An Empirical Study on the Impact of Shared Accommodation Development on Commercial Housing Price -- Taking Beijing as an Example

Haowei Dai [a], Zanxin Zhuang [b]

School of Tourism Management, Sun Yat-Sen University, Guangzhou 519000, China

[a] daihw6@mail2.sysu.edu.cn, [b] zhuangzx6@mail2.sysu.edu.cn

Haowei Dai, Zanxin Zhuang are co-first authors

Abstract. Based on the rise of the shared accommodation market and the guideline of "Housing is for Living in, not for Speculation" proposed in the report of the 19th National Congress of the Communist Party of China, this paper uses the time series data of 2014-2021 in Beijing to establish a VAR model between the shared accommodation market and commercial housing price. Using the methods of co-integration relationship analysis, Granger causality test, impulse response function and variance decomposition, this paper empirically studies the relationship between the number of shared accommodations, the average price of housing per night and commercial housing price in Beijing. The results show that: (1) The number of shared accommodations has a positive driving effect on commercial housing price in Beijing. (2) The rent of shared accommodation has a negative pulling effect on commercial housing price in Beijing. (3) The impact of the development of shared accommodation market on commercial housing price in Beijing should be reflected in the long run. Based on the interaction between the shared accommodation market and the real estate market, corresponding policy suggestions are put forward for housing price regulation and control.

Key words: Shared accommodation; Commercial housing price; Vector autoregressive model.

1. Introduction

As a new form of accommodation service, the emergence of shared accommodation has an important impact on the development of China's housing rental market. Shared accommodation refers to the summation of the economic activities that integrate and share massive and dispersed accommodation resources based on the Internet platform to meet diverse accommodation needs [1]. House holders can rent out their spare beds, rooms or whole sets of houses in exchange for corresponding rental income. Since the shared houses are generally well equipped with kitchen, living room, dining room, entertainment room and other spaces, with high cost-efficient characteristics and strong sense of home, which caters to the diversified accommodation needs of consumers and makes it gradually become a new accommodation choice for consumers with short-term rental needs. Under the influence of Airbnb, the leading enterprise in global shared accommodation market, Tujia, Ant Short Rent, Xiaozhu and other enterprises imitating the business model of Airbnb began to emerge, forming a unique short-term housing rental market [2]. According to the China Shared Economy Development Report (2020) released by the State Information Center, the transaction volume of China's shared accommodation market reached 22.5 billion yuan in 2019, and there were about 3.5 million houses available on major shared accommodation platforms, covering nearly 500 cities in China.

A series of data have shown that the new business form of shared accommodation has become an important part of China's accommodation market. The development of shared accommodation has promoted the prosperity of the accommodation market, and with the booming demand of the tourism market, the massive personal idle housing resources are expected to be continuously revitalized [3]. Therefore, scholars began to pay attention to the impact of shared accommodation market on the real estate market. In terms of China's real estate market, the rapid and high housing price growth in the first and second tier cities has become a serious problem affecting people's livelihood. The high housing price also leads to excessive social resources flowing into the real estate market, which not

only increases the risks of the economy and financial market, but also leads to the inefficient allocation of social resources [4]. To avoid economic and social risks caused by high housing prices, the report of the 19th National Congress of the Communist Party of China clearly put forward that in order to strengthen the construction of the social security system, the positioning of "Housing is for Living in, not for Speculation" should be adhered to. We should speed up the establishment of the housing system which provides both multi-agent supply and multi-channel security, and encourages both renting and purchasing, and constantly regulate the rental housing market in China and ensure the healthy development of the housing rental market. However, the housing price in first-tier cities represented by Beijing still shows a trend of rapid growth in recent years, while the rental price does not increase proportionately or even stagnates. This directly leads to a drop in the price-to-rent ratio of first-tier cities in China to 1/500 [5], which reflects that China's rental market has not achieved healthy development. In this context, considering that the development of the shared accommodation market may further stimulate real estate investment and affect the supply and demand of the housing purchase and rental market, thus leading to the rise of housing price, its impact on housing price cannot be ignored [6]. Therefore, it is of great significance to explore and clarify the development of shared accommodation market for China's housing price and even the healthy development of national economy.

Based on the above discussion, in order to fill the research gap, this study selects Beijing as the case to explore the relationship between the development of shared accommodation market and commercial housing price in Beijing by establishing vector autoregression model (VAR), and further explain the influence mechanism of the development of shared accommodation market on the price of housing through data results. Meanwhile, this paper also provides the corresponding suggestions for formulating effective housing price regulation and control measures and ensuring the healthy development of the real estate market.

2. Literature Review and Theoretical Analysis

2.1 The concept and connotation of shared accommodation

Under the background of flourishing shared economy, the participation of shared tourism resources has subtly changed the way tourists travel. Diversified accommodation demands have changed the structure of tourism accommodation industry, thus giving rise to the emergence of shared accommodation. Although there are different concepts of shared accommodation defined from multiple perspectives, they all contain the idle attribute of the "shared", involve three main bodies of "landlord", "shared platform" and "tourists", and embody the function of "accommodation" [7]. As China's shared accommodation has begun to take shape, relevant national departments also actively pay attention to and promote the conceptualization and regulation of shared accommodation. In the Annual Report on The Development of China's Shared Economy (2019) released by the Shared Economy Research Center of the State Information Center, the concept of shared accommodation is described as "the summation of the economic activities that integrate and share massive and dispersed accommodation resources based on the Internet platform to meet diverse accommodation needs." [8]. Through the above analysis of the concept of shared accommodation, its four characteristics can be preliminarily extracted, namely, the high utilization of the integration advantages of the Internet, the revitalization of a large number of scattered housing resources, the diversified operating entities (including individuals, groups or commercial institutions), and the non-standardized services different from hotels. Based on the concept and characteristics of shared accommodation, it is not difficult to see that the shared accommodation industry is connected with multiple industries including the Internet, tourism, real estate industry, hotel industry, etc. Therefore, it is of great significance to explore the impact of shared accommodation from the perspective of related industries so as to promote the standardized development of shared accommodation and even the entire accommodation market.

2.2 Influencing factors of commercial housing price

Since the reform and opening up, the real estate industry has developed rapidly in China and now has become an important part of China's national economy. The development of the real estate industry can not only boost economic growth by stimulating investment and consumption in the national economy, but also promote the urbanization process in China, which makes it a pillar industry related to China's economy and people's livelihood [9]. Since the real estate price has a relatively large weight in the consumer price of the whole society, the housing price plays a decisive role in the consumer price of the whole market to a certain extent and plays an important role in adjusting the living standard of residents [10]. However, the regional differentiation of China's housing price is very serious [11], and the unreasonable growth of housing price in first-tier and second-tier cities has affected residents' livelihood and may lead to potential financial risks [12]. Therefore, it is of great significance to find and clarify the influencing factors of China's real estate price for the healthy development of the real estate industry and even the national economy.

Housing price can be divided according to different classification standards, according to the type or use of real estate material entity, housing price can be subdivided into commercial housing price, industrial plant price, shop price, office building price, etc. Among them, commercial housing refers to the housing built by real estate development enterprises (units), sold and rented to users only for residential use, and commercial housing price is the housing price index most closely related to people's livelihood. The influencing factors of commercial housing price can be analyzed from different perspectives. As a commodity, the price of commercial housing is affected by the relationship between market supply and demand, and is closely related to factors including economic development level, residents' disposable income, completed residential area, population structure, land price, etc.[13][14]; As an investment product, the price of commercial housing is affected by consumer individual factors, financial environment, housing price expectation, etc. [15]; As a consumer product to maximize the utility of consumers, the price of commercial housing is also affected by its related features and functions [7]; As a part of the whole market economy, the regional price of commercial housing price is affected by other markets. Since the real estate market plays an important role in the development of national economy, the trend of housing price is also closely related to the formulation of national policies [6]. To sum up, the factors influencing commercial housing price are complex. Only by understanding the factors influencing commercial housing price in a comprehensive and profound way can we take measures according to local conditions to ensure the healthy development of the market.

2.3 The influencing mechanism of shared accommodation on commercial housing price

The development of shared accommodation may affect commercial housing price for the following reasons. First, shared accommodation endows commercial housing with new income channels and increases the real estate holding value. Second, shared accommodation brings a unique short-term rental market, which affects the supply and demand of housing sales and rental market. Third, shared accommodation stimulates new tourism demand and increases local residents' income and housing purchase demand. Fourth, the complex external factors of the development of shared accommodation will also have an impact on housing prices. The specific influence mechanisms are as follows.

Firstly, shared accommodation provides a new income channel for real estate and increases property value [16]. Commercial houses can often be held as assets, while the emergence of accommodation shared platforms such as Airbnb allows house owners to rent their homes for a short period of time and generate rental income while they invest in the property. For real estate speculators who are not for the purpose of residence or long-term rent, but only to buy and sell houses to make profits by taking advantage of rising real estate prices, the short-term rental form of shared accommodation can help them obtain rental income while entering and leaving the real estate market flexibly, thus providing a new income channel for this group [17]. Meanwhile, for the house owners with short-term housing needs (such as migratory bird-like residents), they can also rent the house during the idle period and obtain income, so as to reduce the housing ownership cost. Tang pointed

out that this scenario provides a new way to realize the value of housing, which will be reflected through the rise of housing price [2].

Secondly, shared accommodation will lead to the redistribution of housing supply in the long-term rental market and the short-term rental market, and ultimately affect commercial housing price. According to Barron's research, housing owners who develop shared accommodation generally fall into three categories. The first category is the housing owners who still have housing needs. They usually have housing needs at a certain period of time each year, and cannot rent out the houses previously due to the restriction of long-term rent. For such owners, their choice to develop shared accommodation will only lead to the increase of housing supply in the short-term rental market, but not in the long-term rental market. The second category is the housing owners who have not rented their houses but are attracted by the profits of the shared accommodation market. For such owners, their choice to develop shared accommodation will also not lead to a change in the supply of housing in the long-term rental market. The third category is the housing holders who previously develop long-term rent but now switch to short-term rent. The emergence of this group will lead to the decline of housing supply in the long-term rent market [18]. Horna & Merantea pointed out that the flexibility and profitability of short-term rent are the main reasons that attract some owners who previously rented houses in the long term to enter the short-term rent market [17]. Considering the lack of elasticity of housing supply in the short term, the housing supply in the long-term rental market will decline and the long-term rental price will rise [14]. Since the purchase of a house can be regarded as the present value of the rent to be paid in the future, house prices can be reflected by the expected long-term rent, adjusted for tax implications, borrowing costs, maintenance costs and actual depreciation [19]. Therefore, any impact of shared accommodation on long-term rents will be directly translated into house prices, in this case reflected as driving up commercial housing prices.

Moreover, the development of shared accommodation will play a positive role in stimulating the new demand for tourism, boost the tourism industry and regional economic growth, thus promoting the rise of housing price. Cao pointed out that shared accommodation will have a multi-dimensional impact on tourism demand. The interoperability and convenience of shared accommodation platform allows tourists to establish timely and efficient communication with the host, which can not only save transaction costs but also clearly show the appearance of the house for tourists. The unique characteristics of shared accommodation enable it to provide a highly customized and localized experience to meet the diverse needs of tourists. At the same time, the economy of shared accommodation also provides a new way for tourists to save travel expenses [16]. In general, shared accommodation plays a significant positive role in promoting regional tourism demand [13]. The increase of tourism demand will lead to the increase of regional tourism income, which will improve the employment and income of local residents, thus increasing the rigid demand of local residents for housing and driving up the housing price, according to Liu's research. [20] With the advent of the era of mass tourism and the upgrading of tourism consumption, the demand of consumers for shared accommodation will become more and more vigorous. The development of shared accommodation will continue to attract tourists and increase the income of local residents, which will lead to an increase in rigid demand for residential housing by local residents and push up housing prices.

Finally, the externalities of shared accommodation development will also have an impact on housing prices. Sheppard & Udell pointed out that there are both positive and negative externalities in the impact of shared accommodation development on house value [21]. From the perspective of positive externalities, the development of shared accommodation may attract funds into the community, which may be used to update surrounding supporting facilities to improve the quality of the community and boost the appreciation of real estate. From the perspective of negative externalities, the development of shared accommodation will also bring noise and safety problems which reduce the quality of community life, thus leading to a decline in housing price.

Based on the above perspectives, scholars have conducted researches on the impact of the development of shared accommodation on housing price mainly in areas with developed shared accommodation market. Sheppard & Udell took New York as the case, adopted the characteristic

price method and found that the increase in the number of shared accommodations in New York would lead to the rise of regional housing price. [21] Barron et al. took the United States as an example and established a multiple linear regression model to find that every 1% increase in the number of Airbnb listings would lead to an 0.026% increase in regional housing price [18]. P Taking Florence as the research object, Patatu drew a similar conclusion by constructing a fixed effect model, that is, each additional 100 shared accommodations in Florence will lead to an increase by 0.8% in regional housing price. [4] Todd et al. found a significant positive correlation between the number of Airbnb listings and the local housing price in London using similar methods [22]. In terms of domestic scholars, Tang used relevant data in Shanghai and calculated that the increase of short-term rental listings in Shanghai would significantly lead to the rise of second-hand house prices by constructing a classical time series model [12].

Although most scholars believe that the development of shared accommodation market has contributed to the rise of housing prices, some scholars have reservations about this judgment. As Alvarez's research shows, the impact of the development of shared accommodation market on housing price is more obvious in areas with high housing price and low population density, while there is little impact in most cities and densely populated areas [23]. Sheppard & Udell pointed out that the development of shared accommodation can promote the increase of social welfare, and it may not be appropriate to regulate housing prices by restricting the development of shared accommodation market [16].

Therefore, the impact of the development of the shared accommodation market on housing prices has been inconclusive. Meanwhile, most scholars have ignored the impact of an important variable, shared accommodation price, on housing price. Specifically, the rental price of shared accommodation per night directly determines the income of shared accommodation, which reflects the cognition of the rental rate of house buyers motivated by the development of shared accommodation, and affects the real estate investment demand. Meanwhile, the rent will affect the travel choices of tourists and other factors including the income of local residents. Therefore, it is necessary to explore rental price of shared accommodation as an important variable affecting housing price fluctuations. In addition, given the differences in business environment, tourism development status, shared accommodation regulations and other objective factors in different regions, the existing conclusions cannot be directly applied to all regions. In sum, in order to obtain conclusions that match China's national conditions and fill in the research gap, this paper takes Beijing as the case and establishes the VAR model to analyze the impact of the number and rental of shared accommodations on the housing price in Beijing, and further explain the influence mechanisms of shared accommodation market development on housing price.

3. Research Design

3.1 Model selection

This paper explores the relationship between the development of shared accommodation market and commercial housing price in Beijing by establishing the vector autoregression model (VAR). VAR model can analyze the dynamic relationship between endogenous variables by constructing regression equation of lagged T-term of endogenous variables without any constraints. This unstructured modeling method is often used for the dynamic influence of multivariate time series and random disturbance on variable system. The mathematical expression of the model is:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \cdots \ldots + A_p y_{t-p} + Bx_t + \varepsilon_t \ , t = 1,2, \ldots \ldots \ , T$$

yt refers to the endogenous variable vector, xt refers to the exogenous variable vector. Both yt and xt are n-dimensional variables. p refers to the lag order and T refers to the sample number. A1, A2, …, At-p, N are coefficient matrices to be estimated, and ε_t is the disturbance term.

Considering that the inclusion of too many variables in the VAR model will lead to too many coefficients to be estimated and the increase the estimation error, this paper only introduces endogenous variables including the number of shared accommodations, rental price of shared

accommodation and commercial housing price as endogenous variables into the model. At the same time, in order to improve the goodness of fit and the reliability of empirical results, this paper introduces control variables including completed commercial residential area, per capita disposable income and commercial residential investment, controlling from the perspective of commercial housing supply, economic level and commercial housing investment demand, respectively, so as to explore the relationship between the number of shared accommodations, rental price and regional housing price with more accuracy of prediction.

3.2 Variable declaration and pretreatment

The explanatory variables of this paper are the number of shared accommodations (LAN) and average price of shared accommodation (LAP), the core explained variable is commercial housing price (LP), and the control variables are completed commercial housing area (SPA), per capita disposable income of residents (REV) and commercial housing investment (INV). In this paper, the variables are preprocessed as follows: (1) in order to weaken the heteroscedasticity and reduce the absolute difference, the data are transformed into logarithm. (2) Except for the number of shared accommodations, other sequences have obvious seasonality and thus adjusted through the moving average method, so as to show the trend cyclical component reflecting the objective law of economic time series. The final descriptive statistical results are as follows.

Table 1. Descriptive Statistical Results

Variable	Implication	Indicator	Mean	SD	Min	Max	Seasonal adjustment
lnLAN	Development scale of shared accommodation market	Number of Airbnb listings in a quarter	6.6030	0.2978	2.5649	8.4355	No
lnLAP	Market price level of shared accommodation	Average nightly price of Airbnb listings in a quarter (yuan)	7.4046	0.0410	6.7778	7.8436	Yes
lnLP	Average price of commercial housing	Quarterly average price of commercial housing in Beijing (yuan/m^2)	10.3908	0.0574	9.7365	10.8829	Yes
lnSPA	The supply of commercial housing	Total completed commercial housing area in Beijing in the quarter (million m^2)	5.6384	0.0987	4.5061	6.5823	Yes
lnREV	Purchasing power of local residents	Quarterly per capita disposable income in Beijing (yuan)	9.6844	0.0303	9.3861	9.9300	Yes
lnINV	Investment demand for commercial housing	Quarterly commercial housing investment in Beijing (100 million yuan)	6.2377	0.0361	5.9125	6.8264	Yes

3.3 Data sources and case selection

The data of explanatory variables of this paper lnLAN, lnLAP were selected from Beijing housing dataset official released by Airbnb (http://insideairbnb.com/get-the-data.html). The data released by Inside Airbnb, the official data platform of Airbnb, have strong authority and reference significance. The data of explained variable lnLP were selected from the official website of the National Bureau of Statistics. The data of control variables lnSPA, lnREV and lnINV were selected from China Real Estate Information.

In this paper, the 32 quarters, from 2014Q1-2021Q4, were selected as the research period, and the quarterly data of relevant indicators were used. This paper selected Beijing as the case for study.

Beijing has a strong demand for shared accommodation, and the number of shared accommodation houses and the number of nights (the number of rooms * the number of days) are among the top in China. In addition, the overall development of Beijing's shared accommodation market started early and now the market has become relatively mature. Therefore, it is representative and feasible to select Beijing as the case for study.

4. Empirical Analysis

4.1 Unit root test

Before incorporating time series data into the model, the stationarity test of the data should be carried out first. In this paper, ADF test was used to test the stationarity of time series data of lnLAN, lnLAP, lnLP, lnSPA, lnREV and lnINV. ADF unit root test results showed that the ADF values of lnLAN, lnLAP, lnLP and lnSPA were all within the given interval of 1%-10% significance level. Therefore, the null hypothesis of the existence of unit root could be rejected and the above sequences were considered to be stationary without unit root. However, the ADF values of lnREV and lnINV were both outside the given interval of 1%-10% significance level, so the null hypothesis that the sequence has unit roots could not be rejected, and there may be unit roots. After the first-order difference was applied to lnREV and lnINV, the sequence reached a stationary state.

Table 2. ADF Unit Root Test Results

Variable	ADF	Critical value at different confidence levels			p value	Result
		1% confidence level	5% confidence level	10% confidence level		
lnLAN	-3.1696	-3.6793	-2.9678	-2.6230	0.0324	stationary
lnLAP	-3.0307	-3.6793	-2.9678	-2.6230	0.0442	stationary
lnLP	-3.1128	-3.6793	-2.9678	-2.6230	0.0367	stationary
lnSPA	-3.3819	-3.6616	-2.9604	-2.6192	0.0195	stationary
lnREV	-1.2613	-3.6616	-2.9604	-2.6192	0.6345	non-stationary
DlnREV	-5.2824	-3.6702	-2.9640	-2.6210	0.0002	stationary
lnINV	-1.4504	-3.6616	-2.9604	-2.6192	0.5448	non-stationary
DlnINV	-5.3499	-3.6793	-2.9678	-2.6230	0.0001	stationary

4.2 VAR model construction

4.2.1 Selection of lag order

To construct the VAR model, the lag order of variables should be determined, and the appropriate lag order can correctly reflect the dynamic characteristics of variables. In this paper, the lag order was determined according to the lag length criteria, and the test results showed that the lag order selected by all criteria is 2. Therefore, order 2 was selected as the optimal lag order of the model in this paper, which can reflect the dynamic characteristics between data more accurately and effectively.

Table 3. Test Results of Optimal Lag Order

Lag Order	LogL	LR	FPE	AIC	SC	HQ
0	-82.9504	NA	0.0924	6.1300	6.5504	6.2645
1	60.2751	229.1608	1.22e-05	-2.8183	-1.9776	-2.5494
2	75.7607	21.6799*	8.23e-06*	-3.2507*	-1.9896*	-2.8473*

Note. LogL is log—likelihood; * refers to the optimal lag order selected according to the lag length criteria.

4.2.2 Parameter estimation of VAR model

VAR model can analyze the dynamic relationship between endogenous variables and predict the impact of disturbance terms on variables, so as to explain the impact of economic shocks. In this

paper, the unconstrained VAR model was selected, with lnLP, lnLAN and lnLAP as endogenous variables, and lnSPA, DlnREV and DlnINV as control variables. The estimation results of the VAR model constructed by lnLP are shown as follows.

$$lnLP_t = 0.3577lnLP_{t-1} + 0.5590lnLP_{t-2} - 0.0130lnLAN_{t-1} + 0.0199lnLAN_{t-2} - 0.1881lnLAP_{t-1} + 0.2917lnLAP_{t-2} - 0.0655lnSPA + 0.7669DlnREV + 0.0204DlnINV \quad (1)$$

The results showed that the fitting degree of the equation was high (R2=0.9533, F=216.5443), and the AIC value (-2.3370) and SC value (-2.0935) were small, indicating the excellent overall fitness of the equation, and the strong explanatory ability of the model. In addition, the absolute values of parameters of all orders of lnLP in the formula were greater than those of lnLAN and lnLAP, indicating that the change of LP was mainly affected by its own lag period in the short term.

4.2.3 VAR model stationarity test

In AR root test, if all the characteristic roots of the model are located inside the unit circle, that is, all the characteristic roots are less than 1, then the VAR model is in a stationary state. The test results showed that all the roots were in the unit circle, indicating that this model was relatively stationary and met the premise of impulse response analysis and variance analysis.

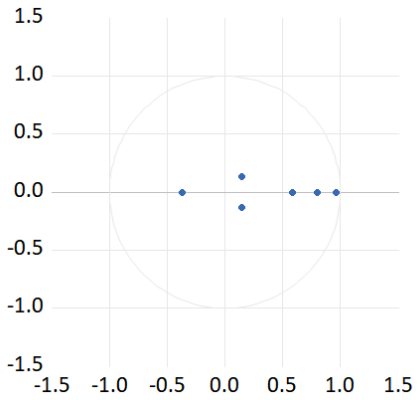

Fig. 1 Stationarity Test Results

4.3 Co-integration relationship Test

Existing studies generally applied E-G Two-step Method and Johansen co-integration test method to examine the co-integration relationship between variables. The traditional E-G two-step method can only be used to judge one co-integration relationship between multiple variables, while three non-stationary sequences may have at most two co-integration relationships, which are limited by the number of samples. In order to reduce the error of model estimation, Johansen co-integration test was selected in this paper to test the co-integration relationship between variables, and judged the total number of co-integration by testing trace statistics. Johansen co-integration test can not only predict whether the stationary relationship between variables exists for a long time, but also determine the number of co-integration vectors. In this paper, with the aid of EViews11, the trace statistics test method was selected to test the Johansen co-integration relationship. Since the co-integration test is to test the first-order difference of variables, and the optimal lag period of unconstrained VAR is 2 periods, the optimal lag period of the co-integration test is 1 period.

Table 4. Results of the Trace Statistics Test

Null hypothesis	Eigenvalue	Trace statistics	5% critical value	Probability value
0*	0.6799	66.8445	29.7971	0.0008
At most 1*	0.5757	31.5323	15.4947	0.0001
At most 2*	0.1477	4.9539	3.84147	0.0260

Note. * refers to significance at 10% level.

Table 5. Standardized Co-integration Equation Coefficient

lnLP	lnLAP	lnLAN
1	0.1806	-0.1353
Standard deviation	0.0799	0.0130

Table 4 showed that at least two co-integration relationships existed for each variable at the significance level of 5%, indicating that there was a long-term dynamic equilibrium relationship between the average price of commercial housing, the shared accommodation price and the number of shared accommodations. As can be seen from table 5, the standardized co-integration vector (lnLP lnLAP lnLAN) is (1,0.1806, -0.1353), and the long-term co-integration equation of lnLP, lnLAN and lnLAP is:

$$\mathrm{lnLP} = -0.1806 * \mathrm{lnLAP} + 0.1353 * \mathrm{lnLAN} \quad (2)$$

Based on the co-integration equation, the growth elasticity between commercial housing price and shared accommodation price, and between commercial housing price and the number of shared accommodations can be obtained. That is, when shared accommodation price increases by 1%, commercial housing price decreases by 0.1806%; when the number of shared accommodations increases by 1%, commercial housing price increases by 0.1353%. This result showed that the number of shared accommodations had a positive impact on commercial housing price, which is consistent with the research conclusions obtained by foreign scholars such as Sheppard & Udell (2016), Barron (2021) and Patatu (2020), and similar to the results obtained by Tang (2019) who selected Shanghai as the case for study. At the same time, this conclusion also reflects that the price of shared accommodation will have a negative impact on commercial housing price, and the two have a negative co-integration relationship.

4.4 Granger causality test

Granger causality test can detect whether the lag variable of the dependent variable is affected by the lag variable of the independent variable. If there is Granger causality between the dependent variable and the independent variable, it indicates that the independent variable is an endogenous variable, which can be included in the VAR model and will have an impact on the dependent variable. The test results are shown in Table 6.

Table 6. Granger Causality Test Results

Null Hypothesis	F Statistics	P value	Result
lnLAP is not the Granger cause of lnLP	7.6379**	0.0220	Rejected
lnLP is not the Granger cause of lnLAP	1.0395	0.5947	Accepted
lnLAN is not the Granger cause of lnLP	27.1359***	0.0000	Rejected
lnLP is not the Granger cause of lnLAN	1.7824	0.4102	Accepted

Note. **, *** refer to significance at 5% level and 1% level, respectively.

The results showed that at the 5% confidence level, there was one-way Granger causality relationship from lnLAN to lnLP ($p<0.001$) and from lnLAP to lnLP ($p = 0.022<0.05$), indicating that the price and quantity of shared accommodation were granger causes of the price change of commercial housing, while commercial housing price was not the Granger cause of price and quantity change of shared accommodation.

4.5 Impulse response analysis

Impulse response function can explore the impact of one standard deviation shock on the current and future values of other variables when controlling the current and all previous values of other variables, and the results can clearly show the relationship between variables. In order to intuitively analyze the impact of the number and price of shared accommodation on commercial housing price,

this paper constructed the impulse response function of lnLAN and lnLAP to lnLP respectively, with the time series selected as 2014Q1-2021Q4, and the observation time set as 10 periods. The results are shown in Figure 2. In Figure 2, the abscissa is the response time, and the ordinate is the impact degree of the independent variable on the dependent variable.

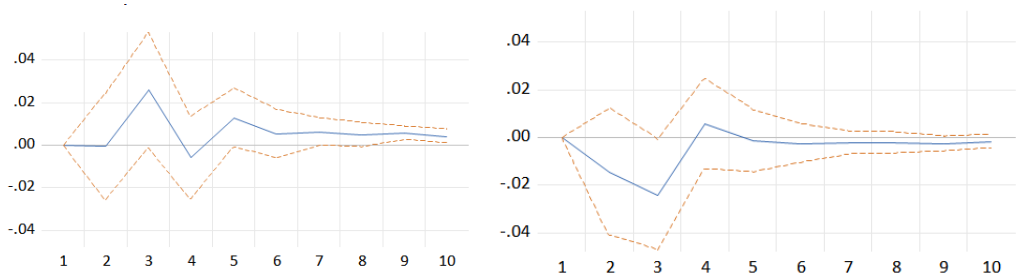

Fig. 2 Impulse Response Results (Left: lnLAN; Right: lnLAP)

As can be seen from the figure on the left, lnLP did not respond immediately in the current period after the standard deviation impact of lnLAN, but began to produce a rapid positive response and reached its maximum value in about the second period, and then the impact effect gradually weakened and remained at a low positive response level. Due to the stickiness of housing price, the fluctuation of the number of shared accommodations did not immediately lead to the change of commercial housing price, which is consistent with the high stickiness of housing price in China [10]. Subsequently, the positive response of the number of shared accommodations to the impact of commercial housing price became more and more significant, indicating that with the increase of the number of shared accommodations, its driving effect on housing price gradually increased and had a continuous positive impact in the long-term development process. Although the number of shared accommodations had a small negative effect on housing price due to the vulnerability and sensitivity of tourism industry development, the two still presented overall stationary relationship. In the figure on the right, after lnLP was subjected to the standard deviation shock from lnLAP, the negative response decreased to the lowest at about the third stage, and then the impact gradually weakened and remained at a low negative response level. As can be seen from the figure, there were also lag period and fluctuation of the response of commercial housing price to shared accommodation price to some extent, but the overall response was still negative, indicating that the impact of shared accommodation price on commercial housing price had a negative trend in the long term.

4.6 Variance decomposition

Variance decomposition can predict the future development of commercial housing price by analyzing the contribution of price and quantity of shared accommodation to the change of commercial housing price. Similarly, the observation time was set as 10 periods. The results showed that the change of commercial housing price lnLP was mainly influenced by its own, and the variance proportion was basically maintained at about 80% in the third and subsequent tracking period, which suggests that the impact of housing price on its own took a large proportion. This may be because the past and current prices of expected housing prices have strong explanatory power for Chinese urban housing prices [24], that is, the speculators often engage in speculative activities based on past prices fluctuations, and the adaptability of investors prices are expected to be price fluctuation of the main causes of itself. The variance contribution of lnLAN and lnLAP to lnLP were not significant at the beginning, but then gradually increased, and reached 11.42% and 9.58% in the 10th quarter, respectively. This indicates that the development of shared accommodation market had a gradual and profound impact on commercial housing price in the process of market interaction, and finally had a cumulative impact on the price of housing.

Table 7. Variance Decomposition Results

Period	S.E.	lnLP	lnLAN	lnLAP
1	0.078196	100	0.000000	0.000000
2	0.083793	97.03564	0.004699	2.959666
3	0.090935	82.39415	8.100763	9.505086
4	0.092087	82.07017	8.259218	9.670615
5	0.093214	80.53093	10.00492	9.464143
6	0.093404	80.20911	10.29121	9.499682
7	0.093706	79.81795	10.68158	9.500466
8	0.093858	79.56029	10.91381	9.525898
9	0.094087	79.17807	11.25356	9.568366
10	0.094199	79.00485	11.41905	9.576103

4.7 Robustness test

Commercial housing includes residential apartments, office buildings and other commercial premises. Given the many shared accommodation also began to develop based on apartment buildings and office buildings [25], this paper adopted the method of replacing dependent variable to replace Beijing commercial housing price (LP) by Beijing commercial residential housing prices (LHP) to conduct robustness test. The results showed that after replacing the dependent variable, the change tendency of the impulse response of the figure and the proportion of each factor in variance decomposition were basically consistent with the previous results, which proved the robustness of the model.

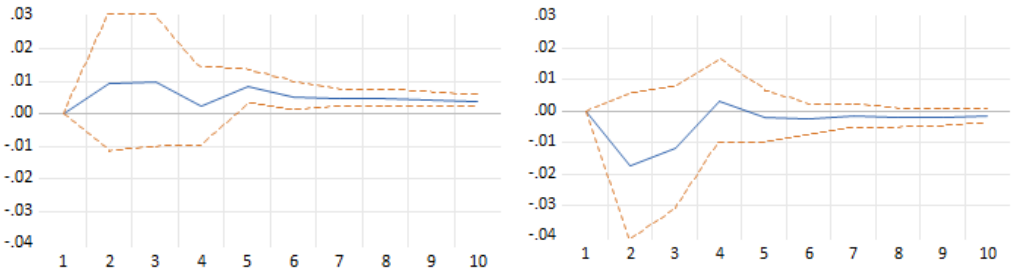

Fig. 3 Impulse Response Results of Robustness Test (Left: LAN; Right: LAP)

Table 8. Variance Decomposition Results of Robustness Test

Period	S.E.	lnLHP	lnLAN	lnLAP
1	0.078196	100	0.000000	0.000000
2	0.083793	91.70521	1.871415	6.423379
3	0.090935	87.42764	3.760316	8.812039
4	0.092087	82.50467	3.756610	8.738717
5	0.093214	86.26650	5.082391	8.651113
6	0.093404	85.68698	5.592419	8.720596
7	0.093706	85.33049	5.972406	8.697101
8	0.093858	84.88377	6.377324	8.738909
9	0.094087	84.50669	6.716449	8.776857
10	0.094199	84.25602	6.961251	8.782728

5. Conclusions

This paper selected the time series data of 2014Q1-2021Q4, constructed a vector autoregressive model, and comprehensive applied methods including Johansen co-integration relationship test, granger causality test, impulse response function analysis and variance decomposition, to analyze the dynamic relationship between the number of shared accommodations, rental price per night and regional commercial housing price. The main conclusions are as follows.

5.1 The number of shared accommodations has a positive driving effect on commercial housing price

The number of shared accommodations has a significant driving effect on commercial housing price in the long run. According to the co-integration equation coefficient, the price of regional commercial housing increased by 0.1353% when the number of shared accommodations increased by 1% in Beijing. This conclusion is basically consistent with the mainstream conclusion reached by current academic scholars, that is, the increase of the number of shared accommodations will lead to the rise of regional housing prices. Based on further analysis of impulse response function, the impact of the number of shared accommodations on housing price was not significant in the short term, but gradually accumulated over time, and finally reflected a certain positive pulling effect. Specifically, the decline of long-term housing supply, the increase of tourism demand and its positive externalities caused by the increase in the number of shared accommodations may be the path of pulling up commercial housing price. From a macro perspective, the expansion of shared accommodation market reflected by the increase in the number of shared accommodations will further lead to the rise in the price of regional commercial housing.

5.2 The rental price of shared accommodation has a negative pulling effect on commercial housing price

The driving effect of the rental price per night of shared accommodation on commercial housing price is significant in the long run. According to the coefficient of the co-integration equation, the price of regional commercial housing in Beijing decreased by 0.1806% when the price of shared accommodation increased by 1%. Based on this conclusion, the decrease of tourism demand caused by the increase of shared accommodation price may be one of the reasons explaining the negative impact of shared accommodation price on housing price. If analyzed from the perspective of real estate investment, this conclusion also indicates that the increases of income and rental rate reflected by the rising price of shared accommodation have no significant positive driving effect on housing price. This may be because the price of shared accommodation cannot directly reflect the cognition of rental rate of home buyers, or house owners care more about the benefits of ownership than the benefits of developing shared accommodation. On the one hand, the rise in the price of shared accommodation does not represent a higher rental rate of return. Considering that the rental of shared accommodation has higher management costs compared with traditional rental [26], investors may have doubts about the actual return rate of the development of shared accommodation. Meanwhile, the vulnerability of tourism demand may also lead to the unstable demand of tourists for shared accommodation [27]. Even if the expected income from the development of shared accommodation is high, investors may also be concerned about the impact of unconventional events such as epidemics and natural disasters on the tourism and shared accommodation industry, thus affecting their speculative demand for housing. On the other hand, house owners may be more concerned with the value of their property than the additional benefits of developing shared accommodation. This is not only closely related to the cold rental market under the epidemic, but also plays a significant role in the strong “housing complex” of Chinese people. Therefore, house owners will not pay too much attention to the development and pricing of shared accommodation, resulting in the deviation of shared accommodation price from the rise of housing prices. In this paper, the results of Granger causality test also help to explain the view. Since the housing price is not a Granger cause of shared accommodation price, the house owner will not adjust shared accommodation price according to the change of benefits caused by fluctuations of housing prices. Meanwhile, the housing price-to-rent ratio in Beijing has been lower than the ideal price-to-rent ratio range of 1/200 ~ 1/300 for a long time [28]. This also confirms that the demand and supply of Beijing’s housing market are much higher than that of rental market, which makes the growth rate of housing price higher than that of rent, further leading to the divergence between shared accommodation price and housing price.

5.3 The impact of shared accommodation development on housing price should be reflected in the long term

According to the results of impulse response analysis and variance analysis, the impact of the number and price of housing in the shared accommodation market on commercial housing price should be reflected in the long term. In the short term, as housing prices are sticky, the development of the shared accommodation market will not lead to immediate changes in housing prices. However, with the gradual deepening of the cumulative impact of the shared accommodation market on the real estate market, the decline of long-term rental housing supply caused by the development of shared accommodation, the upgrading of related property facilities and other factors will have a lasting impact on the housing price, and will be ultimately manifested in the change of commercial housing price. It is worth noting that, according to the result of variance decomposition, although the explanatory power of the number of shared accommodation sources and rent will continue to rise over time, the contribution of housing price to its own variance still remains at about 80%. This suggests that the fluctuations of house price are still largely influenced by itself. The reason is that in China's real estate market, expectation is an important factor affecting the fluctuation of housing price, and the role of adaptive expectation is greater than rational expectation. [22], the proportion of investors making predictions about future housing price based on past numerical trends is greater than the proportion of investors making rational judgments about future housing price based on current information. This makes past housing price a major factor in the volatility of housing price. From the perspective of relevant policies, Beijing issued the "strictest ever" real estate purchase restriction order in 2017, which not only strictly controlled the purchase restriction quantity and purchase qualification, but also put forward stricter requirements on down payment ratio, loan interest rate, etc. [29] The increasingly strict purchase restriction policy and the reduction of migrant population caused by the epidemic have lowered speculative demand in Beijing's real estate market, reduced the elasticity of demand for commercial housing, and made Beijing's housing price less sensitive to price changes caused by other factors.

6. Research prospects

6.1 Policy suggestions

There are many factors influencing commercial housing price. This paper explored the influence of the number and rental of shared accommodation on commercial housing price in Beijing. In order to ensure the healthy development of shared accommodation and real estate market, this paper puts forward the following policy suggestions: (1) The government should pay close attention to the dynamics of shared accommodation market, speed up the improvement of shared accommodation regulation policies, and prevent excessive houses in the long-term rental market from flowing into the short-term rental market and causing the increase in housing price. (2) The government should accelerate the establishment and strict implementation of the housing system which provides both multi-agent supply and multi-channel security, and encourages both renting and purchasing, so as to promote the development of the housing rental market, ensure the supply of rental housing, and pull up Beijing's real estate price-to-rental ratio. (3) The government should guide residents to form a correct concept of real estate investment, reduce real estate speculation caused by adaptive expectations, and try to avoid the irrational rise of housing price, so as to avoid the possible collapse of housing price bubble.

6.2 Research significance and innovation

In terms of theoretical significance, this paper first explores the influence of the number and rental of shared accommodation on commercial housing price, which fills in the void in the field of the impact of shared accommodation price on housing price, improves the interaction between tourism and real estate industry, and provides new research ideas and research perspectives for housing price

regulation and real estate de-financialization. In terms of practical significance, this paper explores the significance of shared accommodation as a new real estate development mode in combination with the guideline of "Housing is for Living in, not for Speculation", which not only provides new ideas for the development of real estate enterprises caught in the "liquidity trap", but also promotes the stable and healthy development of the real estate market.

6.3 Research limitations

There are some limitations of this research to be improved. On the one hand, this paper only studied and analyzed the data of a single city, Beijing, and the differences in the number of shared accommodation sources and rents between different cities on the housing price should be further explored. On the other hand, this paper only judged the direction of the impact of the development of the shared accommodation market on the regional housing price, while the specific influencing mechanism and the actual impact of each influencing factor should be further explored. In addition, influencing factors such as the quantity of hotel supply can also be included in the future analysis.

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