Habitat International 117 (2021) 102442

Contents lists available at ScienceDirect

Habitat International

journal homepage: www.elsevier.com/locate/habitatint

Review article

Identifying the critical factors behind the second-hand housing price concession: Empirical evidence from China

Weidong Qu [a], Yiqi Huang [a,*], Guoying Deng [b]

[a] Department of Land and Real Estate Management, Renmin University of China, No. 59 Zhongguancun Street, Haidian District, Beijing, 100872, China
[b] School of Economics, Sichuan University, No. 24 South of the Ring Road, Wuhou District, Sichuan, 610065, China

ARTICLE INFO

JEL classification:
D82
D83
R31

Keywords:
Second-hand housing transactions
Price concession
Real estate broker
Spatio-temporal autoregression
China

ABSTRACT

The seller's price concession reflects the existence of asymmetric information in the second-hand housing market, and it is beneficial to study the influence of the broker's commission incentive source on the information transmission in the process of second-hand housing transactions. This study examined 310,332 transactions in 17 cities, using the spatio-temporal autoregressive model. Results mainly revealed price concession under the both-sides broker commission arrangement was 1.64% significantly lower than that under the buyer-side commission. The broker commission incentive has a moderating effect on the transmission of market information during transactions, whereas the both-sides commission leads to an increase in the effect of objective market conditions and reduces the difference of effects of individual factors on price concessions. An exogenous demand shock may lead to a change in the relationship between brokers' actions and sellers' pricing strategies. The implications will serve to improve the norms of and transparency in the second-hand housing transaction market, and resolve the disparity between the broker agent mode and commission incentive scheme.

Declaration of interest

None.

1. Introduction

The second-hand housing market is a significant aspect of the liquidity and management of urban housing assets. Compared with the new housing market, the stock housing market exhibits a significantly more dispersed housing supply and a higher degree of privacy in transactions, which means increased searching costs that reduce the market efficiency. Drawing on the information asymmetry theory in second-hand markets put forward by Akerlof (1970), the sellers in second-hand housing markets have the advantage of information on unobserved housing and individual characteristics (De Wit & van der Klaauw, 2013; Wong, Yiu, & Chau, 2012; Yang, Chau, & Chen, 2021). Even so, the sellers face uncertainty about market conditions and diverse preferences of buyers.

The existence of imperfect information makes the list price a signal to the potential buyers, integrating the seller's expectations of the market and subjective evaluation of the housing value (Spence, 1974; Lazear, 1986; Albrecht et al., 2016). After searching in the market and bargaining with buyers, the seller may gather some new information and learn more about the demand over time, which may result in a revision of the previous pricing (Merlo, Ortalo-Magné, & Rust, 2013; Merlo & Ortalo-Magné, 2004). Knight (2002) points out that listings with large percentage changes in list prices will take longer to sell, even at lower prices, which means that mispricing is costly to the seller. Therefore, studying the factors influencing sellers' price concessions is meaningful to understand the information asymmetry in the second-hand housing market and to find ways to improve the efficiency of the transaction.

To avoid increased search costs due to lack of information, buyers and sellers in the second-hand housing market mostly seek the assistance of brokers (Jud, 1983; Agarwal, He, Tien, & Changcheng, 2019). Brokers do help clients with information about the market and housing to some extent (Baryla & Zumpano, 1995; Zumpano, Elder, & Baryla, 1996), but several studies have expressed concern about the negative effects of principal-agent problems caused by the broker's information advantage (Agarwal et al., 2019), and about incentive distortions in an imperfect information market (Munneke & Yavas, 2001; Rutherford, Springer, & Yavaş, 2005; Barwick & Pathak, 2010; Sahin, Sirmans, & Yavas, 2013). Most previous studies focused on the impact of brokerage commission

* Corresponding author.
E-mail addresses: quwd@ruc.edu.cn (W. Qu), miggiehyq@ruc.edu.cn (Y. Huang), dengguoying@scu.edu.cn (G. Deng).

https://doi.org/10.1016/j.habitatint.2021.102442
Received 4 May 2021; Received in revised form 12 September 2021; Accepted 21 September 2021
Available online 29 September 2021

schemes on the time of sale and closing price (Yinger, 1981; Barwick, Pathak, & Wong, 2017; Johnson, Anderson, & Benefield, 2004; Rutherford, Springer, & Yavaş, 2001; Stelk & Zumpano, 2017), but there is a need for research on the relationship between the source of the commission and price reduction strategies. Whether and how the broker's commission source affects the seller's price concession decision is the main question this paper focuses on.

This study is unique in that it uses high-precision data from China's second-hand housing market and the practice of two commission sources of dual agents, innovatively combining the brokerage commission incentives with traditional market factors in the information flow and price cutting process of the second-hand housing transactions. Based on the spatio-temporal autoregressive model, the findings on the second-hand housing markets of 17 cities in China from June 2016 to October 2020 indicate that price concessions are smaller under the both-sides broker commission arrangement. It was also found that the commission incentives affect the transmission of both market and individual information during sellers' list price concession process.

The remainder of this paper is structured as follows: a review of relevant literature, followed by the background introduction of the second-hand housing transaction market in China and the hypotheses of research in Section 3. Section 4 elaborates on the empirical methodology and data source, while Section 5 presents the empirical results, followed by discussions in Section 6. Conclusions and limitations are summarized in Section 7.

2. Literature review

2.1. Price concession in second-hand housing market

Drawing on the research about the ascertainment of price in markets with imperfect information by Stigler (1961), information asymmetry is noted as a prominent feature of the search process in the second-hand housing market. Sellers are uncertain about the number of potential buyers and their various preferences at any given time, while the buyers experience difficulty in fully understanding the real attributes of the properties due to the heterogeneity in the housing market. A listing price is therefore often regarded as a signal to the buyer of the unobserved properties of the housing and the seller's motivation for and willingness to sell (Benjamin & Chinloy, 2000; Herrin, Knight, & Sirmans, 2004; De Wit & van der Klaauw, 2013). Lazear (1986) points out that the initial price is a function of the information the seller has about heterogeneous goods and potential buyers. The initial price can be supplemented using additional information such as the seller's urgency, market changes, and obscured negative housing characteristics reflected by subsequent price adjustments. The frequency and the size of price concessions are functions of what has been learned that takes place during the marketing period (Lazear, 1986; Knight, 2002). After setting a high price, the seller will learn about the market reaction over time and revise the listing price downwards (De Wit & van der Klaauw, 2013; Merlo et al., 2013; Merlo & Ortalo-Magné, 2004). Price concessions are common in the housing market, as evidenced in the study of Knight (2002): 38.4% of the properties sold underwent at least one price adjustment. Studies from the Netherlands and the United Kingdom suggest that 20%-40% of sellers in the housing market will modify the initial list price (Merlo & Ortalo-Magné, 2004; Herrin et al., 2004; De Wit & van der Klaauw, 2013).

Price concessions are mainly affected by market factors. Considering the uncertainty of demand, a reduction in the list price is more likely to happen during a particular market cycle than in other periods (De Wit & van der Klaauw, 2013; Liu & van der Vlist, 2019). Hoeberichts, van Rooij, and Siegmann (2013) showed that decreases in list prices are more prevalent during a market boom, while list price adjustments are less likely to occur during a market bust. Sass (1988) found that in thinner markets, where there are less potential buyers in a submarket, such as very expensive housing, prices are reduced faster than in the ordinary market. Conversely, Herrin et al. (2004) provided evidence to the effect that owners whose houses in thinner markets are less likely to reduce their prices. Additional information about the prevailing market conditions can also be obtained from sales during the recent past. In a market with a high turnover rate, where there is more information available to sellers about what the appropriate pricing strategy given the current demand may be, they can be expected to exhibit less sensitivity to prices and be less inclined toward rapid price reductions (Sass, 1988). Homeowners also need to balance the marginal utility increase from higher prices with the reduction in marginal utility from the property spending a longer time on the market (TOM). Due to some reasons that buyers are not easy to observe, such as the immigration, liquidity constraints, and the urgency of the sale, the seller's preference for TOM and securing the listing price may change (Hayunga & Pace, 2017). Given the cost of holding on to the property, sellers often reduce their prices to improve their competitiveness in attracting potential buyers and to ensure a quick transaction.

2.2. Real estate brokerage in second-hand housing transactions

In the literature on real estate brokerage, there is consensus that the imperfect flow of information is the main reason for the emergence of the real estate broker (Yinger, 1981; Jud, 1983; Wu & Colwell, 1986). The transaction cost theory suggests that the process includes pre-costs ascribed to information search, information exchange, matching and contract negotiation, and post-costs such as bargaining and supervision (Williamson, 1985). Because real estate brokers are more informed about houses on sale, the market conditions, buyers and sellers, and are experts in the housing transaction process, they can reduce transaction costs by internalizing the externality of the transaction process and creating value (Yavaş, 1992). Baryla and Zumpano (1995) suggest that choosing a broker will improve the marginal efficiency of a search, and make it more likely to reach a satisfactory match between a seller and buyer earlier in the search process. Huang and Rutherford (2007) also find that compared with Realtor listings, non-Realtor listings sell at lower prices, but take longer time on market and less likely to sell.

However, information asymmetry can also induce the principal-agent problem, which means that the broker's actions will not always meet the seller's or buyer's goals (Jud & Frew, 1986; Yavaş, 1992; Han and Strange, 2015; Turnbull & Waller, 2018). The principal-agent theory (Arrow, 1985) indicates that moral hazards and adverse selections may occur in the relationship between brokers, sellers, and buyers, since buyers and sellers have an information disadvantage in not only the housing transaction but also the skills and efforts of agents (Han and Strange, 2015). The goal of a broker's service is to maximize commission income, and an extensive study of literature has examined the commission arrangements that distorts the broker's incentives (Munneke & Yavas, 2001; Rutherford et al., 2005; Bernheim & Meer, 2013). Based on housing transaction data in Singapore, Agarwal et al. (2019) proposed that many real estate brokers might not reveal full information to the parties involved in the transaction because the effort needed to obtain the best possible prices for their clients is not commensurate with incremental increases in commissions. Brokers earning full-commissions are motivated to sell the properties of clients more quickly and at a higher premium than split-commission agents (Allen, Faircloth, Forgey, & Rutherford, 2003); properties with lower commission rates have a 5% less likelihood of being sold and takes 12% longer to sell (Barwick et al., 2017). Zeng, Yu, and Wen (2017) examines the relationship between buyers' agent commissions and selling price, and find that commission structure between the seller and the buyer's broker may cause principal-agent problems because the buyer's agent may not be in the best interests of the client.

The seller's price concession strategy and the behavior of real estate brokers were two of the areas of focus and concern in previous studies of the housing market. However, there are other aspects that also require research: First, the factors influencing list price reductions are varied,

from the states of the market to private information and, to compound it, prior empirical evidence has been mixed. The primary reason for this phenomenon may be that the data used in different studies reflect the uniqueness of the local market, and the measurement may also be subject to endogenous problems. Empirical research that considers the impact of information from previous transactions when analyzing the factors affecting price concession strategies is limited. This is also the main reason for using the spatio-temporal autoregression method in this study, to improve the results of research in this field. Second, real estate brokers in their role as mediators between the buyers and sellers of properties, contribute significantly to the process of second-hand housing transactions, but the impact of broker commission incentives on seller's decisions to reduce their prices is unclear, especially from the perspective of commission sources (the brokerage factors influence housing transactions in representative studies are presented in Table A.1 in **Appendix**). Unlike the separate listing and selling brokers, "dual agency", serving both seller and buyer in the same transaction, is legal and pervasive in China, which may lead to incentive conflicts because of the potentially biased position of the broker (Brastow et al., 2011). The contribution of this study to the literature is to introduce the broker's commission incentive into the analytical framework of the seller's price concession strategy, to analyze the different effects of market conditions and other factors under different commission sources, and to strengthen the relationship between real estate brokerages and the efficiency of information exchanges in the housing market.

3. Background and theoretical predictions

3.1. Second-hand housing market in China

Since the commodification of housing in 1990s, during the last two decades, China's housing market has been shifting from a new housing market to a second-hand housing market. Second-hand housing sales reached 6.53 trillion yuan in 2018, accounting for 34.1% of total housing sales in China, and the proportion of second-hand housing sales in Beijing and Shenzhen, two of Chinese first-tier mega-cities, have reached 76% and 69% respectively.[1] As a result, the second-hand housing market is a significant aspect of the liquidity and management of urban housing assets in China.

In 2019, the brokerage penetration rate in newly constructed and second-hand housing transactions n China reached 25.9% and 88.1%, respectively.[2] This reflects the different market structures between the two segments, and that real estate brokerage plays a prominent role in the stock housing market. Two notable, uniqueness characteristics of real estate brokerage in China are the way in which brokers serve their clients and how commissions are charged. Unlike in the United States, where there are "cooperating agents" and "listing agents", who work with buyers and with sellers respectively (Han and Strange, 2015), just one agent works for both the seller and the buyer in China. Due to the absence of a real estate market information system, such as multiple listing services in the United States, buyers and sellers sometimes choose to approach and compare different brokers' services and information at the same time (He, Dong, & Yu., 2018), which will increase the competition among brokers.

In most Chinese cities, the commissions are typically 2–4% of the sale price, which are borne by the buyers. If a price concession can reveal the presence of asymmetric information between the seller's initial price signal and the housing market (De Wit & van der Klaauw, 2013), there is a need to explore whether the commission source of dual agency has an influence on price concession strategies and information delivery in the second-hand housing market. Lianjia, one of the biggest professional real estate agencies in China, adjusted its second-hand housing transaction commission source from buyer-only to both buyer and seller in Chengdu, Jinan, Suzhou and Shanghai since around 2010. This situation allows for studying price concessions under two broker commission sources. Comparing the average trends of price concession under two broker commission sources in China (See Fig. 1), reveals that most of the time, the average price concession of cities with a both-sides broker commission is smaller than that of cities where commissions are only from buyers. This inspires the research on the reasons for the differences in price revision strategies of the seller under different broker commission sources.

3.2. Theoretical framework and hypotheses

The second-hand housing transaction process is considered as an information transmission system between sellers, buyers, brokers and the market (see Fig. 2). Sellers and buyers will collect information on their own through learning from the housing market, but they also benefit from information flows from their brokers, who are paid by the either one or both of the transacting parties.

Therefore, a price concession decision is a bundle of housing-related information, as expressed by Eq. (1):

$$\begin{aligned} Price\ Concession\ &= \alpha_0 + \alpha_1 MARKET + \alpha_2 TOM + \alpha_3 HOUSE + \alpha_4 PERSON \\ &+ \alpha_5 COMMISSON + \varepsilon_0, \end{aligned} \tag{1}$$

where *Price Concession* is the change in the sales price relative to the initial list price of property. *MARKET* includes the market conditions that influence the seller's pricing decisions, among which *market hotness* and *market thinness* are two of the most important market factors that influence the seller's pricing decisions. The housing returns from the real estate market, especially in China, are probably driven by some irrational factors and sentiment (Hui, Dong, Jia, & Lam, 2017). A hot market will release a signal on the strong demand in the local housing market, which means a given seller is more likely to meet with a buyer who accepts to pay the higher asking price, and the rational owner enjoys the opportunity of keeping the list price high without concern about long-term stagnation. In a thinner market, such as the mansion market, the pool of potential buyers is limited, which may prompt sellers to cut their listed prices more to attract buyers and to reduce the cost of searching (Sass, 1988). However, owners of high-value properties may have higher incomes and liquidity, or have a strong loss aversion, so the willingness to reduce prices may be weakened (Herrin et al., 2004).

TOM includes both the time-on-market of the owner (*TOM_seller*) and of the potential buyer (*TOM_buyer*). Assuming that search cost is an increasing function of the time-on-market, due to the trade-off between search costs and prices, price concessions are expected to be positively related to the seller's TOM, as opposed to the buyer's (Sass, 1988). From the perspective of unobserved information, a long TOM may be considered as the existence of hidden flaws by buyers that led to the price reduction.

HOUSE includes attributes of structure, accessibility, and neighborhood, which constitutes the value of the property. Most housing characteristics can be observed by buyers through visits to the house. Properties close to superior transport systems and educational resources may be prone to smaller price cuts.

Individual characteristics will affect the behaviors of the participants in an imperfect market (Zeng et al., 2017). *PERSON* comprises the seller's personal factors, including some accessible information like gender, age, and payment method, as well as personality, income, and other private information. Older owners may have more trading and pricing experience and their price reductions may be smaller. Besides, ε_0 contains other unobserved factors, such as the learning mechanism in

[1] Data source: QCRI (QIANZHAN Research Institute). (2019). FORWARD. EB/OL. https://bg.qianzhan.com/trends/detail/506/191107-915cb259.html. (Accessed 6 February 2021).

[2] Data source: BEKERI (BEKE Research Institute). (2020) BEKE. EB/OL. https://research.ke.com/. (Accessed 6 February 2021).

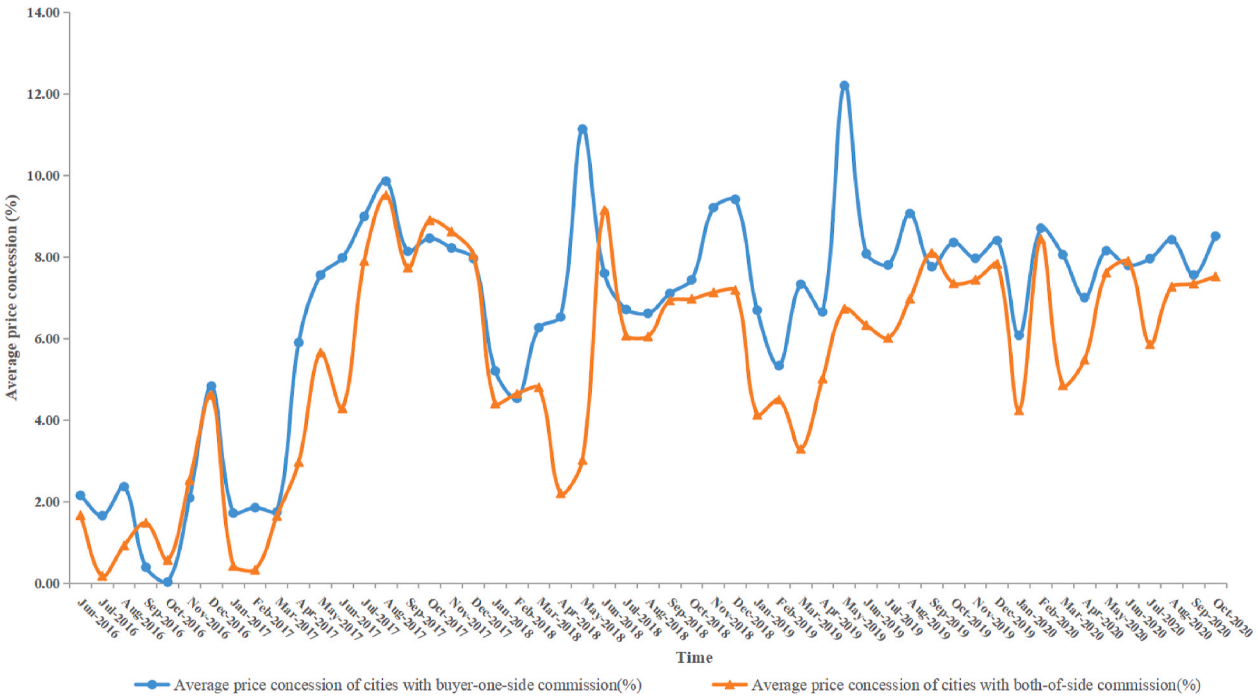

Fig. 1. Trends in the average price concession of the second-hand housing market in 17 cities of China.
Note: The data source is BEKE Research Institute.

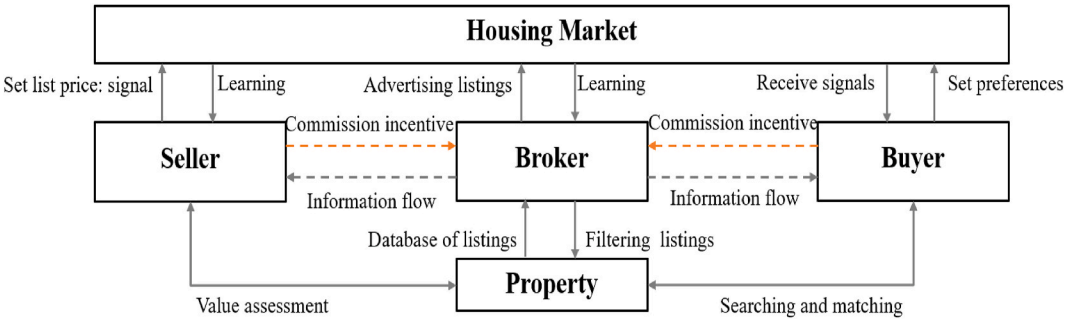

Fig. 2. Structure of information transmission in the second-hand housing transaction process.

which sellers refer to prior transactions for pricing.

The impact of the broker's incentive source should also be considered from the principle-agent perspective. *COMMISSON* is a dummy variable, where the buyer-side commission corresponds to 0 and both-sides commission to 1. The buyer-side commission will give the buyer more bargaining power in negotiations on the selling price, payment methods and commission rates. Due to the commission costs to be borne, the buyer will pay more attention to the efforts the broker exerts, and may even compare the quotations from other intermediaries to judge whether to stay with or leave the broker, which may increase competition among brokers and prompt them to distort the information transmission. Rational brokers are more inclined to use their information advantage to persuade the seller to accept the buyer's offer. However, under the both-sides commission source, the broker may tend to represent both the buyer and the seller, with less incentive to interfere with the bargaining power of both parties. Therefore:

Hypothesis 1. List price concession, to some extent reflecting the information asymmetry, is predicted to be smaller under the both-sides commission scheme.

The channels in which *COMMISSON* affects the price concession during the information transmission is now further analyzed. In China, brokers usually participate in the searching and matching process of housing transactions through four stages (Yang & Xu, 2018). First, the broker will advise the seller on setting the list price and set a certain ceiling on the list price. Theoretically, the price limit strategy is aimed at making the list price correspond with the real value of the market to achieve the matching and improve the turnover rate. Especially when the market is sluggish, it is beneficial to send the supply and demand signals to some sellers to correct their inflated pricing. Second, using the database of listings, brokers will select those that are cost-effective or urgent out of all the listings to focus on. This process is the stage at which brokers filter information to determine which listings are worth more concerted efforts. The broker will then take the buyer to the house, and share information about the owner and the property. Finally, the broker will act as intermediary in the seller–buyer bargaining process and have a subjective initiative in deciding which information to convey and which to obscure. As a result, commission incentives may influence brokers' actions, including sending, filtering, and hiding information and to change price decisions. Eq. (1) can be therefore expanded to Eq. (2) as follows:

$$Price\ Concession = \beta_0 + \beta_1 MARKET + \beta_2 TOM + \beta_3 HOUSE + \beta_4 PERSON + \beta_5 COMMISSON + \gamma_1 MARKET \times COMMISSON + \gamma_2 TOM \times COMMISSON + \gamma_3 PERSON \times COMMISSON + \varepsilon_1, \quad (2)$$

where $MARKET \times COMMISSON$ and $PERSON \times COMMISSON$ are interaction items, which respectively capture the effect of the market states and the seller's individual information on the price concession under the both-sides commission, relative to the buyer-side commission. Given that the buyer-side commission will distort the principal-agent relationship in the transaction, the broker will reduce the transmission of market information to the seller and screen the listing from less experienced seller. We therefore propose:

Hypothesis 2. The direction of the coefficients of $MARKET \times COMMISSON$ and $MARKET$ will be the same, which means the impact of objective market conditions on price concession is strengthened under the both-sides commission scheme.

Hypothesis 3. The direction of coefficients of $PERSON \times COMMISSON$ and $PERSON$ will be converse, which means the impact of private individual information is weakened under the both-sides commission scheme.

$TOM \times COMMISSON$ captures the effect of differences in commission sources on the speed of price reductions (Sass, 1988). If the broker is inclined to represent the buyer, the listings with a strong urgency to sell may be preferred by the broker, and the relatively weak bargaining power may induce the seller to sell faster. Therefore, our assumption about the speed of price concession is proposed as follows:

Hypothesis 4. The interaction item of $COMMISSON$ and the seller's time-on-market is predicted to have a negative coefficient, that means sellers will cut prices at a slower rate under the both-sides commission scheme.

4. Methodology

4.1. Data source

A high-precision second-hand housing transaction sample covering the period June 2016 to October 2020 from 17 main cities in China (see Appendix Fig. A.1), assembled by the Real Data Center of the BEKE Research Institute, which originated from Lianjia and can be considered representative of the second-hand housing transactions through real estate brokerage, was used. The original data set was week-by-week and consisted of 455,646 transactions. Data was trimmed by removing observations marked with missing or unreliable information, culminating in 310,332 reliable transactions. Every transaction comprises housing attributes and transaction details, including the date of transaction, initial listing price, final transaction price, time-on-market of seller, time-on-market of buyer, payment method and basic individual characteristics of the seller. GPS coordinates of each residential observation point were gathered to identify addresses through the Google API system. The data set included information on real estate broker commission sources, which are different among cities (see Appendix Table A.2). Due to the changes in sales volumes being more sensitive to market conditions than prices in the Chinese second-hand housing market, the monthly index of second-hand housing sales volume in different cities were used to reflect the local market hotness, which originated from CCHI.[3]

Table 1 displays the descriptive statistics of the main variables (the definitions and expected signs of variables showed in Table A.3). In view of the full sample, the price concession has a positive average at 5.6%, similar to the results obtained by De Wit and van der Klaauw (2013), in which the average list price reduction is 5.5%. The distribution of price concessions for the transactions in 17 cities and the Kernel density estimate results are depicted in Appendix Figs. A.2 and A.3, respectively. The average time for buyers and sellers spent in the market is 51 and 92 days respectively, reflecting sellers usually wait longer in the market than buyers.

4.2. Spatial temporal autoregressive model

The correlation from the spatio-temporal dimension could exist in the error terms of the traditional hedonic model because the price decision of the owner may be influenced by the pricing information of the previous transactions adjacent to the property (Clapp, Walter, & Dogan, 1995). Therefore, several studies tend to use some global spatial models, such as the simultaneous autoregressive estimator (SAR) (Pace & Gilley, 1998) and Bayesian framework (Gelfand et al., 1998), to address the spatial or temporal effects. Some researches use localized modeling techniques, such as the geographically weighted regression (GWR) technique (Brunsdon, Fotheringham, & Charlton, 1996; Fotheringham, Brunsdon, & Charlton, 2002; Nilsson, 2014), and the improved geographically and temporally weighted regression (GTWR) model (Huang, Wu, & Barry, 2010; Fotheringham, Crespo, & Yao, 2015), to capture spatial and temporal variations in local housing markets. Considering that the sample of this paper comes from 17 separate cities, the core variable, commission source, varies from the city level and the local model cannot capture the impact of its differences. Therefore, this article takes into account the spatio-temporal autoregressive model (STAR) proposed by Pace, Barry, Clapp, and Rodriguez (1998), which yields better predication precision than the standard hedonic model when used in a residential housing price context (LeSage & Pace, 2009; Liu & van der Vlist, 2019).

Following Pace et al. (1998), a basic model was developed to predict the price concession as

$$PC = \beta X + u, \quad (3)$$

in which PC is represented by a $(n \times 1)$ vector formed by price concession of n transaction observations, is regressed onto X, which is a $(n \times k)$ vector composed by k influencing factors with β as its corresponding coefficient vector, and u is the $(n \times 1)$ error vector of the model. The autoregression error process was followed to explain the correlated errors, expressed as

$$u = Wu + \varepsilon, \quad (4)$$

where W is the $(n \times n)$ vector of the spatial weighting matrix with temporal dimension by retaining previously sold properties as the possible neighbors to the target property, and ε is the white noise. Combining Eqs. (3) and (4), the price concession of second-hand housing transaction can be specified as Eq. (5)

$$PC = WPC + (\beta - W\beta)X + \varepsilon. \quad (5)$$

Based on the spatial statistics toolbox provided by Pace, Barry, Gilley, and Sirmans (2000) through MATLAB, the optimal number of neighbors are identified by ranking the calculated Euclidean distance between every pair of the target property and previous transactions. Assuming that the relative distance between the transactions from separate cities is far enough, the spatio-temporal lags of price concession from the previous transactions are obtained within every city.

[3] China City Housing Index was co-founded by the China Institute of Real Estate Appraisers and Agents (CIREA) and Hang Lung Center for Real Estate of Tsinghua University. The index to measure the relative rise and fall of the overall second-hand housing market in cities over a period was used.

Table 1
Descriptive statistics of all variables.

	Full sample					Buyer-side commission sample					Both-sides commission sample				
Continuous variables	Observations	Mean	St. Err.	Min	Max	Observations	Mean	St. Err.	Min	Max	Observations	Mean	St. Err.	Min	Max
Initial listing price (¥/m^2)	310,332	52349	28888	4077	533333	292,170	53686	28667	4077	533333	18,162	30837	23403	4231	186567
Final sale price (¥/m^2)	310,332	49366	27244	3308	533333	292,170	50608	27026	3308	533333	18,162	29379	22538	3913	177612
Price concession (%)	310,332	6	8	−98	94	292,170	6	8	−98	94	18,162	5	8	−70	92
Market hotness (2015 = 100)	310,332	175	25	100	255	292,170	175	24	117	255	18,162	172	35	100	252
TOM_seller (days)	310,332	91	118	0	1803	292,170	89	113	0	1707	18,162	123	181	0	1803
TOM_buyer (days)	310,332	51	113	0	2634	292,170	52	115	0	2634	18,162	31	72	0	1590
Bedrooms	310,332	2	1	1	5	292,170	2	1	1	5	18,162	2	1	1	5
Housing age (years)	310,332	18	9	3	35	292,170	18	9	3	35	18,162	13	9	3	35
Size (m^2)	310,332	82	35	15	845	292,170	82	35	15	721	18,162	89	39	19	845
Age_seller (years)	310,332	37	8	21	55	292,170	38	8	21	55	18,162	36	8	21	55

	Full sample		Buyer-side commission sample		Both-sides commission sample			Full sample		Buyer-side commission sample		Both-sides commission sample	
Discrete variables	Observations	Percentage	Observations	Percentage	Observations	Percentage	Discrete variables	Observations	Percentage	Observations	Percentage	Observations	Percentage
Commission source							Gender_seller						
Buyer-side (commission = 0)	292,170	94.15%	292,170	100%	0	0%	Male	166,067	53.51%	155,996	53.39%	10,071	55.45%
Both-sides (commission = 1)	18,162	5.85%	0	0%	18,162	100%	Female	144,265	46.49%	136,174	46.61%	8,091	44.55%
Market thinness							Marriage_seller						
non-villa	309,846	99.84%	291,818	99.88%	18,028	99.26%	Unmarried	95,295	30.71%	86,438	29.58%	8,857	48.77%
villa	486	0.16%	352	0.12%	134	0.74%	Married	215,037	69.29%	205,732	70.42%	9,305	51.23%
Payment method							Housing type						
Full payment	62,689	20.20%	58,895	20.16%	3,794	20.89%	Slab	180,001	58.00%	121,584	41.61%	8,747	48.16%
Mortgage	247,643	79.80%	233,275	79.84%	14,368	79.11%	Other	130,331	42.00%	170,586	58.39%	9,415	51.84%
School zone							Floor						
Out of school zone	167,765	54.06%	152,088	52.05%	15,677	86.32%	Low floor	83,829	27.01%	78,929	27.01%	4,900	26.98%
In school zone	142,567	45.94%	140,082	47.95%	2,485	13.68%	Top floor	226,503	72.99%	213,214	72.98%	13,262	73.02%
Subway							Decoration						
No subway nearby	115,801	37.32%	109,486	37.47%	6,315	34.77%	No decoration	15,537	5.01%	13,125	4.49%	2,412	13.28%
Subway nearby	194,531	62.68%	182,684	62.53%	11,847	65.23%	With decoration	294,795	94.99%	279,045	95.51%	15,750	86.72%

5. Empirical results

5.1. Influencing factors of price concessions

Before investigating the unobserved information from neighboring transaction deals, Table 2 indicates the preliminary results of factors that influence the price concessions by the ordinary least squares (OLS) method. The estimation process was conducted by stepwise regression method, and the coefficients of commission source were found to be always negative at the significance level of 1%. When fixed effects were controlled, both the market hotness and market thinness have negative impacts on price concessions. As the seller's time-on-market increased and the buyer's time-on-market decreased, the price concession increased, which supports our basic hypothesized theoretical framework. It was also found that the age and gender of the seller have significant impacts on price concessions, indicating the seller heterogeneity in the pricing strategy. In addition, if the buyer obtains a loan to purchase the property, the seller's price concession will be smaller. Owners of older properties will have a greater price discount.

To consider the possible spatio-temporal lagged effect of price concession, it must first be tested whether time and spatial autocorrelation exist among the data. Global Moran's I is a widely used and effective tool to measure spatial autocorrelation (Anselin, 1988). Calculated by spatial statistics tool in ArcGIS 10.2, Table 3 shows that the value of Moran's I for the residuals from the OLS model is 0.0324, and the z-score is 6.4035 which is significant. This indicates that spatio-temporal autocorrelations are present in the price concession.

Table 4(a) shows the full sample results of the STAR model by adding the spatial temporal lags. To compare the goodness-of-fit of the models, the adjusted R^2 of OLS and STAR are 0.2282 and 0.2991, respectively, indicating that the STAR model has a better explanation of variance in price concessions. The value of Moran's I for the residuals from the STAR model is −0.0001 and is not significant (see Table 3), indicating that most of the spatio-temporal lagged factors have been captured. The coefficient value of the spatio-temporal lag item is 0.0915 at a 0.1% significance level, indicating that the previous transactions had a positive spillover effect on the price concessions.

Table 3
Global Moran's I statistics.

	Moran's I	Z-score	P-value
OLS	0.0324	6.4035	0.0000
STAR	−0.0001	0.1720	0.8635

Notes: Global Moran's I statistics are calculated by the Spatial Statistics Tools in ArcGIS 10.2.

The findings of factors affecting the price concessions are consistent with the studies of Sass (1988) and Hoeberichts et al. (2013). A hotter market will see smaller price concessions, proving that the state of the local market is an important information to make price revisions. The TOM of the seller had a general positive effect on price concessions, contrary to the buyer's TOM, due to the increasing search costs and decreasing bargaining power over time. Although in a thin market with limited potential buyers, the owners of high-value properties in China are less likely to reduce the list prices, which is consistent with the findings of Lazear (1986) and Knight (2002), and possibly reveals that buyers of expensive properties are inclined to convey less information through price signals, and to prevent more potential losses. As age increases, most sellers make fewer price concessions, and the female owners generally offer more price concessions which is an interesting insight regarding individual differences in price decisions. Compared with the full payment, the price concession is smaller due to the possible credit risk of the mortgage purchase. In addition, properties within the school zone have smaller list price reductions, due to its proximity to scarce quality educational resources, which improves the bargaining power of such owners.

From the STAR model, the price concession under the both-sides broker commission is always significantly lower than that under the buyer-side commission. This supports Hypothesis 1, namely, that the level of information asymmetry is influenced by brokers' actions. From Table 4(b) to Table 4(g), the results of the heterogeneity tests show that female sellers are less affected by brokers from different commission sources, while more affected by market thinness. Brokers from different commission sources have a significantly different impact on school zone

Table 2
Regression results of factors affecting the price concession of second-hand housing by OLS.

Parameters	OLS				
	Dependent variable: Price concession				
	(1)	(2)	(3)	(4)	(5)
Commission source	−1.6091*** (0.1378)	−1.8627*** (0.1236)	−1.6485*** (0.0894)	−1.4658*** (0.2819)	−1.8613*** (0.3112)
Market hotness	−0.0018*** (0.0003)	−0.0017 (0.0012)	−0.0033*** (0.0003)	−0.0075*** (0.0006)	−0.0084*** (0.0005)
Market thinness	0.0314 (0.5102)	−0.4530 (0.5238)	−0.7271 (0.4912)	−0.3015 (0.4693)	−1.6270** (0.7514)
TOM_seller	0.0196*** (0.0002)	0.0193*** (0.0002)	0.0159*** (0.0002)	0.0160*** (0.0002)	0.0151*** (0.0003)
TOM_buyer	−0.0024*** (0.0001)	−0.0026*** (0.0001)	−0.0012*** (0.0001)	−0.0011*** (0.0001)	−0.0012*** (0.0001)
Age_seller	−0.0061*** (0.0018)	−0.0269*** (0.0020)	−0.0046** (0.0019)	−0.0072*** (0.0018)	−0.0109*** (0.0019)
Gender_seller	0.1364*** (0.0270)	0.1155*** (0.0267)	0.0849*** (0.0255)	0.0604** (0.0252)	0.0583** (0.0257)
Marriage_seller		−0.3593*** (0.0343)	−0.2499*** (0.0333)	−0.0292 (0.0328)	0.0473 (0.0320)
Payment method		−1.5284*** (0.0445)	−1.0625*** (0.0429)	−0.9232*** (0.0414)	−0.7827*** (0.0404)
Bedrooms		0.2106*** (0.0459)	−0.0944** (0.0449)	0.0795* (0.0433)	0.0709 (0.0455)
Housing age		0.0100*** (0.0031)	0.0384*** (0.0029)	0.0309*** (0.0027)	0.0178*** (0.0049)
Size		−0.0018 (0.0012)	0.0085*** (0.0011)	0.0052*** (0.0010)	0.0081*** (0.0014)
Decoration		0.0819 (0.0824)	0.1292 (0.0799)	0.3497*** (0.0785)	0.4263*** (0.0867)
Housing type		0.3115*** (0.0439)	0.2593*** (0.0408)	0.1679*** (0.0406)	0.0105 (0.0534)
Floor		−0.1414*** (0.0307)	−0.1439*** (0.0296)	−0.1444*** (0.0292)	−0.1889*** (0.0293)
Subway		0.0834* (0.0438)	−0.0284 (0.0399)	−0.0338 (0.0374)	0.0081 (0.0502)
School zone		−0.6065*** (0.0507)	−0.3874*** (0.0470)	0.0829* (0.0492)	−0.2007*** (0.0204)
Intercept	−3.7124*** (0.0815)	5.6252*** (0.1628)	4.6209*** (0.1538)	2.7165*** (0.1531)	2.6069*** (0.1955)
adj R^2	0.0931	0.1015	0.1673	0.1896	0.2282
F	1135.13	645.71	441.17	382.12	313.83
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000
Root MSE	7.3262	7.2922	7.0198	6.9255	6.7250

Notes: N = 310,332. Cluster robust standard errors on community are in the parentheses, and *, **, *** denote 10%, 5% and 1% statistical significance, respectively. Column (1) shows the results of OLS without control variables, and from Column (2) to Column (5), results are reported with the control variables, year fixed effect, city fixed effect, and community fixed effects stepwise adding up to the model.

Table 4
Regression results of factors affecting the price concession of second-hand housing by STAR.

Parameters	STAR						
	Dependent variable: Price concession						
	(a) Full sample	Seller heterogeneity		Housing heterogeneity		Payment method	
		(b) Female	(c) Male	(d) School zone	(e) Non-school zone	(f) Mortgage	(g) Full payment
Commission source	−1.6421*** (0.2764)	−1.8592*** (0.3165)	−1.8612*** (0.3006)	−6.1105*** (0.2604)	−0.5445*** (0.2140)	−2.0409*** (0.3620)	−1.6845*** (0.2990)
Market hotness	−0.0075*** (0.0006)	−0.0082*** (0.0009)	−0.0067*** (0.0008)	−0.0167*** (0.0010)	0.0022*** (0.0008)	−0.0011 (0.0018)	−0.0083*** (0.0006)
Market thinness	−1.4206* (0.7696)	−2.2957* (1.2609)	−0.2063 (0.9077)	−5.6770** (2.7973)	−0.4743 (0.7408)	−1.2909 (0.9842)	−1.7777* (0.9112)
TOM_seller	0.0142*** (0.0003)	0.0138*** (0.0004)	0.0143*** (0.0003)	0.0135*** (0.0004)	0.0142*** (0.0003)	0.0140*** (0.0003)	0.0146*** (0.0006)
TOM_buyer	−0.0003*** (0.0001)	−0.0002 (0.0001)	−0.0004*** (0.0001)	−0.0003** (0.0001)	−0.0003** (0.0002)	−0.0003*** (0.0001)	−0.0004** (0.0002)
Age_seller	−0.0041** (0.0018)	−0.0048* (0.0027)	−0.0033 (0.0025)	−0.0047* (0.0025	−0.0041 (0.0026)	−0.0026 (0.0022)	−0.0155*** (0.0035)
Gender_seller	0.0682*** (0.0245)			0.0066 (0.0343)	0.1172*** (0.0346)	0.0633 (0.0636)	0.0701*** (0.0269)
Marriage_seller	0.0517* (0.0304)	0.0268 (0.0455)	0.1005** (0.0429)	0.0056 (0.0445)	0.1041** (0.0416)	0.0052 (0.0326)	0.2429** (0.0971)
Payment method	−0.6282*** (0.0391)	−0.5829*** (0.0530)	−0.6518*** (0.0562)	−0.4120*** (0.0505)	−0.8302*** (0.0588)		
Bedrooms	0.0577 (0.0445)	0.1032* (0.0591)	0.0528 (0.0579)	0.0586 (0.0693)	0.0457 (0.0567)	0.0913* (0.0504)	−0.1384 (0.0873)
Housing age	0.0193*** (0.0046)	0.0186*** (0.0069)	0.0189*** (0.0070)	0.0167*** (0.0059)	0.0227*** (0.0076)	0.0232*** (0.0050)	0.0072 (0.0119)
Size	0.0094*** (0.0013)	0.0091*** (0.0018)	0.0091*** (0.0018)	0.0114*** (0.0021)	0.0084*** (0.0017)	0.0095*** (0.0016)	0.0117*** (0.0023)
Decoration	0.3814*** (0.0855)	0.1927 (0.1259)	0.5314*** (0.1136)	−0.1587 (0.1409)	0.5715*** (0.1045)	0.4566*** (0.0958)	0.0865 (0.1966)
Housing type	0.0041 (0.0510)	−0.1021 (0.0727)	0.0940 (0.0652)	0.0229 (0.0621)	−0.0542 (0.0803)	−0.0131 (0.0531)	0.0436 (0.1180)
Floor	−0.2118*** (0.0279	−0.1899*** (0.0414)	−0.2510*** (0.0388)	−0.2546*** (0.0391)	−0.1755*** (0.0393)	−0.2155*** (0.0306)	−0.2157*** (0.0674)
Subway	−0.0219 (0.0490)	−0.0419 (0.0734)	0.0207 (0.0631)	−0.0203 (0.0687)	−0.0299 (0.0686)	−0.0177 (0.0535)	−0.0411 (0.1179)
School zone	−0.0397** (0.0175)	−0.1195*** (0.0266)	−0.1853*** (0.0221)			−0.1613*** (0.0204)	−0.5579* (0.3278)
_lag	0.0915*** (0.0077)	0.0933*** (0.0106)	0.0976*** (0.0094)	0.1202*** (0.0095)	0.0455*** (0.0127)	0.0937*** (0.0082)	0.0744*** (0.0167)
Intercept	4.0118*** (0.1960)	4.3246*** (0.9217)	3.6689*** (0.2719)	5.1652*** (0.2740)	3.1794*** (0.2533)	2.9972*** (0.2151)	4.4168*** (0.4444)
adj R^2	0.2991	0.2997	0.3028	0.3185	0.2895	0.2973	0.3165
F	255.01	129.01	154.72	181.41	143.86	207.43	50.03
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Root MSE	6.4084	6.3445	6.3849	6.1474	6.5934	6.2366	6.7975
N	310,332	144,265	166,067	142,567	167,765	247,643	62,689

Notes: Cluster robust standard errors on community are in the parentheses, and *, **, *** denote 10%, 5% and 1% statistical significance, respectively. The fixed effects of year, city and community are all controlled. Column (a) shows the results of STAR model with full sample. Column (b) and Column (c) report the results of male and female sample to test the seller heterogeneity. Column (d) and Column (e) report the results of samples within and out school zone to test the housing heterogeneity. Column (f) and Column (g) report the results of full payment sample and mortgage sample to test the payment method heterogeneity.

housing transactions in China, with 6.11% less price concessions under both-sides commissions, compared to buyer-side commissions. In the case of the mortgage purchases, the price concession that the buyer can obtain is influenced more by the commission source. These findings seem to reflect that the broker under a buyer-side commission will exert more effort in assisting the buyer in obtaining price concessions in cases where the buyer's bargaining power is weaker, suggesting that the commission source does lead to bias in the behavior of the dual-agent broker.

5.2. Moderating effects of commission incentive

Considering the moderating effects of brokers' commission incentive on information transmission in transactions. Table 5(a) reports the full sample results involving the interaction items of commission source with market and individual factors. The coefficients of *Commission source* × *Market hotness* and *Commission source* × *Market thinness* are both significantly negative, which means that the both-sides commission scheme strengthens the flow of objective market information during the seller's price revision. The coefficients of *Commission source* × *Age_seller* have an opposite sign to the original age factor, indicating the weakened effects of the seller's individual characteristics in both-sides commission transactions. These results validate the Hypothesis 2 and Hypothesis 3, supporting the buyer-side commission brokers using two channels, market information blocking and individual information screening, to assist buyers with securing lower prices. The coefficient of *Commission source* × *TOM_seller* is negative, indicating that the list price of properties with a both-sides broker will fall more slowly than the prices of other properties, which supports Hypothesis 4.

The moderating effects of commission sources on the transmission of market information were similar between the different gender owners. However, with both-sides commission brokers, male owners will cut prices even more slowly (see Table 5(b) and Table 5(c)). It is worth noting that the enhanced market condition effects by both-sides commission brokers are even greater in school zone housing and mortgage purchase transactions, and the rate of price reductions has slowed even more (see Table 5(d) to **Table 5(g)**). This may indicate that in the market where the bargaining power of buyer and seller is unbalanced, the difference in information transmission behavior of the broker due to incentives bias is more obvious.

Table 5
Regression results of moderating effect of broker commission source.

Parameters	STAR						
	Dependent variable: Price concession						
	(a) Full sample	Seller heterogeneity		Housing heterogeneity		Payment method	
		(b) Female	(c) Male	(d) School zone	(e) Non-school zone	(f) Mortgage	(g) Full payment
Commission source	−1.4158***	−1.4948***	−1.2178***	−2.0109***	−0.0837***	−1.1862***	−1.0366***
	(0.1037)	(0.4657)	(0.2542)	(0.3127)	(0.0313)	(0.3695)	(0.2400)
Market hotness	−0.0057***	−0.0072***	−0.0042***	−0.0160***	−0.0075***	−0.0070***	−0.0070***
	(0.0005)	(0.0010)	(0.0009)	(0.0010)	(0.0013)	(0.0007)	(0.0009)
Commission source × Market hotness	−0.0093***	−0.0104***	−0.0104***	−0.0128***	−0.0090***	−0.0091***	−0.0042***
	(0.0019)	(0.0024)	(0.0020)	(0.0049)	(0.0021)	(0.0020)	(0.0009)
Market thinness	−0.9890**	−2.2734**	−0.1019**	−5.0310**	−0.9638**	−1.0325	−1.4586***
	(0.4138)	(1.1090)	(0.0443)	(2.5281)	(0.4283)	(1.1005)	(0.5546)
Commission source × Market thinness	−2.4604**	−1.9097**	−2.0880**	−2.1319*	−1.6473**	−2.3484*	−1.9463**
	(1.1762)	(0.9051)	(1.0308)	(1.1340)	(0.7734)	(1.3427)	(0.9780)
TOM_seller	0.0143***	0.0139***	0.0145***	0.0137***	0.0145***	0.0110***	0.0142***
	(0.0003)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0006)
Commission source × TOM_seller	−0.0008**	−0.0008***	−0.0024***	−0.0127***	−0.0017**	−0.0070***	−0.0020***
	(0.0004)	(0.0002)	(0.0009)	(0.0026)	(0.0007)	(0.0008)	(0.0006)
Age_seller	−0.0027***	−0.0031*	−0.0025	−0.0029*	−0.0021***	−0.0015	−0.0027*
	(0.0008)	(0.0017)	(0.0026)	(0.0015)	(0.0006)	(0.0023)	(0.0014)
Commission source × Age_seller	−0.0188***	−0.0242**	−0.0102*	−0.0074***	−0.0203**	−0.0330***	−0.0233*
	(0.0069)	(0.0106)	(0.0054)	(0.0025)	(0.0080)	(0.0092)	(0.0130)
_lag	0.0953***	0.0967***	0.1014***	0.1221***	0.0437***	0.0981***	0.0684***
	(0.0077)	(0.0106)	(0.0095)	(0.0098)	(0.0127)	(0.0082)	(0.0166)
Control Variables	YES	YES	YES	YES	YES	YES	YES
Intercept	−0.4804	−0.0451	−0.6144	4.3287***	−8.6191***	−0.6094	−5.1682***
	(0.6365)	(0.8845)	(0.8340)	(0.9041)	(0.9320)	(0.6698)	(1.7046)
adj R^2	0.2997	0.3003	0.3034	0.3192	0.2917	0.2977	0.3183
F	201.45	100.51	120.72	149.39	124.16	163.35	41.03
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Root MSE	6.4060	6.3420	6.3821	6.1443	6.5832	6.2346	6.7887
N	310,332	144,265	166,067	142,567	167,765	247,643	62,689

Notes: Cluster robust standard errors on community are in the parentheses, and *, **, *** denote 10%, 5% and 1% statistical significance, respectively. The fixed effects of year, city and community and other control variables are controlled in the models.

5.3. Results of further checks

To enhance the robustness of the findings, two methods were used. The first robustness check randomly re-sampled 50% randomly from the original data set and repeated the models in Table 5(a). The results in Table 6(a) reveal that the coefficients of main explanatory factors, including commission source, market conditions, time-on-market and individual characteristics and their interactions, have consistent sign and significance levels with the previous results. The other robustness check split the sample period. Considering the outbreak of COVID-19 in early 2020, which impacted the supply and demand of the second-hand housing market in China, the sample was split to transactions prior to 2020 and those during 2020.

As illustrated in Table 6(b) and **Table 6(c)**, most of the results of the two split-samples proved robust. Whether in 2020 or before, the list price concessions under both-sides commission were smaller than those under buyer-side commissions, and the coefficients of market factors remained negative. However, it is important to note that for the transactions in 2020, the effects of *Commission source* and *Market hotness* became smaller, while the rate of price cutting increased and the effects of individual characteristics became stronger. During the market downturn, the difference between the price concessions under the two commission sources was smaller, but all of the interactions reflected increased absolute values of coefficients, which indicates that the impacts of brokers' incentive distortion on information transmission had increased. The increased effect of *Market thinness* shows that there will be a greater difference in price concessions between the owners with high net value properties or more experience and those without, while the commission source no longer had a significant impact on the effect of market thinness. The coefficient of spatio-temporal lag item increased from 0.1241 to 0.4069, which means that sellers are more proactive in obtaining pricing information from similar recent trading cases in the face of market downturns. The adjusted R^2 decreased from 0.2995 to 0.2019, indicating that the price concession in the depressed second-hand housing market had been influenced by more unobserved factors.

6. Discussion

This analysis confirms that sellers' price concession decisions during the second-hand housing transaction process are influenced by the flow of market, housing and individual information, which is consistent with previous studies (De Wit & van der Klaauw, 2013; Hayunga & Pace, 2017; Sass, 1988). The difference in the list price concessions of second-hand housing under the two commission schemes verifies to some extent the incentive distortion of brokers behind the imperfect information market. The results indicate that brokers can at least influence the bargaining process and results of buyers and sellers by interfering with the transmission of market information and filtering housing or individual information. From the perspective of transaction costs, there is a cost to acquire information to reduce uncertainties in housing market (Ma, Chan, & Choy, 2018); the less complete information and increased price concession can be considered opportunity costs for the seller to avoid paying commissions under the buyer-side commission scheme.

Furthermore, there are some issues that deserve further discussion. One is that an exogenous demand shock may lead to a change in the relationship between brokers' actions and sellers' pricing strategies. Haurin, McGreal, Adair, Brown, and Webb (2013) found evidence that sellers' list prices are sticky during a downturn in the market, which is also supported by the studies of Hoeberichts et al. (2013) and Liu and van der Vlist (2019). The results of this study implies weaker effects of commission sources and market states, but stronger effects of market

Table 6
Regression results of robustness checks.

Parameters	Dependent variable: Price concession		
	(a) Re-sampling	Splitting sample period	
		(b) Transactions prior 2020	(c) Transactions in 2020
Commission source	−1.3399*** (0.0643)	−1.3260*** (0.2540)	−0.8621*** (0.3046)
Market hotness	−0.0069*** (0.0009)	−0.0077*** (0.0008)	−0.0052*** (0.0006)
Commission source × Market hotness	−0.0119*** (0.0021)	−0.0149*** (0.0019)	−0.0184*** (0.0066)
Market thinness	−1.1429* (0.6623)	−1.4749*** (0.5717)	−2.8650** (1.3968)
Commission source × Market thinness	−2.7066** (1.2929)	−1.2183** (0.5297)	−2.5720 (3.2148)
TOM_seller	0.0139*** (0.0004)	0.0139*** (0.0003)	0.0164*** (0.0005)
Commission source × TOM_seller	−0.0020* (0.0010)	−0.0006* (0.0003)	−0.0092*** (0.0011)
Age_seller	−0.0013* (0.0007)	−0.0037* (0.0019)	−0.0054* (0.0028)
Commission source × Age_seller	−0.0094*** (0.0036)	−0.0180** (0.0072)	−0.0399* (0.0208)
_lag	0.0917*** (0.0105)	0.1241*** (0.0076)	0.4069*** (0.0223)
Control Variables	YES	YES	YES
Intercept	−0.9866 (0.8881)	−4.2310*** (0.7501)	9.2771*** (0.6352)
adj R^2	0.2979	0.2995	0.2019
F	95.15	168.47	169.72
Prob > F	0.0000	0.0000	0.0000
Root MSE	6.4079	6.3203	7.3961
N	155,166	278,610	31,722

Notes: Cluster robust standard errors on community are in the parentheses, and *, **, *** denote 10%, 5% and 1% statistical significance, respectively. The fixed effects of year, city and community and other control variables are controlled in the models.

thinness and individual factors on price concessions of transactions during the epidemic, which also confirms that price reduction decisions had become insensitive to the information flow of supply and demand in the face of an overall market depression. In this situation, brokers who make a living in a depressed market, motivated by different commission sources, may be further differentiated according to their actions. Prospect theory may help explain this result. Sellers are averse to realizing nominal losses and set higher list price (Genesove & Mayer, 2001; Hayunga & Pace, 2017), indicating the interaction between market conditions and expectation. The findings in this research provide insights to understand the phenomenon of more unobserved factors, such as psychological loss aversion of housing market participants, existing during the downturn market, which may result in more uncertainty and discrepancies across the housing market.

Another issue is recognizing the mismatch between the brokerage service mode and the commission incentive scheme. The current brokerage practice in China may be regarded as dual agency in the U.S. context, which is outlawed in some states (Brastow et al., 2011). Kadiyali, Prince, and Simon (2009) point out that misaligned principal-agent incentives of dual agency especially happen with the sale of properties that occurred very quickly. Gardiner, Heisler, Kallberg, and Liu (2007) found a dual agency would have an 8% negative impact on sales price before the enactment of legislation requiring mandatory disclosure, relative to only a 1.4% impact post legislation. This is consistent with our findings that buyer-side commission scheme will exacerbate the agent bias of dual agent brokers, for example, to help buyers push prices more. Establishing a real estate market information system and legislation on the disclosure of agency may reduce information costs for housing buyers and sellers, enabling them to make more informed choices concerning brokers' services (Wiley & Zumpano, 2009). Additionally, for the developing second-hand housing market, the division of the brokerage industry can be further refined to seller agent and buyer agent and paid by the seller and buyer, respectively, to reduce commission incentive conflicts from dual agency.

7. Conclusion

Based on the theory of information asymmetry and the existing studies, this research investigated the influencing factors of price concession, especially brokers' commission incentives, in China's second-hand housing transactions. Three research disparities were addressed in the study: (1) The results provide evidence that brokers' commission incentives will affect the price revision during the transaction, since the price concession under the both-sides broker commission is significantly lower at 1.64% than those under the buyer-one-side commission. Both-sides broker commissions will slow down the speed of the seller's price reduction. There is also a positive spillover effect in the price concession from the results of the STAR model, which reflects that the price cutting in the process of second-hand housing transactions is influenced by previous transactions. (2) Broker commission incentives have a moderating effect on information transmission during transactions. The both-sides commission scheme leads to an increase in the effect of objective market conditions and weakens the difference of effects from individual factors on price concessions. In the market where the bargaining power of buyer and seller is more unequal, such as school zone housing and mortgage housing purchase market, the difference in information transmission by the broker due to incentive bias, is more obvious. (3) An overall exogenous demand shock may bring greater information asymmetry by a stronger psychological loss aversion of housing market participants and larger differentiated broker actions due to incentive distortions. These findings provide insights into the process of second-hand housing transactions and price concessions from a micro perspective. The complex interaction mechanism of the principal-agent relationship between brokers and transaction parties remains to be further explored.

CRediT authorship contribution statement

Weidong Qu: Conceptualization, Supervision, Resources, Funding acquisition. **Yiqi Huang:** Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Guoying Deng:** Methodology, Validation, Writing – review & editing.

Acknowledgements

This work was supported by the National Social Science Fund Project of China (NSSFC) (No. 18BJY223).

Appendix

Table A.1
Brokerage factors that influence the housing transaction.

Study	Region	Sample	The dependent variable	Brokerage factors
Munneke & Yavas (2001)	Athens, Georgia (US)	615 transactions from multiple listing service (MLS), from July 1994 through March 1997	Sales price TOM	Full-commission and split-commission
Gardner, Heisler, Kallberg, & Liu (2007)	Honolulu (US)	1,989 listings during 1977–1980 and 1,858 Listings during 1987–1989, gathered from MLS		Disclosed and un-disclosed dual agency
Rutherford, Springer, & Yavas (2005)	Texas (US)	306,869 MLS listings, during the years 1999 through 2002		Agent-owned versus client-owned homes
Agarwal, et al.,(2019)	Singapore	108,534 private (non-landed) housing transactions recorded in the caveats for the period from January 1995 to December 2012		
Rutherford, Springer, & Yavas (2001)	Dallas–Fort Worth (US)	49,219 transactions In MLS, across the period of 1994–1997		Exclusive agency and exclusive right-to-sell arrangements
Huang & Rutherford (2007)	Texas (US)	116,596 observations of residential properties in MLS, between January 1, 2005 and December 31, 2005	TOM Probability of sale	Realtor versus Non-Realtor listings
Barwick, Pathak, & Wong (2017)	Eastern Massachusetts, covering 85 towns and cities surrounding Boston (US)	653,475 residential listings in MLS, from 1998 to 2011		Commission rates
Zietz &Newsome (2001)	Orem (Utah) area (US)	592 house sales for the years 1990 through 1997	Sales price	Commission structure

Table A.2
List of sample cities.

City code	City name	Region	Commission source	observations
1	Beijing	Eastern	Buyer-side	192,101
2	Hangzhou	Eastern	Buyer-side	11,009
3	Nanjing	Eastern	Buyer-side	11,225
4	Qingdao	Eastern	Buyer-side	3,417
5	Shenzhen	Eastern	Buyer-side	11,079
6	Shenyang	Eastern	Buyer-side	3,994
7	Tianjin	Eastern	Buyer-side	11,507
8	Suzhou	Eastern	Both-sides	5,253
9	Jinan	Eastern	Both-sides	5,410
10	Shanghai	Eastern	Both-sides (Since September 2018)	7,227
11	Hefei	Central	Buyer-side	3,599
12	Wuhan	Central	Buyer-side	7,054
13	Changsha	Central	Buyer-side	1,878
14	Zhengzhou	Central	Buyer-side	13,218
15	Chengdu	Western	Both-sides	978
16	Xi'an	Western	Buyer-side	4,183
17	Chongqing	Western	Buyer-side	17,201

Table A.3
Definitions of variables.

Variables	Definitions	Expected signs
Price concession	The difference between the initial list price and final sale price of a property as a percentage of the listing price. (Sass, 1988; De Wit & van der Klaauw, 2013)	
Commission source	Dummy which takes the value of 1 if the broker commission from both buyer and seller, while 0 is only from buyer.	–
Market hotness	Market hotness measured by the city monthly second-hand housing price index. (Deng, Gabriel, Nishimura, & Zheng, 2012; Novy-Marx, 2009)	–
Market thinness	Dummy which takes the value of 1 if the house is villa, while 0 means non-villa. (Lazear, 1986; Sass, 1988; Herrin, Knight & Sirmans, 2004)	+/–
TOM_seller	The time cost of the seller's search and matching process measured by the days from the entry to transaction. (Knight, 2002; Sass, 1988; Taylor, 1999)	+
TOM_buyer	The time cost of the buyer's search and matching process measured by the days from the entry to transaction. (Han and Strange, 2015)	–
Payment method	Dummy which takes the value of 1 if the buyer purchased house through mortgage, while 0 is full payment.	–
Bedrooms	Total number of bedrooms. (De Wit & van der Klaauw, 2013; Sun & Ong, 2014; Hayunga & Pace, 2017)	+/–
Housing age	Years the property has been built. (De Wit & van der Klaauw, 2013; Sun & Ong, 2014; Hayunga & Pace, 2017)	+/–
Size	The area of property. (De Wit & van der Klaauw, 2013; Sun & Ong, 2014; Hayunga & Pace, 2017)	+/–
Decoration	Dummy which takes the value of 1 if the house with decoration, 0 otherwise.	+/–
Housing type	Dummy which takes the value of 1 if the house is slab, while 0 means other types. (Hayunga & Pace, 2017; Sun & Ong, 2014)	+/–

(*continued on next page*)

Table A.3 (*continued*)

Variables	Definitions	Expected signs
Floor	Dummy which takes the value of 1 if the house is from top floor, while 0 means low floor (Sun & Ong, 2014).	+/−
Subway	Dummy which takes the value of 1 if the distance between the property and subway is within 1 km, 0 otherwise (Chang, Chao, & Yeh, 2016).	−
School zone	Dummy which takes the value of 1 if the distance between the property and top school zone is within 1 km, 0 otherwise. (Chang et al., 2016)	−
Age_seller	Seller's actual age registered at the real estate agency. (Hayunga & Pace, 2017; Chang et al., 2016)	−
Gender_seller	Dummy which takes the value of 1 if the seller is female, while 0 is male. (Sahin et al., 2013)	+/−
Marriage_seller	Dummy which takes the value of 1 if the seller married, including divorced or widowed, while 0 unmarried.	+/−
Commission source × Market hotness	Interaction captures the effect of differences in commission source on the extent to which market hotness influences.	−
Commission source × Market thinness	Interaction captures the effect of differences in commission source on the extent to which market thinness influences.	+/−
Commission source × TOM_seller	Interaction captures the effect of differences in commission source on the extent to which seller's TOM concession.	−
Commission source × TOM_buyer	Interaction captures the effect of differences in commission source on the extent to which buyer's TOM influences.	+/−
Commission source × Age_seller	Interaction captures the effect of differences in commission source on the extent to which seller's age influences.	+
Commission source × Gender_seller	Interaction captures the effect of differences in commission source on the extent to which seller's gander influences.	+/−

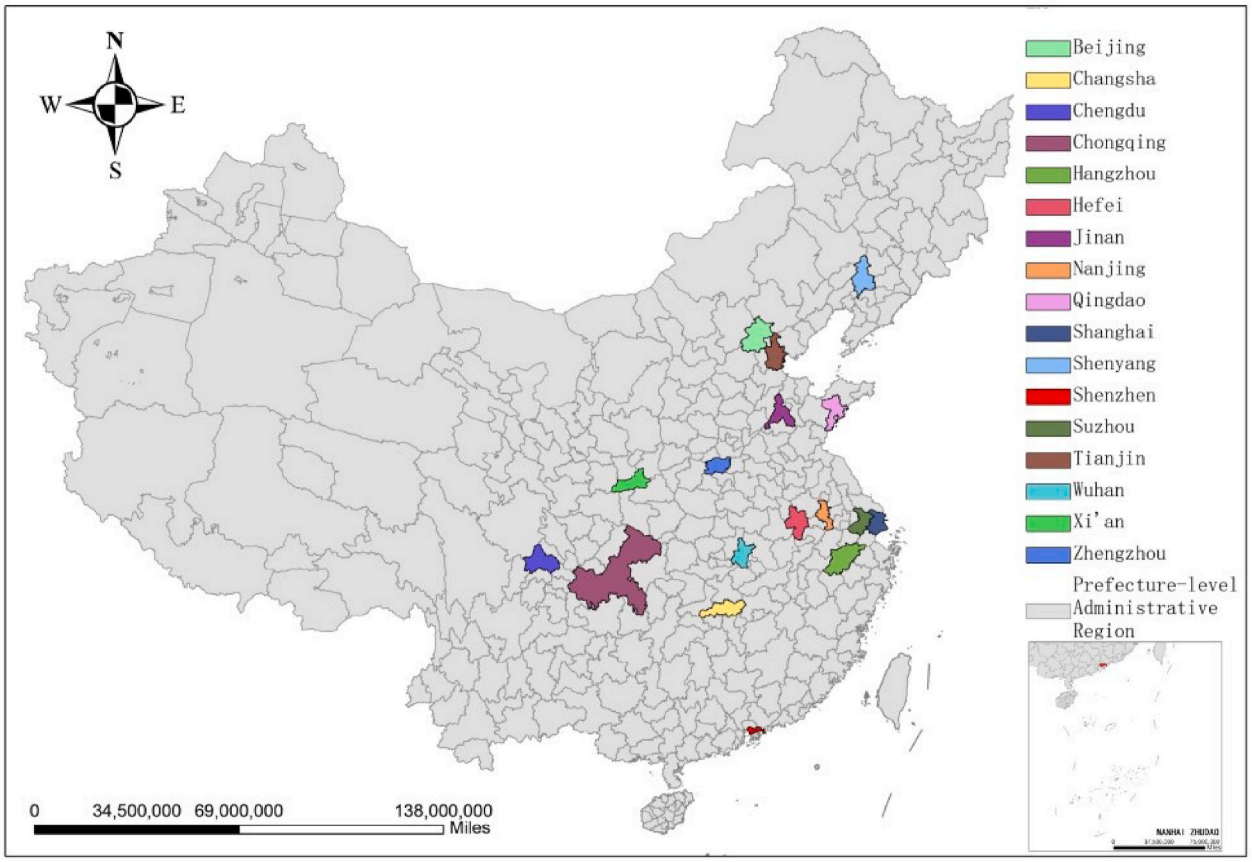

Fig. A.1. Distribution of sample cities in China.
Note: the map source is National Catalogue Service for Geographic Information.

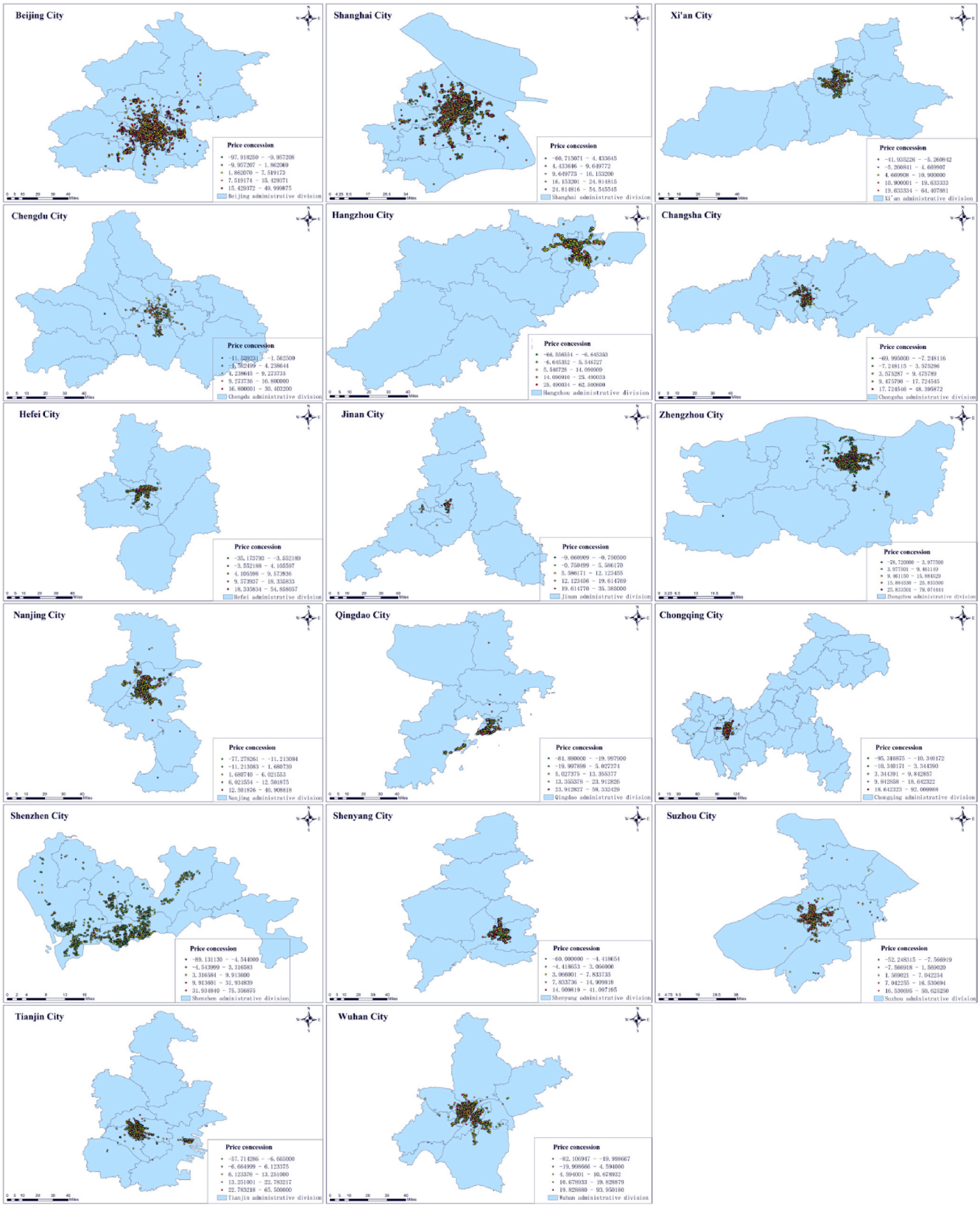

Fig. A.2. Distribution of price concession in 17 cities.

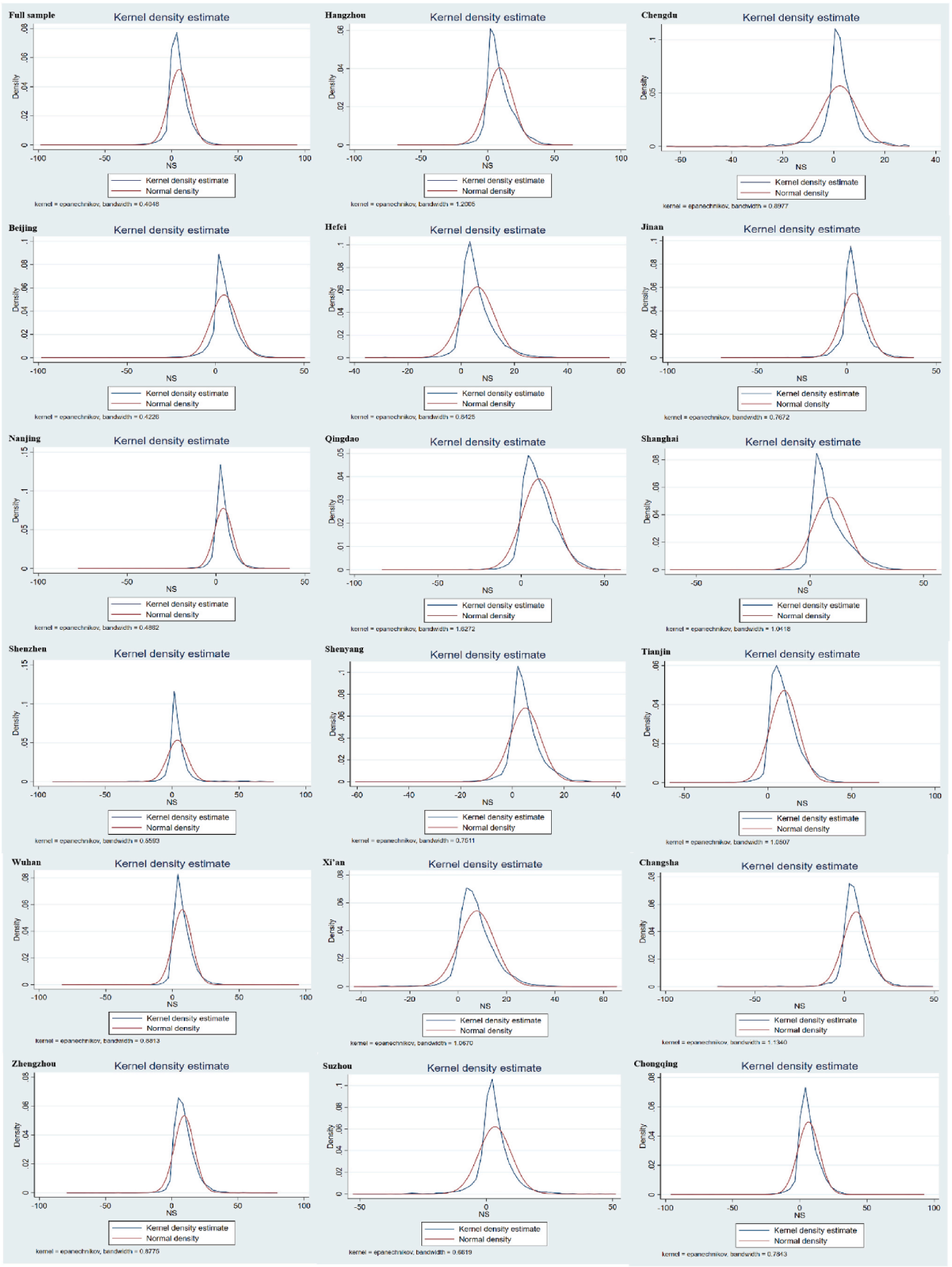

Fig. A.3. Kernel density distribution of price concession in 17 cities.

References

Agarwal, S., He, J., Tien, F. S., & Changcheng, S. (2019). Do real estate agents have information advantages in housing markets? *Journal of Financial Economics, 134*, 715–735. https://doi.org/10.1016/j.jfineco.2019.05.008

Akerlof, G. A. (1970). The market for "lemons": Quality uncertainty and the market mechanism. *Quarterly Journal of Economics, 84*, 488–500. https://doi.org/10.1007/978-1-349-24002-9_9

Albrecht, J., Gautier, P. A., & Vroman, S. (2016). Directed search in the housing market. *Review of Economic Dynamics, 19*, 218–231. https://doi.org/10.1016/j.red.2015.05.002

Allen, M. T., Faircloth, S., Forgey, F., & Rutherford, R. C. (2003). Salesperson's compensation and performance in the housing market. *Journal of the Academy of Finance, 1*, 62–71.

Arrow, K. J. (1985). *The economics of agency. Principals and agents: The structure of business*. Boston.

Barwick, Panle Jia, & Pathak, Parag A. (2010). The impact of commissions on home sales in greater Boston. *American Economic Review: Papers & Proceedings, 100*(2), 475–479. https://doi.org/10.1257/aer.100.2.475

Barwick, P. J., Pathak, P. A., & Wong, M. (2017). Conflicts of interest and the realtor commission puzzle. *American Economic Journal: Applied Economics, 9*(3), 191–222. https://doi.org/10.3386/w21489

Baryla, E. A., & Zumpano, L. V. (1995). Buyer search duration in the residential real estate market: The role of the real estate agent. *Journal of Real Estate Research, 10*, 1–14. https://doi.org/10.1080/10835547.1995.12090769

Benjamin, J. D., T, P., & Chinloy. (2000). Pricing, exposure and residential listing strategies. *Journal of Real Estate Research, 20*, 61–74.

Bernheim, B. D., & Meer, J. (2013). Do real estate brokers add value when listing services Are Unbundled? *Economic Inquiry, 51*(2), 1166–1182. https://doi.org/10.1111/j.1465-7295.2012.00473.x

Brastow, R., Thomas, S., & Bennie, W. (2011, April). *The motivating causes of dual agency transactions: Specialization and incentives*. Seattle, WA: American Real Estate Society (ARES) 26th annual meeting.

Brunsdon, C., Fotheringham, A. S., & Charlton, M. (1996). Geographically weighted regression: A method for exploring spatial non-stationarity. *Geographical Analysis, 28*, 281–298. https://doi.org/10.1111/j.1538-4632.1996.tb00936.x

Chang, Chuang-Chang, Chao, Ching-Hsiang, & Yeh, Jin-Huei (2016). The role of buy-side anchoring bias: Evidence from the real estate market. *Pacific-Basin Finance Journal, 38*, 34–58. https://doi.org/10.1016/j.pacfin.2016.02.008

Clapp, J. M., Walter, D., & Dogan, T. (1995). Imperfect information and investor inferences from housing price dynamics. *Real Estate Economics, 23*, 239±269. https://doi.org/10.1111/1540-6229.00665

De Wit, E. R., & van der Klaauw, B. (2013). Asymmetric information and list-price reductions in the housing market. *Regional Science and Urban Economics, 43*, 507–520. https://doi.org/10.1016/j.regsciurbeco.2013.03.001

Deng, Yongheng, Gabriel, Stuart A., Nishimura, Kiyohiko G., & Zheng, Diehang (2012). Optimal pricing strategy in the case of price dispersion: New evidence from the Tokyo housing market. *Real Estate Economics, 40*(1), 234–272. https://doi.org/10.1111/j.1540-6229.2012.00347.x

Fotheringham, A. S., Brunsdon, C., & Charlton, M. E. (2002). *Geographically weighted regression: The analysis of spatially Varying relationship*. Chichester.

Fotheringham, A. S., Crespo, R., & Yao, J. (2015). Geographical and temporal weighted regression (GTWR). *Geographical Analysis, 47*(4), 431–452. https://doi.org/10.1111/gean.12071

Gardiner, J., Heisler, J., Kallberg, J., & Liu, C. (2007). The impact of dual agency. *The Journal of Real Estate Finance and Economics, 35*, 39–55. https://doi.org/10.1007/s11146-007-9028-8

Gelfand, A. E., Ghosh, S. K., Knight, J. R., & Sirmans, C. F. (1998). Spatio-temporal modeling of residential sales data. *Journal of Business & Economic Statistics, 16*(3), 312–321. https://doi.org/10.1080/07350015.1998.10524770

Genesove, D., & Mayer, C. (2001). Loss aversion and seller behavior: Evidence from the housing market. *Quarterly Journal of Economics, 116*(4), 1233–1260. https://doi.org/10.1162/003355301753265561

Han, L., & Strange, W. C. (2015). The microstructure of housing markets: Search, bargaining, and brokerage. *Handbook of Regional and Urban Economics, 5*, 813–886. https://doi.org/10.1016/B978-0-444-59531-7.00013-2

Haurin, D., McGreal, S., Adair, A., Brown, L., & Webb, J. R. (2013). List price and sales prices of residential properties during booms and busts. *Journal of Housing Economics, 22*, 1–10. https://doi.org/10.1016/j.jhe.2013.01.003

Hayunga, D. K., & Pace, R. K. (2017). List prices in the US housing market. *The Journal of Real Estate Finance and Economics, 55*, 155–184. https://doi.org/10.1007/s11146-016-9555-2

He, Z., Dong, J., & Yu, L. (2018). An agent-based model for investigating the impact of distorted supply-demand information on China's resale housing market. *Journal of Computational Science, 25*, 1–15. https://doi.org/10.1016/j.jocs.2018.01.002

Herrin, W. E., Knight, J. R., & Sirmans, C. F. (2004). Price cutting behavior in residential markets. *Journal of Housing Economics, 13*, 195–207. https://doi.org/10.1016/j.jhe.2004.07.002

Hoeberichts, M., van Rooij, M., & Siegmann, A. (2013). *House list prices and Durations in boom and Bust*. https://doi.org/10.2139/ssrn.2321521. SSRN Working paper No. 2321521.

Huang, B., & Rutherford, R. (2007). Who you going to call? Performance of realtors and non-realtors in a MLS setting. *The Journal of Real Estate Finance and Economics, 35*, 77–93. https://doi.org/10.1007/s11146-007-9029-7

Huang, B., Wu, B., & Barry, M. (2010). Geographically and temporally weighted regression for modeling spatio-temporal variation in house prices. *International Journal of Geographical Information Science, 24*(3), 383–401. https://doi.org/10.1080/13658810802672469

Hui, C. M., Dong, Z., Jia, S. H., & Lam, C. H. L. (2017). How does sentiment affect returns of urban housing? *Habitat International, 64*, 71–84. https://doi.org/10.1016/j.habitatint.2017.04.013

Johnson, K., Anderson, R., & Benefield, J. (2004). Salesperson bonuses and their impact on residential property price and time on market. *Journal of Real Estate Practice and Education, 7*(1), 1–14.

Jud, G. D. (1983). Real estate brokers and the market for residential housing. *AREUEA Journal, 1983, 11*, 69–82. https://doi.org/10.1111/1540-6229.00280

Jud, G. D., & Frew, J. (1986). Real estate brokers, housing prices, and the demand for brokers. *Urban Studies, 23*, 21–31. https://doi.org/10.1080/00420988620080031

Kadiyali, V., Prince, J., & Simon, D. (2009). *Is dual agency in real estate transactions a cause for concern?* Cornell University. https://doi.org/10.1007/s11146-012-9385-9. Johnson School Research Paper Series No. 08-07.

Knight, J. R. (2002). Listing price, time on market, and ultimate selling price: Causes and effects of listing price changes. *Real Estate Economics, 30*(2), 213–237. https://doi.org/10.1111/1540-6229.00038

Lazear, E. P. (1986). Retail pricing and clearance sales. *The American Economic Review, 76*, 14–32. https://doi.org/10.3386/w1446

LeSage, J., & Pace, K. (2009). *Introduction to spatial econometrics*. https://doi.org/10.1111/j.1467-985X.2010.00681_13.x. Boca Raton.

Liu, X., & van der Vlist, A. J. (2019). Listing strategies and housing busts: Cutting loss or cutting list price? *Journal of Housing Economics, 43*, 102–117. https://doi.org/10.1016/j.jhe.2018.09.006

Ma, S. Y. T., Chan, H. W. E., & Choy, L. H. T. (2018). Evolving institutions to tackle asymmetrical information problems in the housing market: A case study on 'shrinkage' of flat sizes in Hong Kong. *Habitat International, 75*, 154–160. https://doi.org/10.1016/j.habitatint.2018.03.009

Merlo, A., & Ortalo-Magné, F. (2004). Bargaining over residential real estate: Evidence from england. *Journal of Urban Economics, 56*, 192–216. https://doi.org/10.1016/j.jue.2004.05.004

Merlo, A., Ortalo-Magné, F., & Rust, J. (2013). *The home selling problem: Theory and evidence*. https://doi.org/10.1111/iere.12111. PIER Working Paper, No. 13-006.

Munneke, H. J., & Yavas, A. (2001). Incentives and performance in real estate brokerage. *The Journal of Real Estate Finance and Economics, 22*, 5–21. https://doi.org/10.1023/A:1007879109026

Nilsson, P. (2014). Natural amenities in urban space: A geographically weighted regression approach. *Landscape and Urban Planning, 121*, 45–54. https://doi.org/10.1016/j.landurbplan.2013.08.017

Novy-Marx, Robert (2009). Hot and cold markets. *Real Estate Economics, 37*(1), 1–22. https://doi.org/10.1111/j.1540-6229.2009.00232.x

Pace, K., Barry, R., Clapp, J., & Rodriguez, M. (1998). Spatiotemporal autoregressive models of neighborhood effects. *Real Estate Finance Economics, 17*(1), 15–33. https://doi.org/10.1023/A:1007799028599

Pace, K., Barry, R., Gilley, O. W., & Sirmans, C. F. (2000). A method for spatial-temporal forecasting with an application to real estate prices. *International Journal of Forecasting, 16*(2), 229–246. https://doi.org/10.1016/S0169-2070(99)00047-3

Pace, K., & Gilley, O. W. (1998). Generalizing the OLS and grid estimators. *Real Estate Economics, 26*(2), 331–347. https://doi.org/10.1111/1540-6229.00748

Rutherford, R. C., Springer, T. M., & Yavaş, A. (2001). The impacts of contract type on broker performance. *Real Estate Economics, 29*(3), 389–409. https://doi.org/10.1111/1080-8620.00016

Rutherford, R. C., Springer, T. M., & Yavaş, A. (2005). Conflicts between principals and agents: Evidence from residential brokerage. *Journal of Financial Economics, 76*(3), 627–665. https://doi.org/10.1016/j.jfineco.2004.06.006

Sahin, M. A., Sirmans, C. F., & Yavas, A. (2013). Buyer brokerage: Experimental evidence. *Journal of Housing Economics, 22*, 265–277. https://doi.org/10.1016/j.jhe.2013.10.004

Sass, T. R. (1988). A note on optimal price cutting behavior under demand uncertainty. *The Review of Economics and Statistics, 70*(2), 336–339. https://doi.org/10.2307/1928319

Spence, A. M. (1974). *Market signaling, information Transfer in Hiring and related Processes*. Cambridge.

Stelk, S., & Zumpano, L. V. (2017). Can real estate brokers affect home prices under extreme market conditions? *Real Estate Brokers and Home Prices, 20*(1), 51–73.

Stigler, G. J. (1961). The economics of information. *Journal of Political Economy, 69*(3), 213–225. https://doi.org/10.5378/indimagahist.111.2.0177

Sun, Hua, & Ong, Seow Eng (2014). Bidding heterogeneity, signaling effect and its implications on house seller's pricing strategy. *The Journal of Real Estate Finance and Economics, 49*, 568–597. https://doi.org/10.1007/s11146-013-9409-0

Taylor, Curtis R. (1999). Time-on-the-market as a sign of quality. *The Review of Economic Studies, 66*(3), 555–578. https://doi.org/10.1111/1467-937X.00098

Turnbull, G. K., & Waller, B. D. (2018). What) do top performing real estate agents deliver for their clients? *Journal of Housing Economics, 22*, 14–152. https://doi.org/10.1016/j.jhe.2018.06.005

Wiley, J., & Zumpano, L. (2009). Agency disclosure in the real estate transaction and the impact of related state policies. *Journal of Real Estate Research, 31*(3), 265–283. https://doi.org/10.1007/s11146-007-9101-3

Williamson, O. E. (1985). *The economic institutions of capitalism*. New York.

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. https://doi.org/10.1007/s11146-011-9326-z

Wu, C., & Colwell, P. F. (1986). Equilibrium of housing and real estate brokerage markets under uncertainty. *Real Estate Economics, 14*(1), 1–23. https://doi.org/10.1111/1540-6229.00366

Yang, L., Chau, K. W., & Chen, Y. (2021). Impacts of information asymmetry and policy shock on rental and vacancy dynamics in retail property markets. *Habitat International, 111*, 1–8. https://doi.org/10.2139/ssrn.1539599

Yang, X. L., & Xu, H. B. (2018). The impact of brokers on the formation mechanism of repeat sale housing price: An empirical analysis based on the data of beijing HOMELINK. *Journal of Central University of Finance & Economics, 9*, 82–93.

Yavaş, A. (1992). A simple search and bargaining model of real estate markets. *Real Estate Economics, 20*(4), 533–548. https://doi.org/10.1111/1540-6229.00595

Yinger, J. (1981). A search model of real estate broker behavior. *The American Economic Review, 71*, 591–605.

Zeng, H., Yu, X., & Wen, H. (2017). What factors drive public rental housing fraud? Evidence from hangzhou, China. *Habitat International, 66*, 57–64. https://doi.org/10.1016/j.habitatint.2017.05.007

Zietz, J., & Newsome, B. (2001). A note on buyer's agent commision and sales price. *Journal of Real Estate Research, 21*(3), 245–254.

Zumpano, L. V., Elder, H. W., & Baryla, E. A. (1996). Buying a house and the decision to use a real estate broker. *The Journal of Real Estate Finance and Economics, 13*, 169–181. https://doi.org/10.1007/BF00154054