Flipping houses:
information, financing and housing price

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Abstract

One driving force of soaring house prices may be the house flipping activities of short-term investors. Short-term investors in housing market profit from purchasing houses at relatively lower prices. To reveal its mechanisms from the prospective of buyers' behaviors, we compare the search behaviors between short-term investors and first-time buyers as they both prefer small houses with similar characteristics. And we construct a buyer search model to theoretically show that the short-term investors profit from his information advantage and lower-leverage advantage compared with the first-time buyer. Then we estimate short-term investors and first-time buyers' primitive parameters and conduct counterfactual analyses by utilizing theoretical structures and data distinguishing first-time buyers and short-term investors with their payment information. Base on the housing transaction records in Guangzhou city from 2013 to 2016, We find that short-term investors purchase houses at 5.77% lower prices than first-time buyers due to the short-term investors' 83% lower loan-to-value ratio. We illustrate that the expected house price increases with the loan-to-value ratio, and this effect is increasing with the buyer's search cost. The findings demonstrate the importance of improving the information infrastructure of the housing market and increasing mortgage convenience in restraining flipping.

Keywords: Housing market, Buyer's search, Information, Financing, Short-term Investor

1. Introduction

The sharp rise in house prices harms residents' housing affordability (Chen & Wen, 2017; JPMorgan Chase Co, 2021) and poses a risk to the economy as a whole (Claeys et al., 2019). The soaring house prices may be fueled by the house flipping activities of short-term investors, who are house buyers with short holding horizon. (DeFusco et al., 2017; Fu & Qian, 2014; Gao et al., 2020; Gay, 2015). And they profit from purchasing houses at lower prices and sell them (Bayer et al., 2020). Yet, it remains unclear why they are able to purchase lower-priced houses, which makes it hard for the government to develop policies that would prevent flipping and stabilize overheated housing markets.

In this study we try to uncover the above question by comparing the short-term buyers with buyers purchasing house for the first time, namely first-time buyers, as they both prefer lower value houses with small areas (National Association of, 2018). We consider two channels through which short-term investors purchasing houses at lower prices than first-time buyers. The first is short-term investors' information advantage compared to first-time buyers. Each house is unique with heterogeneous high-dimensional attributes (Malpezzi 2002; Sirmans, Macpherson and Zietz 2005), and the listing is incapable of containing such abundant information, making the search necessary for buyers (Han and Strange 2016; Carrillo 2012). Therefore, the buyers who have more information about the housing market have higher possibilities of finding low-priced houses. Compared to first-time buyers, short-term investors are more experienced and

may have access to information networks of houses for sale. Hence, the short-term investors may purchase houses at lower prices than first-time buyers due to the information advantage.

The second channel may be the short-term investors' lower leverage advantage compared to first-time buyers. The short-term investors have a high proportion of cash payments when purchasing houses (Allen et al. 2018; DeFusco, Nathanson and Zwick 2017; Han and Hong 2022; Seo, Holmes and Lee 2021). Additionally, short-term investors are likely to use lower leverage due to restrictions imposed by credit policies, such as minimum down payment ratio policies specific to repeat buyers (Chen et al. 2020; Wong et al. 2021). First-time buyers may choose higher leverage due to a lack of cash. They are willing to pay a higher price for a higher leverage, since this allows them to have early access to homeownership. Bian, Lin and Liu (2018) theoretically illustrate that higher leverage brings additional gains to the buyer, enlarges the total gain of the house transaction, and capitalizes on the house price, resulting in mortgage buyers paying more than full-cash buyers. Therefore, short-term investors may purchase houses at lower prices than first-time buyers for a lower leverage advantage.

To test our conjecture, we developed a buyer search model that theorizes how buyers' information and leverage influence transaction prices. Next, we empirically investigate whether short-term investors have information and lower-leverage advantages, and the casual effects of these advantages on housing prices. Lastly, we provide policy recommendations regarding how to restrain short-term

investors' flipping activities based on our findings.

The structure of this paper is organized as follows. Section 2 reviews previous literature. Section 3 illustrates the search model and comparative statics analyses. Section 4 builds the empirical model that adopts structures from Section 3. Section 5 describes our data. Section 6 provides estimates to the model and performs counterfactual experiments of the casual effects of the buyers' information and financing. Section 7 discusses the results and implications. Section 8 concludes the paper and discusses its limitations and avenues for future research.

2. Literature review

This paper is relevant to three strands of research. First, the paper contributes to studies of buyer search models in the housing market by incorporating buyer's financing behavior. Second, the paper complements the work of buyer information and financing's casual effects on housing prices by using counterfactual analysis. Third, the paper contributes to the literature related to real estate short-term investors by proving how they profit by purchases lower price houses.

The seminal work of Stigler (1961) created a search model to depict the nonnegligible role of information friction in decentralized markets. Sequential researchers adopt search models to describe the frictional housing market. However, buyers are only characterized as exogenous arrivals to sellers in most cases (e.g., Merlo et al., 2015). Buyer search studies account for only a tiny

minority. Chernobai and Hossain (2012) study the effects of buyers' holding horizon on search duration and transaction price. Lambson et al. (2004) and Turnbull and Sirmans (1993) study the effects of house size, buyer search costs, and beliefs about price distribution on buyer's search strategies and transaction prices. Carrillo (2012) characterizes heterogeneous buyer and seller searches from a micro perspective and studies the effects of information contained in the listing and the real estate agent's commission rate on market outcomes. The previous buyer search model has not considered the buyers' financing behaviors, and there is only a model of financing effects on seller search (Bian et al., 2018), while our study theoretically reveals the mechanism by which short-term investors purchasing houses at lower prices based on information and cash payment advantages by incorporating financing behavior in the buyers' search model. Our model also predicts how the interplay between buyer information and financing influences house prices.

For the strand of literature related to the causal effect of imperfect information in the housing market, whether a buyer is first-time buyer (or inexperienced buyer) is used as proxy variable of the buyer at information disadvantages to investigate their casual effects on house prices. However, the empirical results of the buyers' information effect based on the proxy variable can be biased due to endogeneity. Lambson et al. (2004) find that inexperienced buyers pay no significantly different price from experienced buyers. Turnbull and Sirmans (1993) and Anglin (1997) study multiple listing service (MLS)

institutions' effect on mitigating buyers' information asymmetry using the results of whether first-time buyers pay more. Since experienced buyers' income is higher than that of inexperienced buyers (National Association of, 2018), with fewer financial constraints, experienced buyers are willing to pay more (Hung & So, 2012). With the consideration that using whether buyer is first-time buyer as an information proxy variable to investigate buyer information effects on housing prices may result in biased estimations, we study buyers' information effects on housing prices by directly measuring buyers search costs and conducting a counterfactual analysis based on structures from the model. We complement the buyer search cost measuring studies of Shimizu et al. (2003) and Carrillo (2012) by giving a nonparametric estimate of buyers' search cost distribution to investigate the details of housing market friction.

For the effects of cash payment on housing prices, empirical studies have found that buyers' cash payment brings significant discounts. Asabere et al. (1992) and Lusht and Hansz (1994) find cash discounts in house transactions of 13.4% and 16.5%, respectively. Jauregui et al. (2017) use the Heckman Sample Selection Model and PSM to mitigate the potential self-selection bias, finding cash discounts of 9% and 11.4%. Han and Hong (2022) give an estimate of 5% after controlling for unobservable house and buyer attributes.

Finally, the short-term investors' literature in the housing market has shown that short-term investors play a crucial role in house price appreciation during booms and further price drops in busts (Chinco & Mayer, 2016; DeFusco et al.,

2017; Gao et al., 2020). Bayer et al. (2020) find that the greater the volume of houses that short-term investors flip, the greater they depend on buying low to profit. However, they have not explained why short-term investors find and purchase low-price houses. We contribute to this thread of the literature by illustrating an estimable model of short-term investors arbitraging through information and cash payment advantages and then showing the casual effects of those advantages on house prices by counterfactual analysis.

3. Model

3.1 The market

The risk-neutral buyers and sellers trade homogenous houses in a frictional market. Time is discrete and denoted as $t = 0,1,2$ .... The house buyers comprise first-time buyers who purchase for occupants and short-term investors who plan to resell after short holding tenure. We assume the two types of buyers have the same valuation v_b to the houses, while the sellers' valuations are heterogenous. From the buyers' point of view, *ex ante* they only know the sellers' valuations distribution but do not know individual seller's valuation, which is a random variable V_s with exogenous and non-degenerate cumulative distribution function $F(\cdot)$ with support $\left[\underline{v_s}, \overline{v_s}\right]$.

3.2 Buyers' financing and bargaining behaviors

For each search, a first-time buyer (or a short-term investor) spends one period and search cost c_F (or c_I) to find one seller. At $t = 0$, the buyer starts searching.

At $t = 1$, he encounters and bargains with a seller, and find out that his valuation is v_s which is the realization of V_s. The seller makes a take-it-or-leave-it offer p_F to the first-time buyer (or p_I to the short-time investor). We denote the first-time buyer's gain of accepting the offer as Π_F, while the short-term investor's as Π_I. In each transaction, the seller takes θ share of the total gain. Therefore, in the transaction with a first-time buyer, the seller's gain is,

$$\Pi_S = \theta(\Pi_S + \Pi_F), \tag{1.}$$

whereas in the transaction with a short-term investor it is,

$$\Pi_S = \theta(\Pi_S + \Pi_I). \tag{2.}$$

If the first-time buyer and the short-term investor accept the offers, they pay by a one term mortgage with loan-to-value (LTV) l_F and l_I, and interest rates i_F and i_I respectively. And Π_F is denoted as the first-time buyer's house valuation minus his present value of paying by mortgage,

$$\Pi_F = v_b - \left[\frac{1 + i_F}{1 + r_F} l_F p_F + (1 - l_F) p_F\right], \tag{3.}$$

, where r_F is his expected homeownership return rate. We define the seller's gain from selling the house to the first-time buyer as $\Pi_S = p_F - v_s$, then by replacing equation (1.) with it and equation (3.) we solve,

$$p_F = \frac{(1 - \theta)v_s + \theta v_b}{1 - \frac{r_F - i_F}{1 + r_F}\theta l_F}. \tag{4.}$$

Intuitively, if the expected rate of homeownership is higher than the interest rate, that is $r_F > i_F$, the buyer has extra gain from the mortgage and end up with higher negotiated price. Then we rewrite Π_F as a function of v_s by eliminating p_F in equation (3.),

$$\Pi_F(v_s) = v_b - \frac{\left(1 - \frac{r_F - i_F}{1 + r_F} l_F\right)[\theta v_b + (1 - \theta)v_s]}{1 - \frac{r_F - i_F}{1 + r_F}\theta l_F}. \quad (5.)$$

And we can also derive the relation between Π_I and v_s by defining Π_I and Π_S and solving p_I. Compared with the first-time buyers, the short-term investors have additional cost τ due to the transaction fee, holding cost and risk of uncertain price when reselling in illiquidity market. Then, the short-term investor's gain of accepting the offer p_I is,

$$\Pi_I = v_b - \left[\frac{1 + i_I}{1 + r_I} l_I p_I + (1 - l_I)p_I\right] - \tau, \quad (6.)$$

where r_I is his return rate of owning the house. Correspondingly the seller's gain from selling the house to the short-term investors at p_I is $\Pi_S = p_I - v_s$, and we replace equation (2.) with it and equation (6.) to solve,

$$p_I = \frac{(1 - \theta)v_s + \theta(v_b - \tau)}{1 - \frac{r_I - i_I}{1 + r_I}\theta l_I}, \quad (7.)$$

And we obtain the relation between Π_I and v_s by substituting p_I for equation (6.),

$$\Pi_I(v_s) = v_b - \tau - \frac{\left(1 - \frac{r_I - i_I}{1 + r_I} l_I\right)[\theta(v_b - \tau) + (1 - \theta)v_s]}{1 - \frac{r_I - i_I}{1 + r_I}\theta l_I}. \qquad (8.)$$

3.3 Buyers' optimal search strategies

The buyers' gains Π_F and Π_I are dispersed since they depend on the realizations of V_s. From the buyers' perspective, the dispersions imply potential benefit of continuing search which also incurs inevitable search cost. Therefore, the buyers use search strategies to maximize their total gains of search. We assume the buyers have infinite search horizon. And the search strategy is that the first-time buyer (the short-term investor) accepts the offer and quits searching if $\Pi_F > \Pi_F^r$ ($\Pi_I > \Pi_I^r$), where Π_F^r (Π_I^r) is his reservation gain, otherwise he rejects the offer and keep searching until his gain from one offer excesses his reservation gain.

We solve the buyers' optimal reservation gains by dynamic programming. We denote the maximized summations of the first-time buyer and short-term investor's expected search gains from t to infinite as s_{F_t} and s_{I_t}, and the optimal reservation gains as Π_F^{r*} and Π_I^{r*}. The bellman equation of the first-time buyer's search problem is,

$$s_{F_1} = \int_{\underline{v_s}}^{v_s^{F*}} \Pi_F(v_s)\, dF(v_s) + \beta_F \left[\int_{v_s^{F*}}^{\overline{v_s}} s_{F_2}\, dF(v_s) - c_F\right], \qquad (9.)$$

where $v_s^F(\cdot)$ is the inverse of equation (5.), and v_s^{F*}=$v_s^F(\Pi_F^{r*})$. And β_F is the first-time buyer's discount factor and $0 < \beta_F < 1$. Since the buyers have infinite search horizon, for any t, the maximized summation of expected search gains from t to

infinite is the same for buyers unmatched at t. Therefore, it implies $s_{F_1} = s_{F_2} = s_F$, and we can rewrite and simplify equation (9.) to have,

$$s_F = \frac{\int_{\underline{v_s}}^{v_s^{F*}} \Pi_F(v_s)\, dF(v_s) - \beta_F c_F}{1 - \beta_F + \beta_F F(v_s^{F*})}. \tag{10.}$$

By analogy with the deduction of equation (10.) we obtain $s_{I_1} = s_{I_2} = s_I$,

$$s_I = \frac{\int_{\underline{v_s}}^{v_s^{I*}} \Pi_I(v_s)\, dF(v_s) - \beta_I c_I}{1 - \beta_I + \beta_I F(v_s^{I*})}, \tag{11.}$$

where $v_s^I(\cdot)$ is the inverse of equation (8.), and $v_s^{I*} = v_s^I(\Pi_I^{r*})$. And β_I is the short-term investor's discount factor and $0 < \beta_I < 1$. By deriving equation (10.) with respect to Π_F^{r*}, we have the first order condition of the first-time buyer's optimal reservation gain Π_F^{r*},

$$c_F = \frac{1}{\beta_F} \int_{\underline{v_s}}^{v_s^{F*}} [\Pi_F(v_s) - \Pi_F^{r*}]\, dF(v_s) - \frac{1 - \beta_F}{\beta_F^2} \Pi_F^{r*}. \tag{12.}$$

Deriving equation (11.), the first order condition of the short-term investor's optimal reservation gain Π_I^{r*} is,

$$c_I = \frac{1}{\beta_I} \int_{\underline{v_s}}^{v_s^{I*}} [\Pi_I(v_s) - \Pi_I^{r*}]\, dF(v_s) - \frac{1 - \beta_I}{\beta_I^2} \Pi_I^{r*}. \tag{13.}$$

Replace c_F and c_I in equation (10.) and equation (11.) using equation (12.) and equation (13.), we have $\Pi_F^{r*} = \beta_F s_F$ and $\Pi_I^{r*} = \beta_I s_I$. Intuitively, since searching in the next period to expectively gain $\beta_F s_F$ ($\beta_I s_I$) is always the best alternative for

the unmatched first-time buyer (the unmatched short-term investor), it is optimal for him to use it as reservation gain.

3.4 The short-term investor's return from flipping

We obtain the first-time buyer's expected house price by taking the expectation of equation (4.) given his optimal reservation gain,

$$E(p_F|\Pi_F^{r*}) = \frac{(1-\theta)E(v_s|\Pi_F^{r*}) + \theta v_b}{1 - \frac{r_F - i_F}{1+r_F}\theta l_F}. \quad (14.)$$

Similarly, we derive the short-term investor's expected house price by taking the expectation of equation (7.) given his optimal reservation gain,

$$E(p_I|\Pi_I^{r*}) = \frac{(1-\theta)E(v_s|\Pi_I^{r*}) + \theta(v_b - \tau)}{1 - \frac{r_I - i_I}{1+r_I}\theta l_I}. \quad (15.)$$

And if the short-term investor sells the house to the first-time buyer, his expected return rate of flipping is,

$$R = \frac{E(\mathrm{P}_F|\Pi_F^{r*})}{E(\mathrm{P}_I|\Pi_I^{r*})} - 1. \quad (16.)$$

Since the buyers' search cost represents their cost of acquiring information, the short-term investor has information advantage over the first-time buyer if the short-term investor has lower search cost, *i.e.*, $c_F > c_I$. Then we denote the short-term investor's information advantage as $\Delta c = c_F - c_I$. And we have the following proposition.

Proposition 1 (Return of the information advantage).

(1) *The short-term investor and the first-time buyer's expected house prices conditional on their optimal reservation gains* $E(p_I|\Pi_I^{r*})$ *and* $E(p_F|\Pi_F^{r*})$ *are monotonically increasing with their search cost* c_I *and* c_F *respectively.*

(2) *And the short-term investor's expected return rate R is monotonically increasing with his information advantage over the first-time buyer* $\Delta c = c_F - c_I$ *where* $c_F > c_I$.

Proof of Proposition 1.

(1) Taking the derivative of $E(p_I|\Pi_I^{r*})$ with respect to c_I we have,

$$\frac{dE(p_I|\Pi_I^{r*})}{dc_I} = \frac{(1-\theta)\frac{dE(v_s|\Pi_I^{r*})}{dc_I}}{\left(1-\frac{r_I-i_I}{1+r_I}\theta l_I\right)}, \qquad (A.1)$$

where $\frac{dE(v_s|\Pi_I^{r*})}{dc_I} = \frac{d(\frac{\int_{\underline{v_s}}^{v_s^{I*}} v_s dF(v_s)}{F(v_s^{I*})})}{dc_I} = \frac{\int_{\underline{v_s}}^{v_s^{I*}}(v_s^{I*}-v_s)dF(v_s)f(v_s^{I*})}{F(v_s^{I*})^2}\frac{dv_s^{I*}}{dc_I}$, and $\frac{dv_s^{I*}}{dc_I} =$

$-\frac{1-\frac{r_I-i_I}{1+r_I}\theta l_I}{(1-\frac{r_I-i_I}{1+r_I}l_I)(1-\theta)}\frac{d\Pi_I^{r*}}{dc_I}$. To obtain $\frac{d\Pi_I^{r*}}{dc_I}$, we implicitly derivate equation (13.) with

respect to Π_I^{r*}, and $\frac{d\Pi_I^{r*}}{dc_I} = \frac{1}{\frac{dc_I}{d\Pi_I^{r*}}} = -\frac{\beta_I^2}{\beta_I F(v_s^{I*})+1-\beta_I} < 0$. Therefore, $\frac{dv_s^{I*}}{dc_I} > 0$,

$\frac{dE(v_s|\Pi_I^{r*})}{dc_I} > 0$ and $\frac{dE(p_I|\Pi_I^{r*})}{dc_I} > 0$. Similarly, we can prove that $\frac{dE(p_F|\Pi_F^{r*})}{dc_F} > 0$.

(2) We take the derivative of the short-term investor's expected return rate *R*

with respect to c_I,

$$\frac{dR}{dc_I} = -\frac{E(p_F|\Pi_F^{r*})\frac{dE(p_I|\Pi_I^{r*})}{dc_I}}{E(\mathrm{P}_I|\Pi_I^{r*})^2} < 0. \qquad (A.2)$$

$\frac{dR}{d\Delta c} = \frac{dR}{dc_I} \cdot \frac{dc_I}{d\Delta c} > 0$ if $\Delta c > 0$, since $c_I = c_F - \Delta c$.

Q.E.D.

Intuitively, (1) of Proposition 1 shows that the lower search cost allows the short-term investor to choose a higher reservation gain as his search strategy, then he only stops searching until receiving an offer from a seller with a low house valuation, resulting in a lower expected house price. If the first-time buyer has a higher search cost, then he will choose lower reservation gain as his search strategy and end up purchasing a house at a high house price from a high valuation seller. And the short-term investor's information advantage create profit for him if he sells the house to the first-time buyer. (2) of Proposition 1 implies that if the short-term investor has greater information advantage over the first-time buyer, he purchases the house at a lower price and thus has a higher return.

If the short-term investor pays by a mortgage with lower leverage, even full cash, then he has a lower-leverage advantage. We denote the short-term investor's lower-leverage advantage as $\Delta l = l_F - l_I > 0$, and we have the following proposition.

Proposition 2 (Return of the lower-leverage advantage).

(1) *The short-term investor and the first-time buyer's expected house prices conditional on their optimal reservation gains* $E(p_I|\Pi_I^{r*})$ *and* $E(p_F|\Pi_F^{r*})$ *are monotonically increasing with their loan-to-value ratios* l_I *and* l_F *respectively, if their expected return rates of homeownership exceed their interest rates* $r_I > i_I$ *and* $r_F > i_F$.

(2) *The short-term investor's expected return R is monotonically increasing with his leverage advantage over the first-time buyer* $\Delta l = l_F - l_I$ *under the conditions that* $l_F > l_I$, $r_I > i_I$ *and* $r_F > i_F$.

(3) *Given* $\beta = 1$, *The effects of the short-term investor and the first-time buyer's loan-to-value ratio on their expected house price* $\frac{dE(p_F|\Pi_F^{r*})}{dl_F}$ *and* $\frac{dE(p_I|\Pi_I^{r*})}{dl_I}$ *are monotonically increasing with their search cost* c_I *and* c_F *respectively, if* $r_I > i_I$, $r_F > i_F$, $G(\cdot)$ is log-concave and $\left(\frac{G(v_s^{I*})}{F(v_s^{I*})}\right)'' < 0$.

Proof of Proposition 2.

(1) The derivative of $E(p_I|\Pi_I^{r*})$ with respect to l_I is,

$$\frac{dE(p_I|v_s^{I*})}{dl_I} = \frac{1-\theta}{1-\frac{r_I-i_I}{1+r_I}\theta l_I}\frac{dE(v_s|v_s^{I*})}{dl_I}$$

$$+\frac{\frac{r_I-i_I}{1+r_I}\theta[(1-\theta)E(v_s|v_s^{I*})+\theta(v_b-\tau)]}{\left(1-\frac{r_I-i_I}{1+r_I}\theta l_I\right)^2}.(B.1)$$

where $\frac{dE(v_s|\Pi_I^{r*})}{dl_I} = \frac{d(\frac{\int_{\underline{v_s}}^{v_s^{I*}} v_s dF(v_s)}{F(v_s^{I*})})}{dl_I} = \frac{\int_{\underline{v_s}}^{v_s^{I*}}(v_s^{I*}-v_s)dF(v_s)f(v_s^{I*})}{F(v_s^{I*})^2}\frac{dv_s^{I*}}{dl_I}$. To obtain $\frac{dv_s^{I*}}{dl_I}$ we implicitly derivate equation (8.) with respect to l_I,

$$\frac{dv_s^{I*}}{dl_I} = \frac{-\frac{d\Pi_I^{r*}}{dl_I}\left(1-\frac{r_I-i_I}{1+r_I}\theta l_I\right)^2+\frac{r_I-i_I}{1+r_I}[\theta(v_b-\tau)+(1-\theta)v_s^{I*}](1-\theta)}{\left(1-\frac{r_I-i_I}{1+r_I}l_I\right)(1-\theta)\left(1-\frac{r_I-i_I}{1+r_I}\theta l_I\right)}.$$

Derivate equation (13.) with respect to l_I, we have $\frac{\mathrm{d}\Pi_I^{r*}}{dl_I} = \frac{\int_{\underline{v_s}}^{v_s^{I*}}\frac{d\Pi_I(v_s)}{dl_I}dF(v_s)}{\frac{1-\beta_I}{\beta_I}+F(v_s^{I*})} =$

$\frac{\frac{(1-\theta)\frac{r_I-i_I}{1+r_I}}{\left(1-\frac{r_I-i_I}{1+r_I}\theta l_I\right)^2}\int_{\underline{v_s}}^{v_s^{I*}}[\theta(v_b-\tau)+(1-\theta)v_s]dF(v_s)}{\frac{1-\beta_I}{\beta_I}+F(v_s^{I*})}$. Then replacing $\frac{\mathrm{d}\Pi_I^{r*}}{dl_I}$ in $\frac{dv_s^{I*}}{dl_I}$ we have,

$$\frac{dv_s^{I*}}{dl_I}$$

$$= \frac{\frac{r_I - i_I}{1+r_I}\left\{[\theta(v_b-\tau)+(1-\theta)v_s^{I*}] - \frac{\int_{\underline{v_s}}^{v_s^{I*}}[\theta(v_b-\tau)+(1-\theta)v_s]\,dF(v_s)}{\frac{1}{\beta_I}-1+F(v_s^{I*})}\right\}}{\left(1-\frac{r_I-i_I}{1+r_I}l_I\right)\left(1-\frac{r_I-i_I}{1+r_I}\theta l_I\right)} \quad (B.2)$$

$$> \frac{\frac{r_I - i_I}{1+r_I}\left\{[\theta(v_b-\tau)+(1-\theta)v_s^{I*}] - \frac{\int_{\underline{v_s}}^{v_s^{I*}}[\theta(v_b-\tau)+(1-\theta)v_s]\,dF(v_s)}{F(v_s^{I*})}\right\}}{\left(1-\frac{r_I-i_I}{1+r_I}l_I\right)\left(1-\frac{r_I-i_I}{1+r_I}\theta l_I\right)}$$

$$= \frac{\frac{r_I - i_I}{1+r_I}(1-\theta)\frac{\int_{\underline{v_s}}^{v_s^{I*}}(v_s^{I*}-v_s)\,dF(v_s)}{F(v_s^{I*})}}{\left(1-\frac{r_I-i_I}{1+r_I}l_I\right)\left(1-\frac{r_I-i_I}{1+r_I}\theta l_I\right)}.$$

Therefore, if $r_I > i_I$, then $\frac{dv_s^{I*}}{dl_I} > 0$ and $\frac{dE(p_I|\Pi_I^{r*})}{dl_I} > 0$. Similarly, we can prove that if $r_F > i_F$, $\frac{dv_s^{F*}}{dl_F} > 0$ and $\frac{dE(p_F|\Pi_F^{r*})}{dl_F} > 0$. Hence, $E(p_I|\Pi_I^{r*})$ and $E(p_F|\Pi_F^{r*})$ are increasing with l_I and l_F respectively, if $r_I > i_I$ and $r_F > i_F$.

(2) Then, take the derivative of R with respect to l_I we have,

$$\frac{dR}{dl_I} = -\frac{E(\mathrm{P}_F|\Pi_F^{r*})}{[E(\mathrm{P}_I|\Pi_I^{r*})]^2}\frac{dE(\mathrm{P}_I|\Pi_I^{r*})}{dl_I} < 0$$

Since $l_I = l_F - \Delta l$, $\frac{dR}{d\Delta l} = \frac{dR}{dl_I}\cdot\frac{dl_I}{d\Delta l} > 0$ where $l_F > l_I$. Therefore R is increasing with the short-term investor's lower-loan advantage over the first-time buyer Δl.

(3) We take the derivative of $\frac{dE(p_I|v_s^{I*})}{dl_I}$ in equation $(B.1)$ with respect to c_I,

$$\frac{d\left(\frac{dE(p_I|v_s^{I*})}{dl_I}\right)}{dc_I}$$

$$= \frac{1-\theta}{1-\frac{r_I-i_I}{1+r_I}\theta l_I}\left(\frac{d^2E(v_s|v_s^{I*})}{dv_s^{I*2}}\frac{dv_s^{I*}}{dl_I}\right.$$

$$\left. + \frac{dE(v_s|v_s^{I*})}{dv_s^{I*}}\left(\frac{d\left(\frac{dv_s^{I*}}{dl_I}\right)}{dv_s^{I*}} + \frac{\frac{r_I-i_I}{1+r_I}\theta}{1-\frac{r_I-i_I}{1+r_I}\theta l_I}\right)\right)\frac{dv_s^{I*}}{dc_I} \quad (B.3)$$

According to Lemma 1 in (Bagnoli & Bergstrom, 2005), $E(v_s|v_s^{I*}) = -\left(v_s^{I*} - \frac{\int_{\underline{v_s}}^{v_s^{I*}} v_s dF(v_s)}{F(v_s^{I*})}\right) + v_s^{I*} = -\frac{G(v_s^{I*})}{F(v_s^{I*})} + v_s^{I*}$ where $G(v_s^{I*}) = \int_{\underline{v_s}}^{v_s^{I*}} F(v_s)\, dv_s$.

Given $\beta = 1$, $\frac{dv_s^{I*}}{dl_I}$ in $(B.2)$ can be written as $\frac{\frac{r_I-i_I}{1+r_I}(1-\theta)}{\left(1-\frac{r_I-i_I}{1+r_I}l_I\right)\left(1-\frac{r_I-i_I}{1+r_I}\theta l_I\right)}\frac{G(v_s^{I*})}{F(v_s^{I*})}$.

$$\frac{d\left(\frac{dE(p_I|v_s^{I*})}{dl_I}\right)}{dc_I}$$

$$= \frac{1-\theta}{1-\frac{r_I-i_I}{1+r_I}\theta l_I}\left(-\left(\frac{G(v_s^{I*})}{F(v_s^{I*})}\right)''\frac{dv_s^{I*}}{dl_I}\right.$$

$$+\frac{\int_{\underline{v_s}}^{v_s^{I*}}(v_s^{I*}-v_s)\,dF(v_s)f(v_s^{I*})}{F(v_s^{I*})^2}\left(\frac{\frac{r_I-i_I}{1+r_I}(1-\theta)}{\left(1-\frac{r_I-i_I}{1+r_I}l_I\right)\left(1-\frac{r_I-i_I}{1+r_I}\theta l_I\right)}\left(\frac{G(v_s^{I*})}{F(v_s^{I*})}\right)'\right.$$

$$\left.\left.+\frac{\frac{r_I-i_I}{1+r_I}\theta}{1-\frac{r_I-i_I}{1+r_I}\theta l_I}\right)\right)\frac{dv_s^{I*}}{dc_I} \quad (B.4)$$

As $\frac{dv_s^{I*}}{dl_I} > 0$ is proved in proof of Proposition 2 (1) and $\frac{dv_s^{I*}}{dc_I} > 0$ is proved in proof of Proposition 1 (1), given $\beta = 1$, $\frac{d\left(\frac{dE(p_I|v_s^{I*})}{dl_I}\right)}{dc_I} > 0$ if $\left(\frac{G(v_s^{I*})}{F(v_s^{I*})}\right)' > 0$ and $\left(\frac{G(v_s^{I*})}{F(v_s^{I*})}\right)'' < 0$.

Since $\left(\frac{G(v_s^{I*})}{F(v_s^{I*})}\right)' > 0$ if and only if $G(\cdot)$ is log-concave (Bagnoli & Bergstrom, 2005), given $\beta = 1$, $\frac{d\left(\frac{dE(p_I|v_s^{I*})}{dl_I}\right)}{dc_I} > 0$ if $G(\cdot)$ is log-concave and $\left(\frac{G(v_s^{I*})}{F(v_s^{I*})}\right)'' < 0$.

Q.E.D.

The assumption $r_F > i_F$ is natural, the first-time buyer chooses to take mortgage other than using cash or renting house because his expected return rate is higher

than the mortgage interest rate.

Under the conditions of $\beta = 1$, i.e., no discounting, if $G(\cdot)$ is log-concave and $\left(\frac{G(v_s^{I*})}{F(v_s^{I*})}\right)'' < 0$, the impact of the loan-to-value ratio on the expected house price increases with the buyer's search cost. This implies that reducing the search cost for first-time buyers not only directly lowers house price, but also diminishes the influence of higher leverage on house prices.

4. Empirical model

4.1 Unobserved heterogenous house attributes

We consider the unobservable house attributes in our empirical model to be consistent with the theoretical model because these attributes will be taken into account by the buyers and sellers when they evaluate the houses. Suppose there are n transaction records, and the buyer's valuation to the unobservable house attributes in transaction i is ϵ_i. Then the house valuation of the first-time buyer (the short-term investor) in transaction i is,

$$v_{b_i} = \gamma^o X_i^o + k + \epsilon_i, \tag{17.}$$

where X_i^o is the vector of the observed house attributes, γ^o is the vector of buyer's marginal valuation to X_i^o, and k is the interception of the buyer's valuation to X_i^o.

The seller's valuation to the house in transaction record i is,

$$v_{s_i} = v_{b_i} + \omega_i, \tag{18.}$$

where $\omega_i < 0$ is the seller's valuation less the buyer's valuation on the house in transaction record i.

The necessary conditions for the first-time buyer's transaction are $\Pi_{F_i} > 0$ and $\Pi_{S_i} > 0$, then we solve for ϵ_i and ω_i by manipulating equation (5.). In the cases of first-time buyers' transactions ϵ_i and ω_i satisfy,

$$D_F = \{\epsilon_i, \omega_i | \frac{\frac{r_F - i_F}{1+r_F} l_F (\gamma^o X_i^o + k + \epsilon_i)}{1 - \frac{r_F - i_F}{1+r_F} l_F} > \omega_i > -\gamma^o X_i^o - k - \epsilon_i \; and \; \epsilon_i > -\gamma^o X_i^o - k\};$$

In the cases of short-term investors' transactions ϵ_i and ω_i satisfy,

$$D_I = \{\epsilon_i, \omega_i | \frac{\frac{r_I - i_I}{1+r_I} l_I (\gamma^o X_i^o + k + \epsilon_i) - \tau}{1 - \frac{r_I - i_I}{1+r_I} l_I} > \omega_i > -\gamma^o X_i^o - k - \epsilon_i \; and \; \epsilon_i > -\gamma^o X_i^o - k\}.$$

To derive the likelihood functions in section 4.3, we assume that the joint distribution of ϵ_i and ω_i is a two-dimensional normal density $\phi_{\epsilon\omega_i}$ with mean $\mu = \begin{bmatrix} \mu_\epsilon \\ 0 \end{bmatrix}$ and variance $\Sigma = \begin{bmatrix} \sigma_\epsilon^2 & 0 \\ 0 & \sigma_\omega^2 \end{bmatrix}$ truncated by D_F in the first-time buyer transactions (or D_I in the short-term investor transactions).

4.2 Unobserved heterogenous bargaining power

We also introduce the heterogenous bargaining power to empirical model. Suppose that the seller's bargaining power in each transaction is a random variable, which follows a normal distribution with support $(0,1)$.

4.3 Likelihood functions

The seller's list price is his optimal strategy to direct buyers' search based on the seller's valuation of the house (Arnold, 1999; Chen & Rosenthal, 1996; Han & Strange, 2016). We assume that the seller sets the list price following the reduced form below, which is unknown by the buyers,

$$p_{L_i} = d_1 v_{s_i} + d_2 = d_1(\gamma^o X_i^o + k + \epsilon_i + \omega_i) + d_2 \qquad (19.)$$

Following equation (7.), the purchasing price of the short-term investor in the ith sample is,

$$p_{I_i} = \frac{\gamma^o X_i^o + k + \epsilon_i + (1-\theta_i)\omega_i - \theta_i \tau}{1 - \frac{r_I - i_I}{1+r_I}\theta_i l_I}. \qquad (20.)$$

We can derive the likelihood function of p_{L_i} and p_{I_i} (or p_{F_i}) by transforming the ϵ_i and ω_i's joint density $\phi_{\epsilon\omega_i}$. Therefore, we solve for ϵ_i and ω_i in the short-term investor transaction record by combining equation (19.) and equation (20.),

$$\epsilon_i = -\gamma^o X_i^o - k + \frac{p_{I_i}\left(1 - \frac{r_I - i_I}{1+r_I}\theta_i l_I\right)}{\theta_i} - (1-\theta_i)\frac{p_{Li} - d_2}{d_1\theta_i} + \tau, \qquad (21.)$$

$$\omega_i = -\frac{p_{I_i}\left(1 - \frac{r_I - i_I}{1+r_I}\theta_i l_I\right)}{\theta_i} + \frac{p_{Li} - d_2}{d_1\theta_i} - \tau. \qquad (22.)$$

Similarly, ϵ_i and ω_i in the first-time buyer transaction record i are,

$$\epsilon_i = -\gamma^o X_i^o - k + \frac{p_{F_i}\left(1 - \frac{r_F - i_F}{1+r_F}\theta_i l_F\right)}{\theta_i} - (1-\theta_i)\frac{p_{Li} - d_2}{d_1\theta_i}, \qquad (23.)$$

$$\omega_i = -\frac{p_{F_i}\left(1 - \frac{r_F - i_F}{1 + r_F}\theta_i l_F\right)}{\theta_i} + \frac{p_{Li} - d_2}{d_1\theta_i}. \quad (24.)$$

Then, the likelihood function of p_{L_i} and p_{I_i} is,

$$l_{p_i} = \int_0^1 \phi_{\epsilon\omega_i}(\epsilon_i, \omega_i)|J_i|d\theta\,, \quad (25.)$$

where $|J_i|$ is the absolute value of the Jacobian transformation determinant.

We denote the distribution of the first-time buyers' search costs as F_{c_F} , and the short-term investor's as F_{c_I}. For the seller in transaction record i, the likelihood of him selling the house at one period is,

$$l_{t_i} = 1 - F_{c_F}\left(c_F\left(v_{s_i}\right)\right). \quad (26.)$$

And the likelihood function of him not selling the house at one period is,

$$l_{nt_i} = F_{c_F}\left(c_F\left(v_{s_i}\right)\right) \quad (27.)$$

Therefore, the log-likelihood of observing the house in transaction i is

$$L_i(\Theta) = (t_i - 1)l_{nt_i} + l_{ti} + l_{p_i}, \quad (28.)$$

where $\Theta = \{\gamma^o, k, \theta, \mu_\epsilon, \sigma_\epsilon, \sigma_\omega, d_1, d_2, F_{c_F}, F_{c_I}, r_I, \tau\}$ for the short-term investor, and $\Theta = \{\gamma^o, k, \theta, \mu_\epsilon, \sigma_\epsilon, \sigma_\omega, d_1, d_2, F_{c_F}, F_{c_I}, r_F\}$ for the first-time buyer. The MLE of Θ is when Equation (28.) reaches its maximum.

5. Data

Three datasets are included in the study. The first dataset's source is from Hope Fluent Properties Limited, a listed real estate company. The first dataset contains housing attributes, such as area, floors, elevator, location, transaction price, listing price, and time on the market. In addition, the first dataset also contains the buyers' purchasing purposes, which come from the real estate agents' survey on buyers. For each transaction, the real estate agent asks the buyer whether the house is being purchased for an occupant or as an investment. For the buyer purchasing for the occupant, the real estate agent further asks about his purchasing history. If the buyer has not purchased a house before, he will be categorized as a first-time buyer. If the buyer owns one house, he is specified as a secondary house buyer. In terms of buyers purchasing as an investment, the real estate agent asks his expected holding tenure to classify him as a short-term or long-term investor. In addition to supporting the company's research on different types of buyers' behaviors, the real estate agents ask the buyers about their purchasing purposes to provide information on local loan policies, for recommending houses, and to promote the company's loan service to these buyers. To get help from agents, buyers have no incentive to provide false information about their purchasing purposes. The dataset also contains financing information about whether the buyers choose to pay by mortgage or cash. If the buyers pay by a mortgage, the dataset records the loan term and the mortgage amounts, including the amounts of commercial mortgage and the Housing Provident Fund (HPF).

The second dataset contains the commercial mortgage interest rates of banks in Guangzhou city from Rong360 during February 2013 through April 2016. The third dataset contains the Housing Provident Fund loan interest rates from the China Stock Market & Accounting Research Database. Since the interest rate changes over time and the Chinese government implements a diverse interest rate policy for first-time buyers and repeat buyers, we link the primary dataset and the monthly average interest rate dataset through the transaction date and buyers' type.

Our unique dataset has advantages in investigating the micro behaviors of first-time buyers and short-term investors. First, our dataset directly distinguishes first-time buyers with short-term investors differently from previous studies that identify repeat buyers by matching buyers' names of the transaction records (Bayer et al., 2020; Han & Hong, 2022). Second, it contains the buyers' mortgage records. The dataset's detailed buyers' financing records allow us to control the financing effect. Third, our datasets are from Guangzhou city, which is one of China's four first-tier cities that have experienced the most intensive housing market boom in the past decade. Low-income nonhomeowners have housing affordability problems. Although there was a prohibition on families owning a third house, short-term investors still can flip houses by selling one house and buying another house, as there is no restriction on a house’s minimum holding period before

Table 1: Summary Statistics of House Transaction Records in Guangzhou, China (2013-2016)

Variables	Short-term Investors		First-time Buyers		Long-term Investors		Secondary House Buyers	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Fundamentals								
Transaction Price (000 yuan)	939.36	500.88	1372.41	687.26	1363.55	889.36	2240.06	1184.23
List Price (000 yuan)	1033.29	539.08	1408.07	732.8	1431.56	955.25	2312.3	1276.58
House Time On the Market (months)	19.45	24.24	28.77	33.3	27.59	32.28	35.04	36.86
Financing								
Loan to Value Ratio	0.08	0.21	0.46	0.26	0.18	0.25	0.25	0.25
Commercial Loan	0.06	0.19	0.3	0.27	0.12	0.21	0.18	0.23
Housing Provident Fund Loan	0.02	0.1	0.16	0.22	0.05	0.14	0.07	0.13
Full Cash	0.81	0.39	0.2	0.4	0.57	0.5	0.39	0.49
Loan Term (years)	1.15	4.31	10.86	6.91	1.83	4.46	4.88	6.3
Attributes								
Area (m^2)	55.72	24.44	80.28	27.53	61.84	37.24	98.65	39.14
Top Floor	0.07	0.26	0.07	0.26	0.06	0.24	0.05	0.23
Elevator	0.31	0.47	0.53	0.5	0.59	0.49	0.7	0.46
Location (km)								
Distance to								
Commercial Center	1.66	1.45	2.26	1.89	1.6	1.45	1.83	1.51
Primary School	0.58	0.61	0.93	0.79	0.66	0.57	0.84	0.76
Kindergarten	0.85	0.77	1.11	0.91	0.87	0.65	1.01	0.81
Metro Station	1.58	3.64	2.7	5.44	1.21	2.25	2.15	6.06
Pearl River	1.55	1.19	1.99	1.71	1.76	1.52	1.89	1.55
Park	1.21	0.9	1.79	1.37	1.43	1.08	1.64	1.08
Property Types								
Commercial House	0.71		0.9		0.81		0.9	
Privatized Public House	0.21		0.09		0.12		0.09	
Apartment	0.03		0		0.04		0	
Other	0.05		0.01		0.03		0.01	
Transaction Date								
Year 2013	0.33	0.47	0.37	0.48	0.33	0.47	0.3	0.46
Year 2014	0.27	0.44	0.19	0.39	0.23	0.42	0.18	0.39
Year 2015	0.29	0.45	0.3	0.46	0.27	0.45	0.36	0.48
Year 2016	0.11	0.32	0.14	0.34	0.16	0.37	0.15	0.36
Observations	194		6511		598		3062	

selling in the research period[1]. It is representative to study China's and developing countries' housing markets using data from Guangzhou city.

Table 1 reports the descriptive statistics of the main variables. The entire sample size is 10,788, including second-time house buyers and long-term investors. Note that in the empirical analysis, we use only the 6,705 samples of first-time buyers and short-term investors. The 194 short-term investors account for 1.8% of all types of buyers in our dataset, which is in accordance with Bayer et al. (2020) that high-volume flippers account for approximately 2% of house purchases during hot markets. We can see that the house transaction price and housing attributes of short-term investors are most relevant to first-time buyers among residential buyers, which indicates that short-term investors share the market with first-time buyers. However, compared with first-time buyers, short-term investors purchase houses with lower mean prices and lower mean TOM values. Regarding financing, first-time house buyers have a much lower proportion of full cash payments and a higher loan-to-value ratio than short-term investors, showing the distinct payment methods adopted by these two groups of buyers. In terms of property types, a privatized public house is owned by the seller through house privatization reform; it has equal rights with commercial houses in

[1] Detail regulation terms during the research period in Guangzhou can be referred to Guangzhou Government Office No.2011-3, No.2013-14, -44, No.2016-146.

accessing public resources, while the apartment has disadvantages. The apartment ratios are both low in the first-time buyer group and the short-term investor group. Since our research focuses on the problem of first-time homeownership affordability and short-term investor arbitraging, we use subsamples of short-term investors and first-time buyers' records in the following empirical analysis.

6. Empirical results

6.1 Model Estimates

The OLS regression results in the middle panel of Table 2 show that after controlling for house attributes, location, transaction date, and cash payment, the *Short-term Investors* dummy variable[2] is significantly negative, indicating that short-term investors pay significantly less than first-time buyers. However, we are unclear about short-term investors' mechanisms for purchasing houses at low prices from OLS. First, the buyer's search cost is unobservable to researchers, and we cannot prove that short-term investors have an information advantage. Second, we cannot separate the effects of cash payments and information, even though we have estimated both coefficients of *Full Cash* and *Short-term Investors*. Table 3 illustrates that these two variables are positively related at the 0.25 level, indicating collinearity that biases the results. Third, we observe a cash premium

[2] *Short-term Investors* dummy variable equals one if the buyer is a short-term investor, and zero if he is a first-time buyer since we only use these two kinds of buyer samples in the empirical analysis.

in the OLS regression instead of a cash discount. The quantile regression in Figure 1 supports this hypothesis by showing that the higher the house price quantile is, the higher the full cash transaction premium. Therefore, we perform structural estimation and counterfactual analysis to investigate short-term investors' information and financing advantage over first-time buyers and the effects on housing prices.

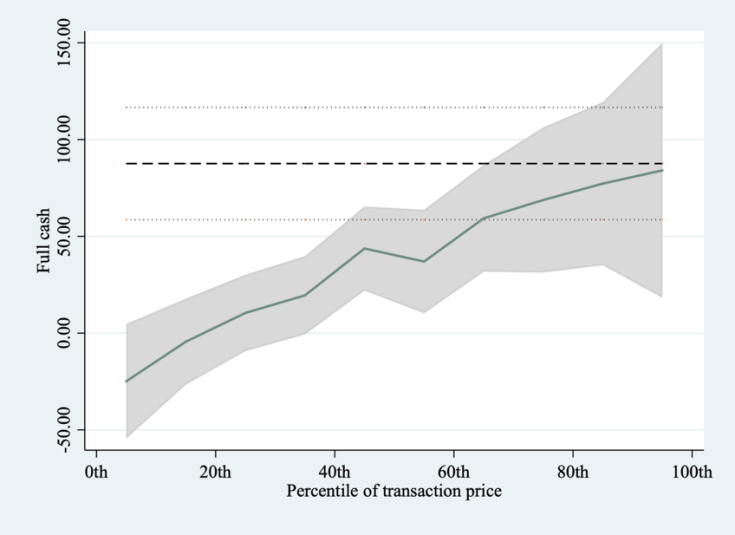

Figure 1: Quantile Regression of *Full Cash*

Table 2: Model Estimates

Variables	OLS regression	Structural Estimation (First-time buyer)	Structural Estimation (Short-term investor)
	Dependent Variable: Transaction Price (000 yuan)		
Buyers' Type			
Short-term Investors	-136.03***	-	-
Cash payment	71,34***		
Attributes			
House Area (m^2)	14.48***	12.81 (0.13)	10.45 (0.86)
Top Floor	-109.56***	-115.00 (0.03)	-64.23 (0.38)
Elevator	424.64***	421.16 (0.31)	333.68 (14.25)
Commercial housing	43.35***	25.37(0.33)	112.78 (3.93)
Location			
Distance (km) to			
Commercial	-46.61***	-43.54 (2.28)	-38.00 (12.43)
Center			
Hospital	-26.87***	-24.88 (0.54)	-22.26 (3.19)
Park	2.19	-3.6 (1.60)	-40.92 (7.19)
Pearl River	-16.78***	-21.01(1.51)	6.23 (7.61)
Transaction Date			
Year 2014	148.26***	149.05 (0.17)	-4.54 (6.64)
Year 2015	146.74***	139.62 (0.41)	-56.50 (6.71)
Year 2016	208.44***	203.92 (0.26)	-26.92 (9.07)
Other Attributes			
Constant	144.81***	254.20 (0.43)	521.90 (36.05)
σ_ϵ (SD of unobserved attributes)		428.23 (1.11)	323.97 (15.80)
Buyer's Parameters			
τ (Short-term investor's additional cost of flipping)	-	-	136.99 (22.64)
r (buyer's expected return rate)	-	0.2 (0.00)	0.2 (0.00)
Seller's Parameters			
d_1 (Parameter of the seller's pricing function)	-	1.02 (0.00)	0.94 (0.02)

d_2 (Parameter of the seller's pricing function)	-	200 (0.00)	200.00 (0.00)
μ_θ (Mean of the seller's bargaining power distribution)	-	0.89 (0.01)	0.74 (0.04)
σ_θ (SD of the seller's bargaining power distribution)	-	2e-3(0.00)	0.01 (0.02)
μ_ω (Mean of the seller's valuation less the buyer's)	-	-122.35 (5.80)	-192.32 (26.28)
σ_ω (SD of the seller's valuation less the buyer's)	-	300 (0.00)	300.00 (0.00)
Observations	6,705	6,511	194
(Pseudo) R-squared	0.59	0.67	0.76

Note. Standard errors are in parentheses. $***p < 0.01$.

Part of the structural estimation results are shown in the right panel of Table 2. In terms of the structural model's goodness of fit, we construct pseudo R-squared $\hat{R}^2$ as Carrillo (2012),

$$\hat{R}^2 = 1 - \frac{\sum_{i=1}^{n}\left(p_i - E\left(p_i \middle| X_i, p_{L_i}\right)\right)^2}{\sum_{i=1}^{n}(p_i - \bar{p})^2}, \quad (1)$$

where $E\left(p_i \middle| X_i, p_{L_i}\right)$ is the expected transaction price, $\bar{p}$ is the sample mean of transaction prices, and n is the sample size. The first-time buyer's model's $\hat{R}^2$ is 0.67 (while the short-term investor's is 0.76) , as shown in Table 2, indicating greater fitness of the structural model than the OLS regression in terms of predicting transaction prices. The structural estimation and the OLS regression

display the same sign and similar coefficients regarding housing attributes, locations and transaction time. The standard deviation of the unobserved attribute value σ_ϵ is 428 thousand for the first-time buyer (324 thousand for the short-term investor), which is also similar to 527 thousand of the residuals' standard deviation in the OLS regression. For the buyer's parameters in model structures, the short-term investor has additional cost of 137 thousand to pay transaction fee and bear uncertainty of holding the house during reselling. The buyers have expected return rate of 20% from owning the houses. In terms of the sellers' valuation determining function, the list price coefficient d_1 is 1.02 and d_2 is 200, implying that most of the seller's valuation can be learned from the list price and the housing attributes. The mean of the seller's bargaining power distribution μ_θ is 0.89, showing that the housing market during 2014-2016 is a seller's market. μ_ω is -122 thousand, representing that the sellers' valuation, on average, is on average 122 thousand less than the first-time buyer's value.

The nonparametric estimates of buyers' search cost distributions are shown in Figure 2. The short-term investors have lower search costs than first-time buyers. The median search cost of first-time buyers is 0.98 thousand yuan per month of searching, while the median search cost of short-term investors is 0.90 thousand yuan per month of searching, 92% of the cost to first-time buyers.[3]

[3] Since the buyers' search cost distribution is right skewed, we use the median to better represent the overall buyers' search cost.

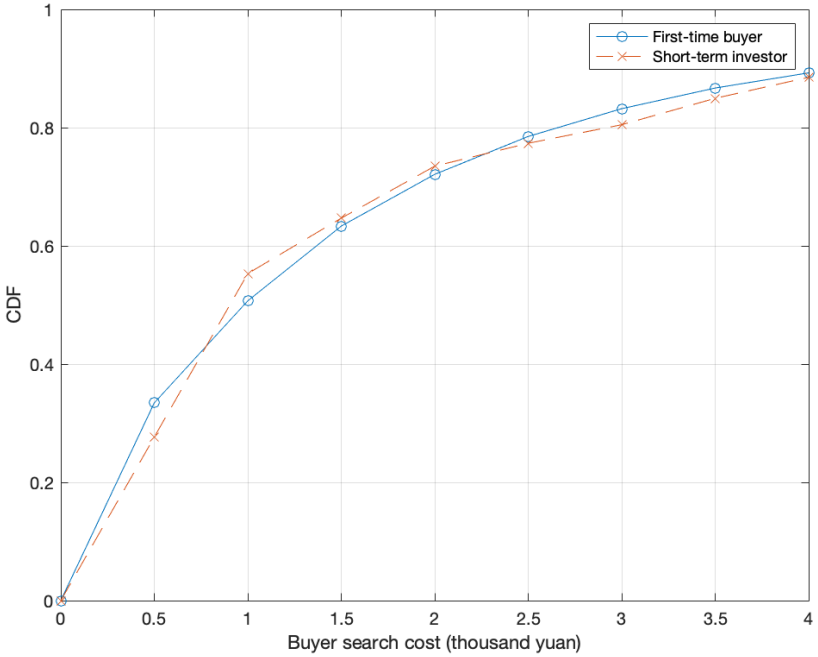

Figure 2: Buyers' Search Cost Distribution

Table 3: Pearson Correlation Coefficient of *Short-term Investors*

Variables	Pearson Correlation Coefficient with *Short-term Investors*
Payment	
Full Cash	0.25***
Attributes	
House Area (m^2)	-0.15***
Top Floor	0.00
Elevator	-0.07***
Location	
Distance (km) to	
Commercial Center	-0.05***
Primary School	-0.07***
Kindergarten	-0.05***
Metro	-0.04***
Pearl River	-0.04***
Park	-0.07***
Transaction Date	
Year 2014	0.03***
Year 2015	0.00
Year 2016	-0.01

Note. $***p < 0.01$.

6.2 Counterfactual Experiments

Table 1 has shown that short-term investors have a much higher ratio of making full cash payments than first-time buyers, and Figure 2 has illustrated that short-term investors have lower search costs than first-time buyers. However, what are the consequences of these variances? Are the higher proportion of full cash payments and lower search costs advantages of short-term investors in terms of purchasing lower price houses? In this section, we show how these differences influence housing prices using a counterfactual analysis of the baseline model. We use the first-time buyers' parameters in the baseline model, including parameters from the structural estimates of the right panel of Table 2, the median search cost, the mean loan-to-value ratio, the loan term from Table 1 and interest rate from the China Stock Market & Accounting Research Database and Rong360.

First, we conduct a counterfactual analysis of the search cost, loan-to-value ratio. As shown in the left panel of Figure 3, if the first-time buyers' search cost of 0.98 thousand yuan per month of searching decreases to the short-term investors' level of 0.90 thousand, *ceteris paribus*, the expected transaction price will drop by 0.56 thousand yuan which is consistent with the prediction of Proposition 1.

In addition, we can see from Figure 4, if the first-time buyers' average loan-to-value ratio of 0.46 decreases to the short-term investors' level of 0.08, the expected transaction price will be lessened by 5.77%.

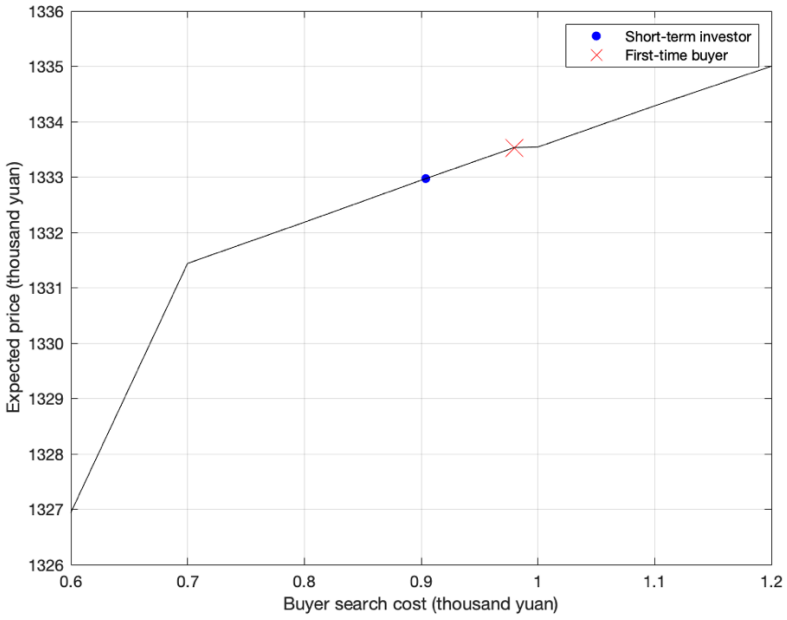

Figure 3: Counterfactual Analysis of Search Cost

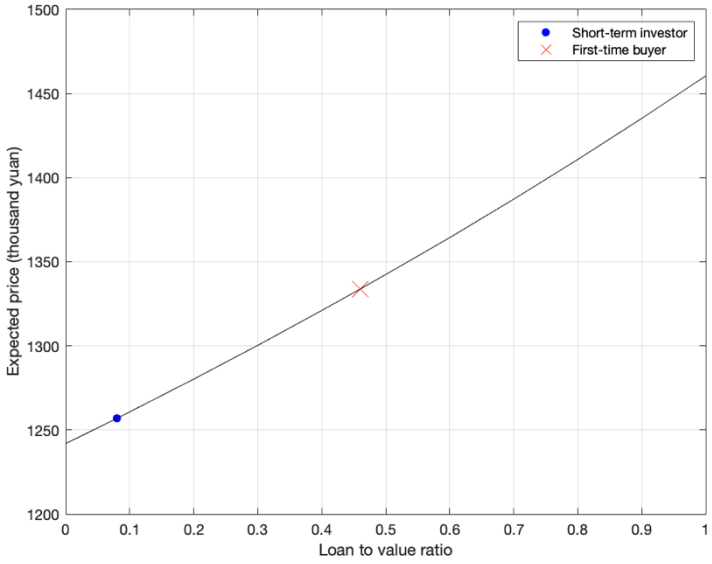

Figure 4: Counterfactual Analysis of Loan to Value Ratio

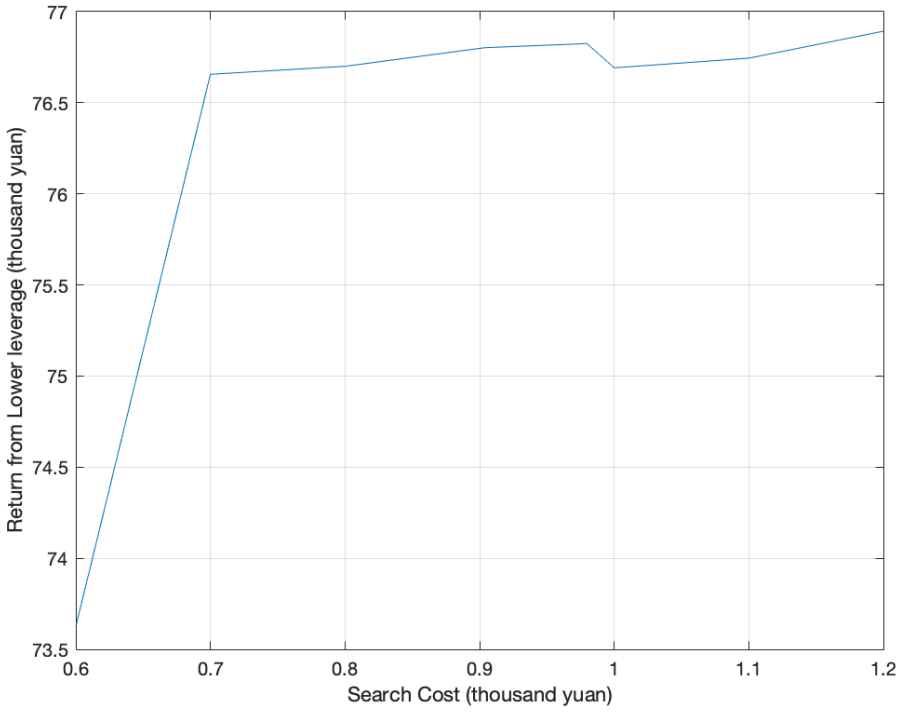

Figure 5: Search Cost's Effect on Return from Lower- Leverage

We also learn that the full cash payment will bring a discount of 6.90% to first-time buyers. The results of the loan-to-value effect on the house price are in line with Proposition 2. The results indicate that short-term investors' lower search costs, the higher proportion of full cash payments make their house transaction prices lower than those of first-time buyers. We further find that the short-term investor's return from lower-leverage is decreasing with first-time buyer's search cost as shown in Figure 5, which is in line with Proposition 2.

In conclusion, short-term investors purchasing houses at lower prices than first-time buyers because their information advantage and lower-leverage

advantage. If the first-time buyer has lower search cost, it will weaken the short-term investor's lower-leverage advantage.

7. Discussion

Our findings show that expected house transaction prices increase with the buyer's search cost and loan-to-value ratio. Given the lower search cost and loan-to-value ratio of short-term investors, that are the information advantage and lower-leverage advantage, they purchased houses at relatively lower prices than first-time buyers. And the return from lower-leverage advantage decreases with the first-time buyer's search cost.

Information is of vital importance to house buyers. Proposition1 illustrates that the higher the search costs, the more buyers will choose a search strategy of a lower reservation gain, resulting in a higher expected transaction price. This prediction is consistent with previous models of house buyer searches (Lambson et al., 2004; Turnbull & Sirmans, 1993). As a result, we complement the studies of buyer search models (Chernobai & Hossain, 2012; Lambson et al., 2004; Turnbull & Sirmans, 1993) and the seller search model (Bian et al., 2018) by theoretically illustrating how mortgage influences the buyer search, and how the effect of mortgage on house price is reinforced by a lack of information.

The nonparametric estimate of a buyer's search cost distribution on the basis of Proposition 1 gives us a full picture of housing market friction and provides a foundation for studying the casual effect of buyer information on house prices.

Carrillo (2012) and Shimizu et al. (2003) estimate buyers' search costs of $506 and $1,700. We extend the previous studies by showing that the buyer search cost distribution has a long tail as Figure 2, which may represent the few wealthy first-time buyers with high and dispersed search costs and the majority of first-time buyers with regular search costs. The similarity of most buyers' search costs suggests that buyer search costs are mainly determined by public factors such as transportation convenience (Shimizu et al., 2003) and information dissemination efficiency (Carrillo, 2012). The estimates of buyer search costs allow us to quantitatively illustrate as Figure 3 that first-time buyers pay 560 yuan more than short-term investors for 9% higher search costs, *ceteris paribus*, and avoid the potential bias of previous studies using proxy variable (Anglin, 1997; Lambson et al., 2004; Turnbull & Sirmans, 1993). The empirical result of the effect of buyer search costs on house prices is consistent with Proposition 1.

In the exploration of mortgage's effect on house prices, we find it diminishes with house prices, as in Figure 1, which was also found by previous studies (Hansz & Hayunga, 2016; Jauregui et al., 2017; Seo et al., 2021; Tidwell et al., 2018). We find that the short-term investor purchases houses at 5.77% lower than the first-time buyer due to lower-leverage advantage as Figure 4, which is consistent with the prediction of Proposition 2. As for return from lower-leverage advantage at different buyer information levels, Han and Hong (2022) find that experienced buyers have larger cash discounts than out-of-state buyers, implying that buyer information may have an impact on cash discounts. We find that the short-term

investor’s return from lower-leverage increases with the first-time buyer's search cost, *ceteris paribus*. We complement the study of Han and Hong (2022) by providing a theoretical prediction as Proposition 2 and counterfactual analysis as Figure 5 of how search costs influence the return from lower-leverage advantage.

The previous studies of short-term investors (Chinco & Mayer, 2016; DeFusco et al., 2017; Gao et al., 2020) emphasize the effects of investments on the overall housing market, but few analyze the micro behaviors of buyers. Bayer et al. (2020) find that purchasing a house at a relatively low price is one source of short-term investors' profit. However, they do not study why short-term investors purchase low-priced houses. Our results of Proposition 2, Figure 2 and Figure 3 imply that, although short-term investors do not have the information capacity to anticipate house price peaks (Bayer et al., 2020), they have an information advantage over first-time buyers and purchase relatively low-priced houses. In addition, short-term investors have a higher full cash payment proportion, as illustrated in Table 1; they also have greater lower-leverage advantage compared with first-time buyers, as shown in Proposition 2 and Figure 3. Therefore, information advantage and lower-leverage advantage are the mechanisms by which short-term investors purchase houses at lower prices.

One way to cut down short-term investors’ return form purchasing houses at lower prices is to reduce the first-time buyers' search costs. Lowering first-time buyers' search costs to the level of short-term investors not only directly lowers first-time buyers' transaction price as Figure 3, but also indirectly reduces the

transaction price by reducing the short-term investor's return from lower-leverage as Figure 5. Both effects of first-time buyers' search cost reduction improve first-time buyers' ability to afford a house and narrow the short-term investors' return of purchasing lower price houses. Thus, the government should improve the public information infrastructure of the housing market, such as the official listing platform.

8. Conclusion

The short-term investors in housing market profit from purchasing houses at lower prices by their information and lower-leverage advantage. Theoretically, we show that the short-term investor buyer purchase houses at lower price due to his lower search cost and lower leverage. Our empirical analysis uses data distinguishing first-time buyers and short-term investors and containing their payment information. The descriptive statistics show that first-time buyers have a higher loan-to-value ratio. Then, we estimate nonparametric buyers' search cost distribution and conduct counterfactual analyses based on the empirical model using the structures from the theoretical model. We find that short-term investors purchase houses at 5.77% lower than the first-time buyer because his lower leverage advantage. We also find that the short-term investors' return from lower leverage decreases with the first-time buyers' search cost.

Our results address the importance of buyer information and mortgage in determining houses price, and a driving force of short-term investor's flipping. To

cut down short-term investors return from purchasing houses at lower prices, the government should improve public information infrastructure to reduce the short-term investor's return rate, and increase the mortgage convenience of first-time buyers. As a result, short-term investors' flipping activities would be reduced, and the housing market would become more stable and more efficient in allocating affordable housing resources to those in need and protecting people's wellbeing and social equity.

It is clear that our theoretical model has some limitations. We model how sellers set their list price in reduced form; however, the list price is the outcome of the seller's optimal strategy directing buyers (Arnold, 1999; Chen & Rosenthal, 1996; Han & Strange, 2016). Future work could include the behaviors of sellers setting their list price and the interplay between buyers and sellers to depict a comprehensive housing market and derive more knowledge about the effects of buyer's information and financing on the housing market. In the empirical analysis, we use housing transaction data from Guangzhou during the housing boom. Future research could use data from other regions and backgrounds to investigate the behaviors of first-time buyers and short-term investors and their impacts on the housing market.

Reference

Anglin, P. M. (1997). Determinants of buyer search in a housing market. *Real Estate Economics*, *25*(4), 567-589.

Arnold, M. A. (1999). Search, Bargaining and Optimal Asking Prices [https://doi.org/10.1111/1540-6229.00780]. *Real Estate Economics*, *27*(3), 453-481. https://doi.org/https://doi.org/10.1111/1540-6229.00780

Asabere, P. K., Huffman, F. E., & Mehdiany, S. (1992). The Price Effects of Cash versus Mortgage Transactions. *Real Estate Economics*, *20*(1), 141-154.

Bagnoli, M., & Bergstrom, T. (2005). Log-concave probability and its applications. *Economic Theory*, *26*(2), 445-469.

Bayer, P., Geissler, C., Mangum, K., & Roberts, J. W. (2020). Speculators and Middlemen: The Strategy and Performance of Investors in the Housing Market. *The Review of Financial Studies*, *33*(11), 5212-5247. https://doi.org/10.1093/rfs/hhaa042

Bian, X., Lin, Z., & Liu, Y. (2018). House price, loan-to-value ratio and credit risk. *Journal of Banking & Finance*, *92*, 1-12.

Carrillo, P. E. (2012). An Empirical Stationary Equilibrium Search Model of the Housing Market. *International Economic Review*, *53*(1), 203-234. https://doi.org/10.1111/j.1468-2354.2011.00677.x

Chen, K., & Wen, Y. (2017). The great housing boom of China. *American Economic Journal: Macroeconomics*, *9*(2), 73-114.

Chen, Y., & Rosenthal, R. W. (1996). Asking Prices as Commitment Devices. *International Economic Review*, *37*(1), 129-155. https://doi.org/10.2307/2527250

Chernobai, E., & Hossain, T. (2012). House Search Duration in Hot and Cold Residential Markets. *Real Estate Economics*, *40*(4), 805-837. https://doi.org/10.1111/j.1540-6229.2012.00329.x

Chinco, A., & Mayer, C. (2016). Misinformed speculators and mispricing in the housing market. *The Review of Financial Studies*, *29*(2), 486-522.

Claeys, G., Efstathiou, K., & Schoenmaker, D. (2019). Soaring House Prices in Major Cities: How to Spot and Moderate Them. *Hot Property*, 169.

DeFusco, A. A., Nathanson, C. G., & Zwick, E. (2017). *Speculative dynamics of prices and volume*.

Fu, Y., & Qian, W. (2014). Speculators and price overreaction in the housing market. *Real Estate Economics*, *42*(4), 977-1007.

Gao, Z., Sockin, M., & Xiong, W. (2020). Economic consequences of housing speculation. *The Review of Financial Studies*, *33*(11), 5248-5287.

Gay, S. (2015). *Investors effect on household real estate affordability*. https://ssrn.com/abstract=2602414

Han, L., & Hong, S.-H. (2022). *Cash Is King? Evidence from Housing Markets*. http://faculty.las.illinois.edu/hyunhong/cash_buyer.pdf

Han, L., & Strange, W. C. (2016). What is the role of the asking price for a house? *Journal of Urban Economics*, *93*, 115-130. https://doi.org/10.1016/j.jue.2016.03.008

Hansz, J. A., & Hayunga, D. K. (2016). Revisiting cash financing in residential transaction prices. *Real Estate Finance, Summer*. https://ssrn.com/abstract=2901885

Hung, M.-w., & So, L.-c. (2012). How Much Extra Premium Does a Loss-averse Owner-occupied Home Buyer Pay for His House? *The Journal of Real Estate Finance and Economics*, *45*(3), 705-722. https://doi.org/10.1007/s11146-010-9293-9

Jauregui, A., Tidwell, A., & Hite, D. (2017). Sample Selection Approaches to Estimating House Price Cash Differentials. *The Journal of Real Estate Finance and Economics*, *54*(1), 117-137. https://doi.org/10.1007/s11146-015-9529-9

JPMorgan Chase Co. (2021). *The long-term impact of COVID-19? Housing affordability*. https://www.jpmorgan.com/insights/research/post-pandemic-housing-

affordability

Lambson, V. E., McQueen, G. R., & Slade, B. A. (2004). Do out-of-state buyers pay more for real estate? An examination of anchoring-induced bias and search costs. *Real Estate Economics*, *32*(1), 85-126.

Lusht, K., & Hansz, J. A. (1994). Some Further Evidence on the Price of Mortgage Contingency Clauses. *Journal of Real Estate Research*, *9*, 213-218.

Merlo, A., Ortalo-Magné, F., & Rust, J. (2015). THE HOME SELLING PROBLEM: THEORY AND EVIDENCE. *International Economic Review*, *56*(2), 457-484. https://doi.org/https://doi.org/10.1111/iere.12111

National Association of, R. (2018). *Buyer bios: profiles of recent home buyers and sellers*. https://cdn.nar.realtor/sites/default/files/documents/2018-buyer-bios-profiles-of-recent-home-buyers-and-sellers-11-02-2018.pdf

Seo, Y., Holmes, C., & Lee, M. (2021). Examining the Cash-Only Price Discount and the Driving Forces of Cash-Only Transactions in the Housing Market. *The Journal of Real Estate Finance and Economics*. https://doi.org/10.1007/s11146-020-09807-z

Shimizu, C., Nishimura, K. G., & Asami, Y. (2003). *Measuring the Cost of Imperfect Information in the Tokyo Housing Market*. https://ideas.repec.org/p/tky/fseres/2003cf238.html

Stigler, G. J. (1961). THE ECONOMICS OF INFORMATION. *Journal of Political Economy*, *69*(3), 213-225.

Tidwell, A., Jauregui, A., Sah, V., & Narwold, A. (2018). Cash and distressed house sales price discounts: Dual sample selection spatial interdependence approaches. *The Journal of Real Estate Finance and Economics*, *56*(1), 101-139.

Turnbull, G. K., & Sirmans, C. F. (1993). Information, search, and house prices. *Regional Science and Urban Economics*, *23*(4), 545-557. https://doi.org/https://doi.org/10.1016/0166-0462(93)90046-H