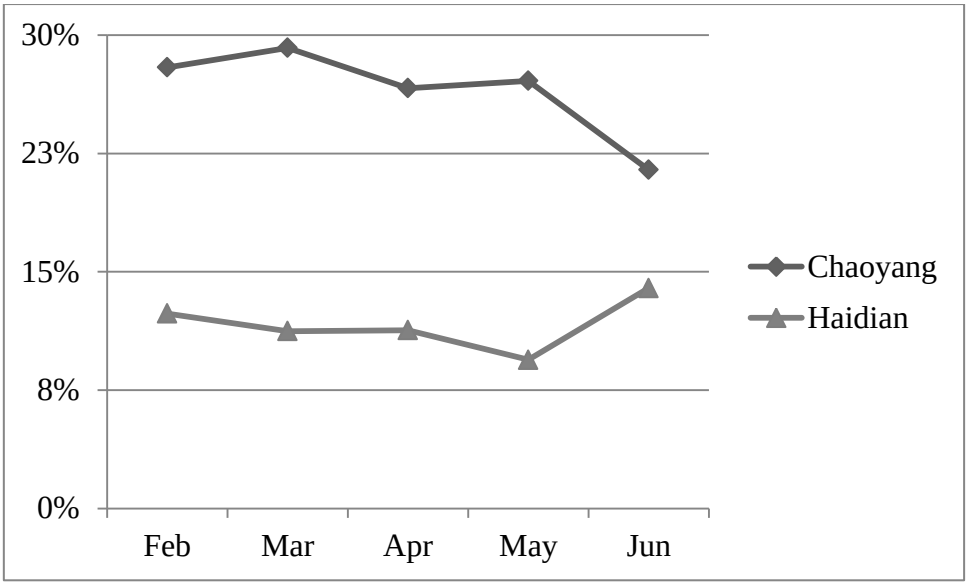


Figure 10. Percentage of transaction volume from February to June 2016[15]

Adding to the complexity of the scenario, differences across administrative districts can also be observed when focusing on the properties in the school catchment area (see Model 3 and 4 in Table 15). *HAIDIAN* exhibits a significant increase in the WTA–WTP gap in its school catchment area, whereas *CHAOYANG* presents a reduction in the gap. This topic is beyond the scope of this study, but it sheds light on potential research on school quality, housing decisions and housing policies. Further studies are necessary to compare the decision bias of sellers in administrative districts with and without high quality schools. Housing policies can then be specifically designed and introduced for administrative districts with high school quality.

5.3.3 Robustness Checks for Loss Aversion

Model 4 in Table 13 is re-estimated using two alternative definitions of loss aversion to further confirm the effect of sellers' loss aversion on the isolated endowment effect. The results are provided in Table 16.

First, *LOSS_AVERSION* is replaced by *LOSS*, which is a continuous variable instead of a dummy variable (see the column which is labeled as 'Model-Loss' in Table 16). In Seller-Scenario F in the sellers' experiment, equal-sized loss and gain are assigned to sellers to create hypothetical loss–gain domains. Specifically, assuming that the utility of an individual will increase by 2 units (e.g., degree of satisfaction increases from 5 to 7) for a RMB 200,000 gain, the participants are asked about how they will value their degree of satisfaction if confronted with an equal-sized loss (i.e., RMB 200,000). The L–G ratio is used to define *LOSS*. Suppose that sellers' response to Seller-Scenario F is *X*, then *LOSS* is defined as $LOSS = (5 - X)/(7 - 5)$.

[15] The data of transaction volume is provided by China Index Academy.

Table 16 Loss, risk preferences, and loss aversion

Category	Variable	Model-Loss		Model-Risk preferences		Model-Loss aversion	
		Coefficient	**VIF**	**Coefficient**	**VIF**	**Coefficient**	**VIF**
Constant	*C*	-16.819**	---	-16.615**	---	-12.702**	---
Risk/Loss aversion	*LOSS*	6.431***	1.881				
	RISK_AVERSION			6.897*	1.971		
	LOSS_AVERSION					8.612***	1.881
Market expectations	*MKTS*	-18.438***	2.214	-12.743**	1.747	-17.782***	2.273
	MKTA	2.841	1.203	4.482	1.193	1.657	1.203
Policy	*POLICY_S*	-2.786	1.674	-1.568	1.653	-3.037	1.676
	POLICY_A	5.421*	1.564	5.625*	1.449	4.912	1.642
Hedonic characteristics	*HAIDIAN*	-4.003	2.179	-4.447	2.007	-4.062	2.246
	CHAOYANG	-6.792**	2.672	-6.809**	2.778	-6.735**	2.838
	SCHOOL	-3.462	1.727	-3.038	1.818	-2.987	1.669
	FLOOR	11.036***	1.574	8.532***	1.502	11.453***	1.582
	ORIENTATION	5.699*	1.470	8.178***	1.574	4.501	1.455
Seller's characteristics	*AGE_S*	6.440	1.524	8.391**	1.474	6.979*	1.546
	GENDER_S	-3.576	1.940	-3.580	2.063	-3.682	1.966
	EDU_S	-3.344	1.914	-4.999	2.049	-2.499	1.880
	OCCP_S	5.380	2.366	7.146	2.278	5.879	2.350
	INCOME_S	3.740	1.621	8.724***	2.133	3.303	1.588
	IMPORTANCE_S	3.195	2.230	2.249	2.129	4.232	2.373
	HOLDING	4.471*	1.531	4.230*	1.500	4.089*	1.608
Real estate agent's characteristics	*AGE_A*	-0.990	1.514	-1.151	1.492	-0.863	1.514
	EDU_A	2.442	1.244	2.579	1.253	2.729	1.239
	GEDNER_A	6.112***	1.211	6.063***	1.176	5.993***	1.210
	WORK_YEARS	0.069	1.420	0.329	1.357	0.059	1.422
Adj-R^2		12.957%		11.352%		14.144%	
F-statistic		3.190		2.884		3.424	

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

Second, *LOSS_AVERSION* is replaced by *RISK_AVERSION* (see the column which is labeled as 'Model-Risk preferences' in Table 16). Previous experimental studies acquire sellers' loss aversion by obtaining their risk preferences. For example, Georgantzis & Navarro-Martnez (2010) consider that risk-averse individuals are prone to uncertainty, which leads to loss-averse, thereby indicating that the degrees of sellers' loss aversion and risk aversion are positively related. The direction of the effect caused by their loss aversion and risk aversion should be identical. Therefore, the results obtained from the question on risk preferences in the experiment are used to define *RISK_AVERSION*.

Both *LOSS* and *RISK_AVERSION* positively contribute to the endowment effect. The explanation power of *LOSS_AVERSION* is stronger than that of *LOSS* and *RISK_AVERSION* (i.e., the adjusted R square in Model-Loss and Model-Risk preferences are lower than that in Model-Loss aversion). Although the numbers of significant coefficients are not strictly identical in the three models in Table 16, all significant coefficient estimates are directionally consistent. In sum, both alternative definitions of sellers' loss aversion support Hypothesis 6.

5.3.4 Agents' Evaluation and Buyers' WTP

In the experiment of Casey (1995), the evaluations of the third group (i.e., choosers) are insignificantly lower than sellers' WTAs but significantly higher than buyers' WTPs. As a result, Casey argues that the substantial WTA–WTP gap is not caused by the endowment effect but by buyers' decision bias such as "buy-low" tendency or reluctance to buy. Following their analysis and discussions, agents' AE and buyers' WTPs are compared and analyzed in this section to further validate the experiment design of introducing real estate agents' evaluations.

Figure 11 shows the average of AE from Agent-Scenario E and buyers' WTPs from Buyer-Scenario E and F in each administrative district. In most of the administrative districts, AE is generally higher than buyers' WTPs when buyers know little private information. After private information is disclosed to home buyers, the difference between AE and buyers' WTPs is significantly reduced (t-stat = 1.896), but the difference remains. The data indicate that home buyers in the secondary housing market in Beijing exhibit a certain degree of "buy-low" strategy or reluctance to buy, which is very common among Chinese buyers who loves bargaining and usually preserve multiple rounds of negotiation. This result tests the validity of introducing real estate agents' evaluations in the field experiment. Subsequently, regression analysis is conducted to investigate the factors causing buyers' decision bias.

As both the Agent–seller ratio and Buyer–seller ratio are greater than 1, merging agents' data with buyers' data does not make sense (e.g., Suppose that one property has four evaluations from agents and five WTPs from buyers. The sample size for this particular property will be artificially increased to 20 if agents and buyers are directly paired up, thereby contaminating the coefficient estimations). Therefore, the average of all AEs in each property is calculated and used as a property's fair evaluation, thus leading to the merging with agents' data according to the property code.

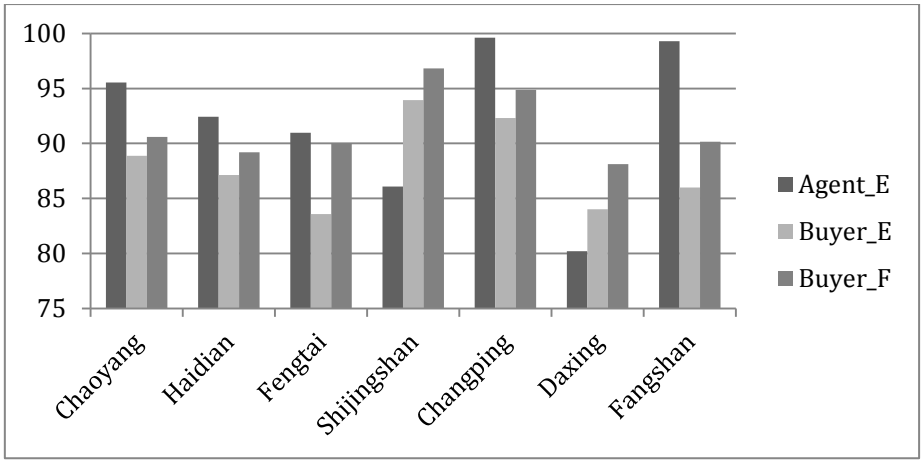


Figure 11. Agents' evaluations vs. buyers' WTPs

The dependent variable used in the following regression analysis is the difference between properties' fair evaluation (from Agent-Scenario E) and buyers' WTP (from Buyer-Scenario F). This difference quantifies buyers' decision bias and disregards information asymmetry. The larger the difference is, the more that the buyer tends to buy low. The independent variables include buyers' market expectations, buyers' characteristics, and properties' hedonic characteristics, among others. As all buyer-related variables have been defined (see Table 7 for details), variable definitions are no longer included here. Agents' characteristics are not included in the model specifications because properties' fair valuation is a "collective decision" by multiple agents. The regression results are provided in Table 17. All coefficient estimations are based on White heteroskedasticity-consistent standard errors and covariance.

Two models are estimated to investigate the factors that cause buyers' decision bias. Model 1 includes buyers' market expectations, buyers' characteristics, and properties' hedonic characteristics. Buyers' market expectations, *AFFORDABILITY,* and three out of six hedonic characteristics contribute to buyers' decision bias. The model is re-estimated by adding buyers' risk preferences, which are similarly defined as those of sellers' risk preference. The inclusion of buyers' risk preferences does not change the significance level and direction of the coefficient estimation of the significant variables, but the adjusted R square slightly increases (see Model 2 in Table 17).

All significant variables are directionally consistent with the ex-ante expectations. Specifically, risk-averse buyers are likely to suffer from decision bias and employ the "buy-low" strategy. The buyers also tend to buy low when having down-market expectations. The negative loading of *AFFORDABILITY* suggests that the more those buyers can afford the lesser that they tend to buy low. Buyers are cautious when buying properties in *HAIDIAN* and *CHAOYANG,* but they are likely to buy properties located on the lower floor or properties facing south.

Table 17 Difference between agents' AE and buyers' WTP

Category	Variable	Model 1		Model 2	
		Coefficient	**VIF**	**Coefficient**	**VIF**
Constant	*C*	6.481	---	2.667	---
Market expectations	*MKTB*	11.676**	1.203	11.696**	1.181
Policy	*POLICY_B*	1.900	1.299	1.481	1.317
Buyer's characteristics	*AGE_B*	5.033	1.102	4.571	1.117
	GENDER_B	1.631	1.109	1.569	1.103
	EDU_B	-3.192	1.252	-3.125	1.257
	OCCP_B	2.520	1.124	2.604	1.125
	AFFORDABILITY	-0.011**	1.262	-0.010**	1.249
	IMPORTANCE_B	0.752	1.186	1.178	1.189
Hedonic characteristics	*HAIDIAN*	5.182**	1.508	5.015**	1.478
	CHAOYANG	4.632*	2.078	4.868**	2.074
	SCHOOL	2.944	1.441	3.187	1.454
	FLOOR	-3.656	1.103	-3.798*	1.101
	ORIENTATION	-5.555**	1.257	-5.759***	1.272
Risk preferences	*RISK_AVERSION_B*			5.115**	1.132
Adj-R^2		5.058%		5.777%	
F-statistic		2.512		2.616	

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

6. Conclusions

The disparity between sellers' WTA and buyers' WTP is considered a violation of the SET and its predictions. This disparity has attracted much attention from academics and the industry for decades as people attempt to understand the driving forces behind the disparity and the interaction of such disparity with transaction volume and market liquidity of traded goods. However, most of the existing studies investigate the WTA–WTP disparity using instruments such as ordinary private goods and lottery. Real estate-related instruments are considerably overlooked in previous literatures. This paper identifies the existence of the WTA–WTP disparity in the housing market and investigates the driving forces behind this disparity by providing field experiment evidence from Beijing, China, to bridge the research gap.

Firstly, the relationship between information asymmetry/ information disclosure and the WTA–WTP disparity in housing transactions is established. By conducting a field experiment on the secondary housing market of Beijing, this study confirms that the difference between sellers' WTA and buyers' WTP is significantly greater than zero in the housing market. Information asymmetry contributes to the discrepancy between WTA and WTP. Home buyers face uncertainty and ambiguity with regard to property conditions because they are usually minimally informed. Consequently, buyers may apply for a large discount to future cash flows to compensate for any uncertainty and risk, thus widening the WTA–WTP gap in the housing market. This phenomenon corroborates the uncertainty hypothesis in previous studies, in which ambiguity increases the WTA–WTP disparity (Casey, 1995; Shefrin & Caldwell, 2001). Information disclosure effectively reduces uncertainty through the elimination of information asymmetry. This elimination ultimately leads to a reduction in the WTA–WTP gap, thereby encouraging people to close deals.

Secondly, by conducting a field experiment that involves real estate agents in the secondary housing market of Beijing as a third-party group, this paper finds that the difference between sellers' WTA and AE is significantly greater than zero in the housing market. The results confirm that the endowment effect exists independent of the "sell-high, buy-low" bias and information asymmetry. The results suggest that even after reducing information asymmetry, the isolated endowment effect remains in the housing market. The relationship between the isolated endowment effect and sellers' loss aversion is then established. The relationship can be confirmed by both theoretical model and empirical evidence. Sellers and real estate agents in this experiment share the same position in trade in terms of the agreed price of transaction (i.e. earning profit from transactions if price is higher). The only difference between sellers and agents is that the former group has physical ownership of the properties whereas the latter does not. Physical ownership promotes emotional attachment to belongings and induces a sense of endowment. Parting with endowments and entitlements induces loss aversion, thus leading to a high WTA. In sum, both the endowment effect and information asymmetry contribute to such disparity. The information asymmetry effect can be reduced by introducing information disclosure laws. However, completely eliminating the endowment effect without understanding the psychological or emotional driving force behind it is difficult. This open question sheds light on the future research on extending this study.

This paper contributes to the academic community by bridging the research gap and investigating the WTA–WTP disparity in the housing market and show that the housing market indeed exhibits WTA–WTP disparity. This study also conducts the first set of experiments that elicit real market participants' WTA or WTP values in the housing market. These experiments are also the first ones to have incorporated information asymmetry materials in the elicitation process of the WTA–WTP gap. Real properties in the market are used as the stimuli in the experiments, which remove the hypothetical ownership bias for the first time. Similar experiments can be conducted with institutional real estate investors; the study should be replicable to the rental market. The research enhances the understanding of housing consumers' decision making process before and during transactions and offers an answer to how home buyers and sellers can be motivated to close deals quickly. All market participants can benefit from this study. In particular, home owners should be conscious of the presence of their endowment effect and strive to minimize their decision bias if they want to seal the deal quickly without having to unfairly compromise on the price. The study can help home buyers to identify willing sellers and make better decisions. The sales performance of real estate agents can be promoted if they can successfully identify the willing sellers and buyers with minimum decision bias. More importantly, this research will eventually facilitate an effective housing policy-making process. For the policy makers designing housing regulations, housing consumers' psychology should be taken into consideration to minimize their decision bias. "Behavioural nudge" can also be incorporated in policies to improve market efficiency. Enacting legislations such as seller information disclosure or similar laws can enhance market fairness by protecting homebuyers' right and reducing the uncertainty regarding the condition of the properties on sale. By providing a good understanding of the WTA-WTP disparity in the housing market, this research also offers the knowledge of the driving force behind real estate market trends (e.g., market liquidity, transaction volume, market efficiency, etc.).

References

Bao, H. X. H., & Gong, C. M. (2016). Endowment Effect and Housing Decisions. *International Journal of Strategic Property Management*, *20*(4), 341–353. http://doi.org/10.3846/1648715X.2016.1192069

Bateman, I. J., Day, B. H., Jones, A. P., & Jude, S. (2009). Reducing gain–loss asymmetry: A virtual reality choice experiment valuing land use change. *Journal of Environmental Economics and Management*, *58*(1), 106–118. http://doi.org/10.1016/j.jeem.2008.05.003

Baucells, M., Weber, M., & Welfens, F. (2011). Reference-Point Formation and Updating. *Management Science*, *57*(3), 506–519. http://doi.org/10.1287/mnsc.1100.1286

Bishop, R., Heberlein, T., & Kealy, M. (1983). Contigent Valuation of Environmental Assets: Comparison with a Simulated Market. *Natural Resources Journal*, *23*(1975), 619–633. Retrieved from http://lawschool.unm.edu/nrj/volumes/23/3/08_bishop_contingent.pdf

Brown, A. L., & Cohen, G. (2015). Does anonymity affect the willingness to accept and willingness to pay gap? A generalization of Plott and Zeiler. *Experimental Economics*, 1–12. http://doi.org/10.1007/s10683-014-9394-z

Brown, T. C. (2005). Loss aversion without the endowment effect, and other explanations for the WTA–WTP disparity. *Journal of Economic Behavior & Organization*, *57*(3), 367–379. http://doi.org/10.1016/j.jebo.2003.10.010

Casey, J. T. (1995). Predicting Buyer-Seller Pricing Disparities. *Management Science*, *41*(6), 979–999. http://doi.org/10.1287/mnsc.41.6.979

Casler, K., Bickel, L., & Hackett, E. (2013). Separate but equal? A comparison of participants and data gathered via Amazon's MTurk, social media, and face-to-face behavioral testing. *Computers in Human Behavior*, *29*(6), 2156–2160. http://doi.org/10.1016/j.chb.2013.05.009

Chapman, G. B., & Johnson, E. J. (1995). Preference Reversals in Monetary and Life Expectancy Evaluations. *Organizational Behavior and Human Decision Processes*, *62*(3), 300–317.

Chordia, T., Roll, R., & Subrahmanyam, A. (2008). Liquidity and market efficiency. *Journal of Financial Economics*, *87*(2), 249–268. http://doi.org/10.1016/j.jfineco.2007.03.005

Christensen, G., Steinmetz, A., Alcorn, B., Bennett, A., Woods, D., & Emanuel, E. J. (2013). The MOOC Phenomenon : Who Takes Massive Open Online Courses and Why ? *University of Pennsylvania, Nd Web*, *6*, 1–14. http://doi.org/10.2139/ssrn.2350964

Chung, D., & Hrazdil, K. (2010). Liquidity and market efficiency: A large sample study. *Journal of Banking and Finance*, *34*(10), 2346–2357. http://doi.org/10.1016/j.jbankfin.2010.02.021

Dommer, S. L., & Swaminathan, V. (2012). Explaining the Endowment Effect through Ownership: The Role of Identity, Gender, and Self-Threat. *Journal of Consumer Research*, *39*(5), 1034–1050. http://doi.org/10.1086/666737

Dupont, D. Y., & Lee, G. S. (2002). The Endowment Effect , Status Quo Bias and Loss Aversion : Rational Alternative Explanation ∗ . *The Journal of Risk and Uncertainty*, *25*(1), 87–101.

Eisenberger, R., & Weber, M. (1995). Willingness-to-pay and willingness-to-accept for risky and ambiguous lotteries. *Journal of Risk and Uncertainty*, *10*(3), 223–233. http://doi.org/10.1007/BF01207552

Ericson, K. M. M., & Fuster, A. (2014). The Endowment Effect. *Annual Review of Economics*, *6*(1), 555–579. http://doi.org/10.1146/annurev-economics-080213-041320

Eriksson, K., & Simpson, B. (2010). Emotional reactions to losing explain gender differences in entering a risky lottery. *Judgment and Decision Making*, *5*(3), 159–163. Retrieved from http://sjdm.cybermango.org/10/10601/jdm10601.pdf

Fisher, J., Gatzlaff, D., & Geltner, D. (2003). Controlling for the Impact of Variable Liquidity in Commercial Real Estate Price Indices. *Real Estate Economics, 31(1).*

Fiva, J. H., & Kirkebøen, L. J. (2011). Information shocks and the dynamics of the housing market. *Scandinavian Journal of Economics*, *113*(3), 525–552. http://doi.org/10.1111/j.1467-9442.2011.01651.x

Floyd, E., & List, J. A. (2016). *Using Field Experiments in Accounting and Finance*.

Garbacz, C., & Thayer, M. A. (1983). An experiment in valuing senior companion program services*. *The Journal of Human Resources*, *XVIII*(1), 147–153.

Genesove, D., & Mayer, C. (2001). Loss Aversion and Seller Behavior: Evidence from the Housing Market. *The Quarterly Journal of Economics*, (November), 1233–1260.

Georgantzis, N., & Navarro-Martnez, D. (2010). Understanding the WTA-WTP gap: Attitudes, feelings, uncertainty and personality. *Journal of Economic Psychology*, *31*(6), 895–907. http://doi.org/10.1016/j.joep.2010.07.004

Gerking S., M. de Haan, & W. Schulze. (1988). The Marginal Value of Job Safety: A Contingent Valuation Study. *Journal of Risk and Uncertainty*, *1*(2), 185–199.

Glosten, L. R., & Milgrom, P. R. (1985). Bid, ask and transaction prices in a specialist market with heterogeneously informed traders. *Journal of Financial Economics*, *14*(1), 71–100. http://doi.org/10.1016/0304-405X(85)90044-3

Hanaoka, C., Shigeoka, H., & Watanabe, Y. (2014). Do Risk Preferences Change ? Evidence from Panel Data Before and After the Great East Japan Earthquake, *2014*, 1–62.

Harinck, F., van Beest, I., van Dijk, E., & van Zeeland, M. (2012). Measurement-induced focusing and the magnitude of loss aversion : The difference between comparing gains to losses and losses to gains. *Judgment and Decision Making*, *7*(4), 462–471.

Hart, S. (2005). An Interview with Robert Aumann. *Macroeconomic Dynamics*, *9*, 683–740. http://doi.org/10.1353/atj.2013.0044

He, Z., & Asami, Y. (2014). How Do Landowners Price their Lands during Land Expropriation and the Motives Behind It: An Explanation from a WTA/WTP Experiment in Central Beijing. *Urban Studies*, *51*(2), 412–427. http://doi.org/10.1177/0042098013492227

Higgs, J. E., Andrews, J., Gurwitz, D., Payne, K., & Newman, W. (2008). Pharmacogenetics education in British medical schools. *Genomic Medicine*, *2*(3-4), 101–105. http://doi.org/10.1007/s11568-009-9032-6

Horowitz, J. K., & Mcconnell, K. E. (2002). A Review of WTA / WTP Studies. *Journal of Environmental Economics and Management*, *44*(3), 426–447. http://doi.org/10.1006/jeem.2001.1215

Irmak, C., Wakslak, C. J., & Trope, Y. (2013). Selling the forest, buying the trees: The effect of construal level on seller-buyer price discrepancy. *Journal of Consumer Research*, *40*(2), 284–297. http://doi.org/10.1086/670020

Joinson, A. N., Woodley, A., & Reips, U. D. (2007). Personalization, authentication and self-disclosure in self-administered Internet surveys. *Computers in Human Behavior*, *23*(1), 275–285. http://doi.org/10.1016/j.chb.2004.10.012

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1990). Experimental Tests of the Endowment Effect and the Coase Theorem. *Journal of Political Economy*, *98*(6), 1325–1348.

Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, *47*(2), 263–292.

Kermer, D. A., Driver-Linn, E., Wilson, T. D., & Gilbert, D. T. (2006). Loss aversion is an affective forecasting error. *Psychological Science*, *17*(8), 649–653. http://doi.org/10.1111/j.1467-9280.2006.01760.x

Keuschnigg, M., Bader, F., & Bracher, J. (2016). Using crowdsourced online experiments to study context-dependency of behavior. *Social Science Research*, 1–15. http://doi.org/10.1016/j.ssresearch.2016.04.014

Kleber, J., Dickert, S., & Betsch, T. (2013). The influence of differential focus on the endowment effect in risky objects. *Swiss Journal of Psychology*, *72*(3), 159–164. http://doi.org/10.1024/1421-0185/a000109

Koszegi, B., & Rabin, M. (2006). A Model of Reference-Dependent Preferences. *The Quarterly Journal of Economics*, *CXXI*(4), 1133–1165.

Kurlat, P., & Stroebel, J. (2015). Testing for Information Asymmetries in Real Estate Markets. *Review of Financial Studies*, *28*(8), 2429–2461. http://doi.org/10.1093/rfs/hhv028

Levitt, S. D., & List, J. a. (2008). Homo economicus evolves. *Science*, *319*, 909–910. http://doi.org/10.1126/science.1153640

Lin, C.-H., & Lin, H.-M. (2006). Role of social value orientation in the endowment effect. *Asian Journal Of Social Psychology*, *9*(3), 210–215. http://doi.org/10.1111/j.1467-839X.2006.00199.x

List, J. A. (2003). Does market experience eliminate market anomalies? *The Quarterly Journal of Economics*, (February), 41–71.

List, J. A. (2004). Neoclassical Theory versus Prospect Theory : Evidence from the Marketplace. *Econometrica*, *72*(2), 615–625.

Loomis, J., Peterson, G., Champ, P., Brown, T., & Lucero, B. (1998). Paired comparison estimates of willingness to accept versus contingent valuation estimates of willingness to pay. *Journal of Economic Behavior & Organization*, *35*(4), 501–515. http://doi.org/10.1016/S0167-2681(98)00050-X

Maddux, W. W., Yang, H., Falk, C., Adam, H., Adair, W., Endo, Y., … Heine, S. J. (2010). For whom is parting with possessions more painful? Cultural differences in the endowment effect. *Psychological Science : A Journal of the American Psychological Society / APS*, *21*(12), 1910–1917. http://doi.org/10.1177/0956797610388818

Masatlioglu, Y., & Ok, E. A. (2013). A canonical model of choice with initial endowments. *Review of Economic Studies*, *81*(2), 851–883. http://doi.org/10.1093/restud/rdt037

Mason, W., & Watts, D. J. (2009). Financial incentives and the performance of crowds. *Proceedings of the ACM SIGKDD Workshop on Human Computation*, *11*(2), 77–85. http://doi.org/10.1145/1809400.1809422

Morewedge, C. K., & Giblin, C. E. (2015). Explanations of the endowment effect: an integrative review. *Trends in Cognitive Sciences*, *19*(6), 339–348. http://doi.org/10.1016/j.tics.2015.04.004

Morrison, G. C. (1997). Willingness to Pay and Willingness to Accept: Some Evidence of an Endowment Effect. *Applied Economics*, *29*(4), 411–417. http://doi.org/10.1080/000368497326903

Nanda, A., & Ross, S. L. (2012). The Impact of Property Condition Disclosure Laws on Housing Prices: Evidence from an Event Study Using Propensity Scores. *Journal of Real Estate Finance and Economics*, *45*(1), 88–109. http://doi.org/10.1007/s11146-009-9206-y

Oppenheimer, D. M., Meyvis, T., & Davidenko, N. (2009). Instructional manipulation checks: Detecting satisficing to increase statistical power. *Journal of Experimental Social Psychology*, *45*(4), 867–872. http://doi.org/10.1016/j.jesp.2009.03.009

Ortona, G., & Scacciati, F. (1992). New experiments on the endowment effect. *Journal of Economic Psychology*, *13*(2), 277–296. http://doi.org/10.1016/0167-4870(92)90034-5

Paraschiv, C., & Chenavaz, R. (2011). Sellers' and Buyers' Reference Point Dynamics in the Housing Market. *Housing Studies*, *26*(3), 329–352. Retrieved from http://web.a.ebscohost.com/ehost/pdfviewer/pdfviewer?sid=445aedf8-d150-4e0b-8eff-d1ee34cad9ac%40sessionmgr4004&vid=2&hid=4114

Peters, E., Slovic, P., & Gregory, R. (2003). The Role of Affect in the WTA / WTP Disparity. *Journal of Behavioral Decision Making*, *330*(July), 309–330. http://doi.org/10.1002/bdm.448

Plott, C., & Zeiler, K. (2005). The Willingness to Pay-Willingness to Accept Gap , the " Endowment

Effect ," Subject Misconceptions , and Procedures for Eliciting Valuations. *American Economic Review*, *95*(3), 530–545.
Plott, C., & Zeiler, K. (2007). Exchange Asymmetries Incorrectly Interpreted Evidence of Endowment Effect and Prospect Theory Theory ? *American Economic Review*, *97*(4), 1449–1466.
Pope, B. D. G., & Schweitzer, M. E. (2011). Is Tiger Woods Loss Averse ? Persistent Bias in the Face of Experience , Competition , and High Stakes. *American Economic Review*, *101*(February), 129–157.
Pope, J. C. (2008a). Buyer information and the hedonic: The impact of a seller disclosure on the implicit price for airport noise. *Journal of Urban Economics*, *63*(2), 498–516. http://doi.org/10.1016/j.jue.2007.03.003
Pope, J. C. (2008b). Do Seller Disclosures Affect Property Values ? Buyer Information and the Hedonic Model. *Land Economics*, *84*(4), 551–572.
Sayman, S., & Öncüler, A. (2005). Effects of study design characteristics on the WTA-WTP disparity: A meta analytical framework. *Journal of Economic Psychology*, *26*(2), 289–312. http://doi.org/10.1016/j.joep.2004.07.002
Schmidt, U., & Traub, S. (2002). An Experimental Test of Loss Aversion. *Journal of Risk and Uncertainty*, *25*(3), 233–249. http://doi.org/10.1023/A:1020923921649
Shefrin, H., & Caldwell, D. (2001). Determinants of the magnitude of willingness to accept relative to willingness to pay. *Journal of Behavioral Decision Making*, *14*(2), 87–105. http://doi.org/10.1002/bdm.367
Shu, S. B., & Peck, J. (2011). Psychological ownership and affective reaction: Emotional attachment process variables and the endowment effect. *Journal of Consumer Psychology*, *21*(4), 439–452. http://doi.org/10.1016/j.jcps.2011.01.002
Suri, S., & Watts, D. J. (2011). Cooperation and contagion in web-based, networked public goods experiments. *PLoS ONE*, *6*(3). http://doi.org/10.1371/journal.pone.0016836
Thaler, R. H. (1980). Toward a Positive Theory of Consumer Choice. *Journal of Economic Behavior & Organization*, *1*, 39–60.
Thaler, R. H. (2016). *Behavioral Economics: Past, Present and Future*.
Thaler, R. H., Tversky, A., Kahneman, D., & Schwartz, A. (1997). The effect of myopia and loss aversion on risk taking:an experiment test.pdf. *The Quarterly Journal of Economics*, *May*, 647–661.
Tunçel, T., & Hammitt, J. K. (2014). A new meta-analysis on the WTP/WTA disparity. *Journal of Environmental Economics and Management*, *68*(1), 175–187. http://doi.org/10.1016/j.jeem.2014.06.001
Willig, R. D. (1976). Consumer's surplus without apology. *The American Economic Review*, *66*(4), 589–597. http://doi.org/10.2307/1806699
Wong, S. K., Yiu, C. Y., & Chau, K. W. (2012). Liquidity and Information Asymmetry in the Real Estate Market. *The Journal of Real Estate Finance and Economics*, *45*, 49–62. http://doi.org/10.1007/s11146-011-9326-z
Zhang, Y., Zhang, H., & Seiler, M. J. (2015). Impact of Information Disclosure on Prices, Volume, and Market Volatility: An Experimental Approach. *Journal of Behavioral Finance*, *16*(1), 12–19. http://doi.org/10.1080/15427560.2015.1000333

Appendix:

Materials and scenarios in Stage one (sellers' experiment)

First, the participants are informed of the following: "The instrument used in this experiment is the property that you want to sell; therefore, you will act as a home seller." Thereafter, the scenarios are provided.

Initially, home sellers are provided with current market information (see Seller-Scenario A), which is presented as the average price and price range of properties in the same neighborhood with a similar unit type.

> *Seller: Q16. (Scenario A): Assume that you are aware that the current market price of a property in the same neighborhood with a similar unit type ranges from (Min) to (Max) and the average price is (Avg). What is the minimum price that you can accept for your property?*

The provided average price and price range of a property are based on the Big Data of the secondary housing market in Beijing and are linked to the official statistics collected by China Index Academy. For example, if the property owned by a participant is located at Olympia Park (a neighborhood) in Chaoyang (an administrative district in Beijing) with a lot size of 120 square meters, then the scenario that he/she will receive is as follows: "*Assume that you are aware that the current market price of a property in the same neighborhood with a similar unit type ranges from RMB 6.6 million to RMB 10.7 million and that the average price is RMB 8.3 million. What is the minimum price that you can accept for your property?"*[16]

Second, historical information on the prices two and four years ago is provided in the second and third scenarios, respectively. The objective of the first three scenarios is to establish an existing up-market condition using current market information and historical information. A similar design of the questionnaire and the scenarios is found in Baucells, Weber, & Welfens (2011) and Paraschiv & Chenavaz (2011). The increasing rates (i.e., 15% in Seller-Scenario B and 85% in Seller-Scenario C) of property prices are provided on the basis of the average increase rate in Beijing's housing market in the past two and four years, respectively. The underscored prices (e.g., RMB 7.2 million in Seller-Scenario B and RMB 4.5 million in Seller-Scenario C) are calculated by Chinese Index Academy on the basis of the current average price and the corresponding increase rate.

> *Seller: Q17. (Scenario B): Assume that you are aware that compared with the price two years ago, the current market price has increased by 15% (the price two years ago was RMB 7.2 million). What is the minimum price that you can accept for your property?*
>
> *Seller: Q18. (Scenario C): Assume that you are aware that compared with the price four years ago, the current market price has increased by 85% (the price four years ago was RMB 4.5 million). What is the minimum price that you can accept for your property?*

Third, the participants are provided with an expectation-based up-/stable/down-market scenario. The design of the following question and the scenario is consistent with the idea of the reference-dependence preference model proposed by Koszegi and Rabin (2006), in which the reference points are affected by recent expectations of future outcomes. Therefore, reference points can be

[16] The prices provided are based on the sample property owned by the participant.

determined by the expected future outcomes or predictions. Similar conclusions are found in Morewedge & Giblin (2015). Therefore, the participants are asked about their expectations on the property market in Beijing. Afterward, an up-/stable/down-market condition is assigned to them based on their response to the following question:

Seller: Q19. What is your expectation about the property market in Beijing?
1. The property price will continue to increase (go to Q20–22).
2. The property price will become stable (go to Q23–25).
3. The property price will decrease by a small degree (go to Q26–28).

For example, if a participant has an up-market expectation in mind, then an up-market scenario (see Seller-Scenario D below) will be assigned to him/her.

Seller: Q20. (Scenario D): Assume that you are aware that the property price will continue to increase in the next few years. What is the minimum price that you can accept for your property?

Fourth, a hypothetical scenario is provided to home sellers to determine if these sellers update their reference points when they possess private information. As explained in the assumptions in section 3.1, neighborhood and locational characteristics are considered public information that can be accessed by both homeowners and buyers. Private information refers to housing characteristics (e.g., structural ones, especially structural defects), provided that desirable structural characteristics are disclosed for marketing purposes. The rationale behind this hypothetical scenario is consistent with that of Wong, Yiu, & Chau (2012). Particularly, the structural defect used in this field experiment is the potential aging problem of cables. This aging issue is considered one of the most serious latent problems for buyers when purchasing a property in the secondary market in China, as the cables used for initial internal decoration exhibit an uneven quality. Problems such as cable concerns may not be fully discovered until buyers have bought the property or occupied the property for a certain period. Therefore, the following scenario (Seller-Scenario E) is provided to home sellers:

Seller: Q21. (Scenario E): Suppose that the cables used for the initial internal decoration in your residential area were of mediocre quality. They have not been changed and they were not replaced when you renovated your property. If these potential undesirable characteristics are considered, what is the minimum price that you can accept for your property?

Fifth, the following scenario is provided to home sellers to determine whether or not they are loss-averse. Similar to the many experimental settings in psychology (e.g., Kermer et al. 2006; Paraschiv & Chenavaz 2011), degree of satisfaction is utilized as a proxy for loss–gain utility in this study. Equal-sized loss and gain are assigned to sellers to create hypothetical loss–gain domains in the following scenarios (Seller-Scenario F). Thereafter, the loss–gain (L–G) ratio is calculated. Participants are loss-averse if the L–G ratio is greater than one. A similar approach is used by Harinck et al. (2012). Specifically, assuming that the utility of an individual will increase by two units (e.g., degree of satisfaction increases from 5 to 7) for an RMB 200,000 gain, the participants are asked about how they will value their degree of satisfaction if confronted with an equal-sized loss (i.e., RMB 200,000). Participants are considered loss-averse when their degree of satisfaction is less than 3[17].

[17] The experiment will be terminated if a participant selects a degree of satisfaction of 5 or higher for the loss.

Seller: Q22. (Scenario F): On a scale of 1 to 10, the highest degree of satisfaction is 10 and the lowest degree of satisfaction is 1. Suppose that the buyers' bid price is RMB 200,000 higher than your minimum willingness to accept for your property and your degree of satisfaction is 7.

When the buyers' bid price and your minimum willingness to accept are identical, your degree of satisfaction drops to 5.

If the buyers' bid price is RMB 200,000 lower than your minimum willingness to accept, how will you value your degree of satisfaction?

○ *1*
○ *2*
○ *3*
○ *4*
○ *5 or higher*

Materials and scenarios in Stage two (buyers' experiment)

According to housing preferences and affordability, each home buyer is assigned 10 real properties obtained from Stage one (sellers' experiment) and is asked to select only one to commence with Part B ("scenarios"). The first four scenarios (i.e., Scenarios A–D, refer to Figure 4) used in the sellers' and buyers' experiments are the same. However, in the case of the latter, the maximum price that he/she is willing to pay for the property (i.e., WTP) is asked and recorded with the same argument provided for the earlier case.

After the expectation-based up-/stable/down-market condition (Buyer-Scenario D) is assigned to home buyers, two hypothetical scenarios (Buyer-Scenarios E and F) with information asymmetry materials are created. In Buyer-Scenario E, home buyers know little private information, but they are reminded of the general latent problems of the secondary property. Provided with the high level of information asymmetry, buyers may apply a discount to future cash flows to compensate for any uncertainty and risk. The following scenario is used to test if a high level of information asymmetry affects the WTA–WTP gap in the housing market.

Buyer: Q21. (Scenario E): Suppose that you learned from an experienced home buyer that various uncertainties (e.g., latent problems) and problems, such as aging problems of cables, leaking pipes, blockage of drains, and cracks on the wall, might be encountered in the future. Such latent problems may cause future expenses. Given these issues, what is the maximum price that you are willing to pay for the property?

In Buyer-Scenario F, the level of information asymmetry is reduced by disclosing a component of the private information. Home buyers are informed that the quality of structure of the property that they are looking for is excellent, except for the quality of cables. The following scenario is designed to determine if information disclosure can reduce the WTA–WTP gap.

Buyer: Q22. (Scenario F): Suppose that a friend, who was in charge of the initial internal decoration in this residential area, told you that the quality of the structure in this area was generally excellent. The only concern might be the cables, which are of mediocre quality. What is the maximum price that you are willing to pay for the property?

Materials and scenarios in Stage three (Agents' experiment)

After the expectation-based up-/stable/down-market condition (Agent-Scenario D) is provided to the real estate agents, one hypothetical scenario (Agent-Scenarios E) with information asymmetry materials is created. The following scenario is used to obtain real estate agents' evaluation on properties if they are aware of any private information (i.e., latent problems) of the property.

> *Agent: Q10. (Scenario E): Suppose that you learned from an experienced colleague that the cables used for the initial internal decoration in this residential area where the property is located were of mediocre quality. Majority of the house owners did not change or replace the cables when they renovated their property. If these potential undesirable characteristics are considered, based on your work experience as a real estate agent, what will be your evaluation on this property?*