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The Impact of Aging on Housing Market: Evidence from China

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Abstract: In recent years, the Chinese government has gradually introduced the multi-child policy to control the aging phenomenon. The aging of the Chinese population has aroused international attention. How the aging of the Chinese population will affect housing prices makes this study focus on the question. This study fitted the housing demand curve using the CGSS database and found that the housing demand will continue to rise as residents enter middle age. After residents enter old age, housing demand shows a slow decline. Then, this study establishes the spatial Dubin model to analyze the influence mechanism of population aging on housing prices in China, and finds that aging has a positive impact on housing prices. However, with the intensification of the aging phenomenon in China, the benefits brought by the welfare housing distribution system to the elderly will be gradually consumed, and the insufficient supply of social labor force and the stagnation of total output, its positive impact on housing prices will gradually weaken or even become negative.

Keywords: aging; housing demand curve; house price; spatial Durbin model

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1. Introduction

With the accelerated pace of housing construction and the deepening of housing allocation system reform since 1978, China's housing market has undergone a process from scratch and has developed tremendously, resulting in a continuous growth of housing demand among Chinese residents. At the same time, housing prices have also been rising, with the average sales price of residential houses in China reaching 9980 yuan per square meter in 2020, and even higher in some cities, such as Shenzhen, where the price reached 56,844 yuan per square meter in 2020. Excessive housing prices have led to the basic housing needs of some residents not being effectively protected, making it increasingly difficult to afford a house, and even becoming a label to measure individual material conditions and symbolize wealth status. Meanwhile, population aging is an important issue that most countries and regions need to face in the 21st century when it comes to social and economic development, with the population over 65 years old in China reaching nearly 190.64 million in 2020. The real estate industry, as an important industry supporting the economy, clarifying the impact of aging on the real estate industry is an issue that must be addressed. Population aging, as the main development trend of future population changes, will affect the consumption behavior of residents at the micro level and the structure and total amount of housing demand at the macro level by changing the population size, population age structure, and household size of a country or region.

Housing demand includes consumption demand and investment demand [1]. According to Dent's research, factors affecting housing demand can be divided into four main categories [2]: first, demographic factors such as age [3], gender [4], and population mobility [5]; second, factors such as the affordability of housing costs for home buyers, such as resident income [6], house prices [7]; third, factors related to housing supply and investment, such as land prices [8]; and fourth, factors related to the macroeconomic environment in which home buyers live, such as economic growth [9]. Among them, demographic consumption is the most important factor that affects housing demand. Therefore, it is

important to explain the continued rise in Chinese house prices from the perspective of buyer demand.

According to the life cycle theory, people have different consumption characteristics at different ages in their life [10]. This theory is also applied to housing consumption. When residents are young, they will choose to hold real estate, and when they are old, they will usually choose to sell real estate and choose liquid assets [11]. The housing demand of residents will change with age. Mankiw and Weil, for the first time, combined the age structure of the population with the housing demand system for analysis and discussion [3]. They built a housing demand decomposition model to analyze the housing market of the United States and found that housing demand will start to decline as the baby boomers grow old. Later, McFadden began to draw on the research ideas of Mankiw and Weil and came to a similar conclusion by analyzing the housing demand of American families [12]. Chinese scholar Chen B. K. has also reached a similar conclusion through the analysis of the housing demand of Chinese families, and believes that the housing demand of Chinese residents will start to decline when they are around 50 years old, and puts forward that the factors leading to the decline of housing demand of the elderly are related to their income and education level [13]. However, the sale or replacement of housing has transaction costs and takes a long time, so the housing demand of the elderly population declines slowly [14].

With the development of aging, scholars in many countries have focused on the impact of aging on the housing market. Jones studied the housing market in the United States and Canada and found that the elderly tend to change from homeowners to house renters [15]. Sinai and Souleles also analyzed the American housing market and found that the housing ownership rate of residents began to decline significantly after the age of 65 [16]. Lindh and Malmberg used data from Sweden and OECD countries to find that the population over 75 years old has a negative impact on investment in housing construction [17]. Chiuri and Jappelli investigated the housing situation of the elderly in 15 OECD countries and found that after the age of 60, the housing ownership rate of residents would start to decline [18]. Andrews and Sánchez analyzed the housing market of OECD countries and found that when the age of residents exceeds a certain level, housing ownership will decrease with the growth of age [19]. Bo Malmberg analyzed the data of OECD countries and Sweden and found that the population over 50 has a negative impact on housing prices [20]. Jäger and Schmidt, based on data from 13 developed countries, found that the proportion of the elderly aged 60–65 is negatively correlated with the housing price, and housing prices will continue to decline in the face of aging [21]. Arestis and Gonzalez's econometric analysis showed that aging would have a significant negative impact on house prices in Ireland, Spain, Australia, and Japan [22]. However, Lim and Lee believed that in South Korea, population aging did not reduce housing demand [23].

Chinese scholars often use the dependency ratio of the elderly population to measure the degree of aging, but the conclusions are not exactly the same. Some scholars argue that an increase in the dependency ratio of the elderly population implies a decrease in the share of the working population and a slowdown in total social output. The low economic income and higher medical expenses of the elderly will increase the dependency burden of the working population. Finally, it leads to a reduction in housing demand, which further has a negative impact on housing prices [24–27]. However, some scholars have argued that in China, it is common for elderly people to purchase houses for their children under the altruistic psychology of benefiting from the welfare housing allocation system, thus playing a positive role [28–30]. In summary, there is no unanimous conclusion on the impact of aging on housing prices in China, as demographics, social customs, and economic development vary significantly from time to time and region to region, and the level of aging development also varies.

Facing the accelerated arrival of an aging population and fewer children, China has gradually introduced multi-child policies to increase the fertility rate. With the implementation of the policy, the age structure of China's population is bound to change significantly in

the future, and the house prices of the population will also change accordingly. Regarding the choice of econometric model, some scholars use the housing demand decomposition model proposed by Mankiw and Weil [3] to plot the housing demand curve with age, and in China, many scholars use panel models, such as the two-way fixed effects model, to conduct their analysis. This study also used the housing demand decomposition model proposed by Mankiw and Weil [3], and controlled for the cohort effect of birth years to analyze the housing area demand of people of different ages in China. Considering that many Chinese scholars have ignored the spatial spillover effect of aging by using the ordinary panel model, this study will use the spatial Durbin model to investigate the effect of population aging on house prices in China.

2. Data

2.1. Microdata

In this study, we obtained mixed cross-sectional data for 2012, 2013, 2015, 2017, and 2018 from the official website of the China General Social Survey Database (http://cgss.ruc.edu.cn/, accessed on 15 November 2022.) to fit the housing demand curve. The China General Social Survey is the earliest national, comprehensive academic survey project in China. CGSS systematically and comprehensively collects data at multiple levels of society, community, family, and individual. At present, CGSS data have become the most important data source for the study of Chinese society, which is widely used in scientific research, teaching, and government decision making. In the data processing process, first, to ensure the accuracy of the sample information, the number of individual household members living together provided by the respondents was summed as the number of current household members living together, and then matched with the answer to the question of the number of household members living together to delete samples with inconsistent information; second, the non-response sample of current living area and the non-response sample of the age of household members living together were deleted. The final number of observations obtained was 41,982.

2.2. Macrodata

The average sales price of housing in China in 2020 was 9980 yuan per square meter, and the average sales price of housing in 2011 was 4993 yuan per square meter, with an annual average growth rate of 107.17%. In 2020, China's elderly population was about 19.064 million, with an old-age dependency ratio of 19.7 percent, an increase of nearly 7.4 percentage points over 2011, indicating that the aging of the population continues to intensify. This study uses the data from 31 regions in China from 2011 to 2020 published on the official website of the National Bureau of Statistics of China (http://www.stats.gov.cn/, accessed on 1 March 2022) for spatial econometric analysis. The logarithm of the average residential sales price (lnhp) was used as the explained variable. The old-age dependency ratio (odr) and its square term (odr2) are explanatory variables. The control variables were the ratio of women to men with higher education (edu_r), the logarithm of marriage registrations (lnmarriage), the logarithm of the permanent resident population (lnpopulation), the logarithm of investment in residential development (lnh_inv), the area of land acquisition (land), the logarithm of GDP per capita (lnave_gdp), the ratio of local fiscal expenditure to local gross domestic product (fiscal), the logarithm of local fiscal expenditure on housing (lnh_exp) and the logarithm of tons of sulfur dioxide emission ($lnSO_2$); descriptive statistics are as follows (Table 1).

Table 1. Descriptive statistical analysis of data.

Variable	Mean	Std. Dev.	Min	Max	N
lnhp	8.7771	0.5163	8.0003	10.6616	310
odr	14.3321	3.8106	6.71	25.48	310
edu_r	0.9179	0.1642	0.4259	2.0977	310
lnmarriage	12.5144	0.8922	9.3588	14.0485	310
lnpopulation	8.1286	0.843	5.7333	9.4434	310
lnh_inv	7.2887	1.1728	1.3181	9.3852	310
land	0.0978	0.0824	0	0.4208	310
lnave_gdp	10.827	0.4389	9.7058	12.013	310
fiscal	30.2638	23.35	10.2798	152.2512	310
lnh_help	4.9593	0.6356	2.2597	6.636	310
$\ln SO_2$	12.3009	1.4486	7.4955	14.4184	310
lnhp	8.7771	0.5163	8.0003	10.6616	310

3. Empirical Methods

3.1. Housing Demand Decomposition Model

In order to plot the housing demand curve, this study used the housing demand decomposition method proposed by Mankiw and Weil [3]. The idea of this method is as follows: assuming that D is the living area of a household and D_j is the living area of member j, then D_j can be expressed as follows.

$$D_j = \sum_k \alpha_k DummyAge_k \tag{1}$$

where $DummyAge_k$ is a dummy variable that takes the value of 1 when member j's age is k. α_k represents the housing demand area of the member whose age is k. Then, the living area of the whole family can be expressed as follows.

$$D = \sum_j \sum_k \alpha_k DummyAge_k \tag{2}$$

On the basis of the above equation, in order to estimate α_k, the following measurement equation is constructed.

$$D_i = \alpha + \sum_j \sum_k \alpha_k DummyAge_k + u_i \tag{3}$$

Considering that populations growing up in different era backgrounds have different characteristics, the effect of cohort effect needs to be controlled. In this study, we referred to Chen, J.X. [31] to introduce dummy variables representing the birth era, such as $Cohort20_j$, which takes a value of 1 to represent that member j was born in the 1920s, and β_1 represents the housing demand of the group born in this era. The model is constructed as follows.

$$\begin{aligned} D_i = \alpha + \alpha_0 \sum DummyAge0_j + \alpha_1 \sum DummyAge1_j + \alpha_2 \sum DummyAge2_j + \cdots + \alpha_{79} \sum DummyAge79_j \\ + \alpha_{\geq 80} \sum DummyAgeover80_j + \beta_1 \sum Cohort20_j + \beta_2 \sum Cohort30_j + \cdots \\ + \beta_8 \sum Cohort90_j + u_i \end{aligned} \tag{4}$$

3.2. Moran Index and Spatial Econometric Model

In the construction process of spatial distance weight matrix, d_{ij} is the distance between province i and province j. The elements W_{ij} of the inverse distance weight matrix W take the following form.

$$W_{ij} = \begin{cases} \frac{1}{d_{ij}}, i \neq j \\ 0, i = j \end{cases} \tag{5}$$

The first law of geography indicates that economic phenomena among regions tend to be spatially correlated. In this study, the global Moran index, which measures spatial

autocorrelation, is used to analyze the spatial correlation between population aging and housing prices, and the global Moran index is calculated as follows.

$$Moran'I = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \overline{x})(x_j - \overline{x})}{S^2 \sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}} \tag{6}$$

where w_{ij} denotes the element of the i-th row and j-th column in the corresponding spatial weight matrix, and $S^2 = \frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n}$. If the global Moran index is positive, the data are spatially positively autocorrelated, showing the phenomenon of clustering high values with high values, and if it is negative, it means the data are negatively correlated, showing the clustering of high values with low values. The global Moran index examines the spatial agglomeration phenomenon in the whole space. To find out the spatial agglomeration in the vicinity of area i, the local Moran index is used.

$$I_i = \frac{(x_i - \overline{x})}{S^2} \sum_{j=1}^{n} w_{ij}(x_j - \overline{x}) \tag{7}$$

The main spatial econometric models are the spatial autoregressive model (SAR), the spatial error model (SEM) model, and the spatial Durbin model (SDM). If the dependent variable of a region is affected by the dependent and independent variables of neighboring regions, the following spatial Durbin model can be considered.

$$y_{i,t} = \rho \boldsymbol{w}_i' \boldsymbol{y}_t + \boldsymbol{x}_{it}' \boldsymbol{\beta} + \boldsymbol{w}_i' \boldsymbol{X}_t \boldsymbol{\delta} + \varepsilon_{it} \tag{8}$$

where y is the dependent variable representing housing demand. x is the explanatory variable, ρ is the spatial autoregressive coefficient, $\boldsymbol{w}_i' \boldsymbol{X}_t \boldsymbol{\delta}$ denotes the spatial lag of the explanatory variable, w_i' is the i-th row of the corresponding spatial weight matrix W, and ε is the random error term. Lesage and Pace [32] pointed out that spatial effects can be decomposed into direct and indirect effects. From Formula (8), we can obtain the following:

$$y_{i,t} = (I - \rho \boldsymbol{W})^{-1}(\boldsymbol{X}\boldsymbol{\beta} + \boldsymbol{W}\boldsymbol{X}\boldsymbol{\delta} + \varepsilon_{it}) \tag{9}$$

The partial derivative of y to the k-th explanatory variable x_k in each region i is as follows:

$$\left[\frac{\partial E(y)}{\partial x_{1k}} \cdot \frac{\partial E(y)}{\partial x_{Nk}}\right] = \begin{bmatrix} \frac{\partial E(y_1)}{\partial x_{1k}} & \cdots & \frac{\partial E(y_1)}{\partial x_{Nk}} \\ \vdots & \ddots & \vdots \\ \frac{\partial E(y_N)}{\partial x_{1k}} & \cdots & \frac{\partial E(y_N)}{\partial x_{Nk}} \end{bmatrix} = (I - \rho \boldsymbol{W})^{-1} \begin{bmatrix} \beta_k & \cdots & w_{1N}\delta_k \\ \vdots & \ddots & \vdots \\ w_{N1}\delta_k & \cdots & \beta_k \end{bmatrix} \tag{10}$$

The main diagonal element represents the average influence of the explanatory variable on the local dependent variable; that is, the direct effect is the matrix $(I - \rho \boldsymbol{W})^{-1}\beta_k$, and the non-diagonal element represents the influence of the explanatory variable on the dependent variable in other areas; that is, the indirect effect. In this study, the logarithm of housing prices was taken as the dependent variable, and the elderly population dependency ratio was taken as the main explanatory variable to conduct spatial econometric analysis.

4. Results

4.1. Housing Demand Curve

In order to remove the effect of extreme values and obtain more accurate housing demand curves, this study applied 1% winsorization to the household housing area. The housing demand curve is shown below.

Figure 1 depicts the housing demand curve with age. Since teenagers live with their parents, Figure 1 also shows a certain demand for living space. However, with a small sample of juvenile residents, the housing demand curve fluctuates irregularly from 0 to

10 years old. However, overall, from 27 to 50 years old, the housing demand of residents shows a rising trend. This is due to the fact that residents at this age are relatively well educated and are starting to work, gradually generating financial income and savings and increasing their ability to purchase a home. In addition, Chinese parents have the altruistic mentality of helping their offspring to settle down and purchase a home, which will help residents at this age increase their housing demand. Housing demand reaches its highest around the age of 50, and thereafter, the housing demand curve shows a downward trend. This means that the deepening of aging will reduce the housing demand of the residents, who at this stage have lower education levels and income, so they tend to exchange their big houses for smaller ones; thus, the housing demand decreases. However, the rate of decline is relatively slow due to the cumbersome and time-consuming process of changing houses.

Figure 1. Housing demand curve.

4.2. Spatial Econometric Analysis Results

4.2.1. Unit Root Test and Cointegration Test

In this study, the HT unit root test, IPS unit root test, and Fisher-ADF unit root test were comprehensively adopted. The HT test assumes that all panel units have the same autoregressive coefficients [33], while the IPS test [34] and Fisher-ADF [35] test allow different panel units to have different autoregressive coefficients. The null assumptions for the above tests assume that the panel contains unit roots. If one of the tests passes, the unit root test is considered to be passed; the test results are shown in Table 2. From the results, it can be shown that all the variables used in this study passed the unit root test, so we could continue to use the data to analyze whether there is a long-term cointegration relationship between house prices and the independent and control variables. In this study, the cointegration test was conducted using the Westerlund test [36,37]. The Westerlund test allows for unequal residual autoregressive coefficients for all individuals. The results of the Westerlund test are shown in Table 3, which shows that there is a stable long-term cointegration relationship between house prices and the remaining variables.

Table 2. Unit root test results.

Variable	HT	IPS	Fisher-ADF
lnhp	0.265 **	−1.676 **	106.955 ***
odr	0.044 ***	−3.906 ***	137.147 ***
odr2	0.11 ***	−1.811 **	96.896 ***
edu_r	0.151 ***	−4.828 ***	327.711 ***
lnmarriage	0.069 ***	−4.252 ***	84.084 **
lnpopulation	0.998	−2.188 **	425.037 ***
lnh_inv	0.412	−140 ***	325.653 ***
land	0.446 ***	−3.804 ***	604.735 ***
lnave_gdp	0.279 *	−1.857 **	95.967 ***
fiscal	0.908 ***	8.722	58.925
lnh_exp	0.198 ***	−2.911 ***	273.073 ***
$lnSO_2$	0.244 **	−1.293 *	77.373 *

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3. Results of cointegration test.

Variable	Statistic	*p*-Value
lnhp and odr	6.9638	0.000
lnhp and odr2	5.9197	0.000
lnhp and edu_r	8.4929	0.000
lnhp and lnmarriage	4.6767	0.012
lnhp and lnpopulation	4.9843	0.000
lnhp and ln lnh_inv	7.1496	0.000
lnhp and land	6.4378	0.000
lnhp and lnave_gdp	6.6755	0.000
lnhp and fiscal	6.3151	0.000
lnhp and lnh_exp	5.3179	0.000
lnhp and $lnSO_2$	6.7835	0.000

4.2.2. Spatial Correlation Test

The results in Table 4 show that the Moran index I of the logarithm of housing prices and the dependency ratio of the elderly population for many years were significantly positive, indicating that housing prices and population aging have significant spatial aggregation in the whole country. However, the global Moran index does not specifically show the local spatial correlation; it also needs to be analyzed by the local Moran index. In this study, the 2020 data were selected for plotting the local spatial agglomeration characteristics, and the results are shown in Figures 2 and 3.

Table 4. Global spatial autocorrelation test.

Year	Odr	Lnhp
2011	0.0164	0.0449 **
2012	0.0197	0.0509 **
2013	0.0175	0.0505 **
2014	0.0002	0.0479 **
2015	0.046 **	0.0626 **
2016	0.0476 **	0.072 ***
2017	0.0656 **	0.0627 **
2018	0.0438 **	0.0488 **
2019	0.047 **	0.0369 **
2020	0.0618 **	0.0314 **

Note: *** $p < 0.01$, ** $p < 0.05$.

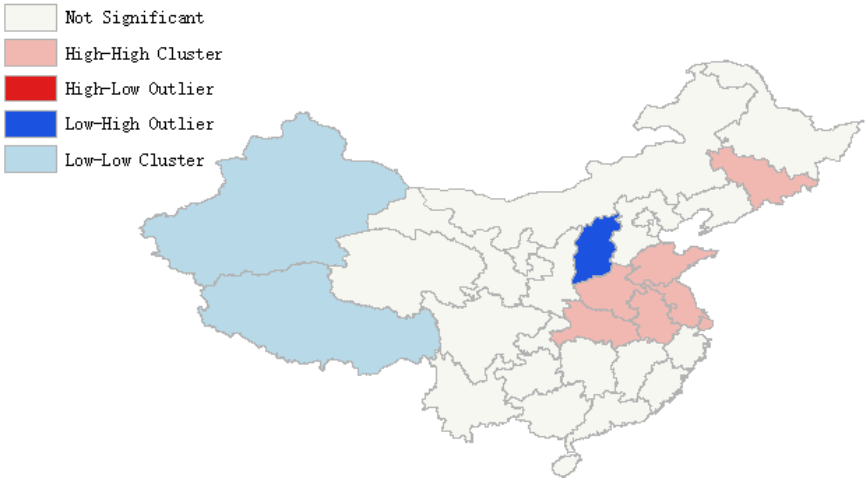

Figure 2. Local spatial clustering characteristics of old-age dependency ratio in 2020.

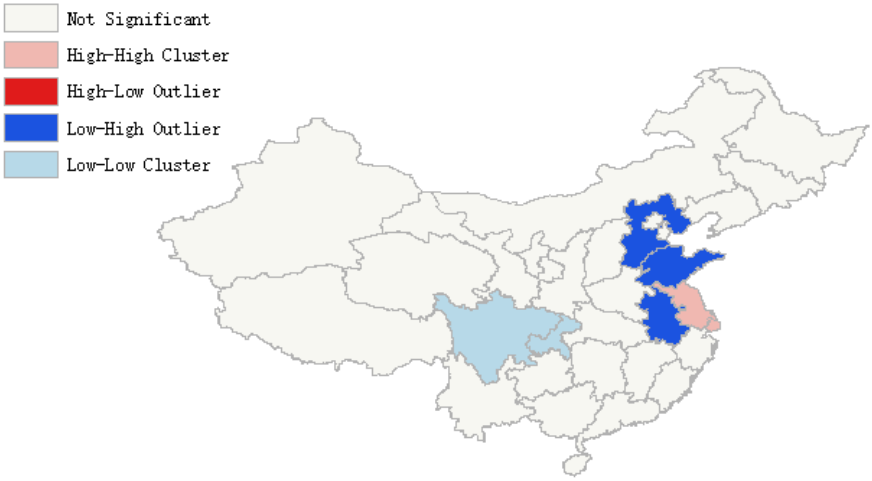

Figure 3. Local spatial clustering characteristics of house prices in 2020.

As can be seen from Figure 2, the aging phenomenon in the western region presents a spatial agglomeration feature of low value surrounded by low value, while the eastern region, especially the economically developed Jiangsu, Zhejiang, and Shanghai, presents a spatial agglomeration feature of high value surrounded by high value. As can be seen from Figure 3, in the eastern coastal areas, housing prices mainly present the spatial agglomeration characteristics of high values surrounded by high values and low values surrounded by high values, while in the central and western regions, the spatial agglomeration characteristics of low values surrounded by low values are presented.

4.2.3. Results of the Models

Table 5 summarizes the results of the Lagrange multiplier test and the likelihood ratio test. The four tests of LM rejected the null hypothesis, which indicates that the samples selected in this study have dual effects of spatial lag and spatial error autocorrelation [38,39]. In addition, the two tests of LR rejected the null hypothesis, which indicates the SDM model will not degenerate into a SAR or SEM model [32]. So, the SDM model can be preliminarily selected for regression. Table 6 summarizes the regression results of the spatial panel econometric model. The results report that all three models passed the Hausman test, indicating that the samples selected in this study were suitable for the fixed-effect model. In addition, it can be seen from the model fit degree and logarithmic likelihood value that the SDM model performed the best. Therefore, this study selected the SDM model to analyze the influence of aging on housing prices.

Table 5. Model selection test.

Test	Statistic	*p*-Value
LM-Lag	27.293	0.000
Robust LM-Lag	43.861	0.000
LM-Error	11.649	0.001
Robust LM-Error	28.216	0.000
LR-Lag	29.46	0.002
LR-Error	52.01	0.000

Table 6. Spatial econometric analysis of aging on house prices.

Variable	SAR	SEM	SDM
odr	0.0307 * (1.71)	0.0348 * (1.77)	0.0329 ** (2)
odr2	−0.0007 * (−1.69)	−0.0008 * (−1.74)	−0.0008 * (−1.95)
edu_r	0.0629 * (1.73)	0.0689 ** (2.17)	0.0622 * (1.86)
lnmarriage	0.0412 (1.05)	0.053 (1.26)	0.0485 (1.24)
lnpopulation	−0.5548 ** (−2.45)	−0.5342 ** (−2.35)	−0.5274 ** (−2.27)
lnh_inv	0.0733 ** (2.27)	0.069 * (1.95)	0.0732 ** (2.44)
land	−0.1779 * (−1.79)	−0.2999 ** (−2.25)	−0.2069 * (−1.68)
lnave_gdp	0.0099 (0.12)	0.0433 (0.44)	0.0252 (0.27)
fiscal	−0.0027 *** (−4.93)	−0.0031 *** (−4.39)	−0.0029 *** (−3.96)
lnh_exp	0.0461 *** (2.84)	0.0509 *** (2.94)	0.0403 ** (2.56)
$lnSO_2$	−0.0584 *** (−3.51)	−0.0654 *** (−2.6)	−0.0533 *** (−2.63)
W*odr	0.6424 *** (8.32)	0.9165 *** (42.79)	0.2525 ** (2.36)
W*odr2			−0.0064 ** (−2.11)
W*edu_r			−0.2724 (−1.57)
W*lnmarriage			−0.2395 (−1.14)
W*lnpopulation			1.4668 (0.68)
W*lnh_inv			0.2635 ** (2.18)
W*land			1.3957 ** (2.36)
W*lnave_gdp			−0.663 ** (−2.16)
W*fiscal			0.0062 (1.06)
W*lnh_exp			−0.0935 (−1.4)
W*$lnSO_2$			0.0052 (0.15)
Spatial rho	0.6424 *** (8.32)		0.4642 *** (4.02)
Log-L	396.9216	385.6476	411.6529
R^2	0.146	0.129	0.3372

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The *t*-test values are in parentheses.

It can be seen from the results of the SDM model that the coefficient of the odr variable is 0.0329, and that of odr2 is −0.0008, which indicates that aging has a nonlinear effect on local housing prices. With the intensification of aging, the positive effect of aging on local housing prices will gradually diminish or even become negative. It can be seen from the coefficient of the spatial lag term that the coefficient of W*odr is 0.2525, and that of W*odr2 is −0.0064, which indicates that the deepening of aging in neighboring provinces will also weaken the positive effect on local housing prices. The proportion of the elderly has a positive impact on housing prices. This is because the elderly in China benefited from the welfare housing allocation system in the last century to obtain real estate with higher value now, which becomes the capital for their investment in housing [28–30]. Moreover, the elderly in China have a strong altruistic psychology and will help their children to establish a new family and buy a house. Especially in the context of the imbalance of the gender ratio of the population in China, the marriage competition of male offspring is intensified. Under the influence of traditional Chinese marriage customs, the elderly have stronger motivation to buy houses to help their male offspring get married, thus driving up the demand for housing and thus housing prices. However, with the increasing degree of aging, the influence of aging on housing prices will gradually weaken or even become negative, which indicates that in China, where aging continues to intensify, the rise in

housing prices is only temporary. With the increasing aging of society, the benefits brought by the housing distribution welfare system will gradually disappear, and the negative impact of aging on housing prices will be gradually exposed. The elderly population has an unstable source of economic income, and medical expenses are more likely to increase with age, so the investment demand for housing and housing demand will decrease, and thus the impetus for housing price growth will weaken [24–27]. In addition, the sex ratio of higher education has a positive impact on the local housing price, which also shows that in the context of the imbalance of the gender ratio, the gradual expansion of women's access to higher education relative to men's will undoubtedly weaken the marital bargaining power of male, and then men and their families will buy houses to improve the competitiveness of male offspring in marriage, which will increase the demand for housing and further increase the housing price.

Since the regression coefficient of the spatial econometric model cannot directly represent the influence degree of the independent variable on the dependent variable, it is necessary to further decompose the spatial effect. The decomposition results are shown in Table 7. It can be seen from the results that the direct effect of aging on housing prices is 0.0445, and the indirect effect is 0.5321. On average, the effect of aging in a single adjacent area on local housing prices is 0.0177, which is smaller than the direct effect. The direct effect of the square term of aging on housing prices is −0.0011, and the indirect effect is −0.0137, indicating that the square term will significantly inhibit the housing price rise in the local and adjacent areas.

Table 7. Spatial effect decomposition.

Variable	Direct Effect	Indirect Effect	Total Effect
odr	0.0445 ** (2.29)	0.5321 ** (2.05)	0.5766 ** (2.13)
odr2	−0.0011** (−2.2)	−0.0137 * (−1.84)	−0.0148 * (−1.9)
edu_r	0.0569 * (1.79)	−0.4376 (−1.3)	−0.3807 (−1.12)
lnmarriage	0.0399 (1)	−0.4189 (−1.09)	−0.379 (−0.95)
lnpopulation	−0.4804 ** (−2.01)	2.5133 (0.6)	2.0329 (0.48)
lnh_inv	0.0863 *** (2.77)	0.6169 * (1.91)	0.7032 ** (2.11)
land	−0.162 (−1.29)	2.4252 ** (2.19)	2.2632 ** (2.04)
lnave_gdp	−0.0055 (−0.06)	−1.3836 * (−1.7)	−1.3891 (−1.63)
fiscal	−0.0026 *** (−4.32)	0.0079 (0.69)	0.0052 (0.47)
lnh_exp	0.0376 ** (2.52)	−0.1491 (−1.07)	−0.1115 (−0.78)
$lnSO_2$	−0.054 *** (−2.74)	−0.0463 (−0.67)	−0.1004 (−1.37)

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The t-test values are in parentheses.

5. Discussion

According to the life cycle theory, the consumption behavior of people at different ages is different, so the impact on housing prices is not the same. At the same time, China's multi-child policy has been introduced to cope with the aging of China's population. Therefore, it is necessary to analyze the impact of population aging on the housing market in China. The mechanism of population aging on house prices is the focus of this study. Firstly, we use the CGSS database to draw the housing demand curve, which shows that as young people get older, their demand for housing will gradually increase as they enter the working and marriage stages. Finally, as residents enter old age, their financial resources become unstable, and their medical needs increase, so housing demand will show a slow decline, which means that the area of housing demand for the elderly will decrease with age, which is consistent with the experience of scholars such as Mankiw and Weil [3], McFadden [12] and Chen, B.K. [13].

After that, a spatial Durbin model is used for analysis, and the results show that in the short term, the increase in the proportion of the elderly has a significant positive impact on housing prices. Under the influence of the welfare housing allocation system at the end of the last century and the altruism of the elderly, the elderly in China have the capital to invest in housing and help their descendants buy houses, which further

promotes the housing price rise. However, in the long run, as the aging phenomenon continues to intensify across China, the benefits brought by the welfare housing allocation system are gradually consumed, and the positive effect of the rising proportion of the elderly population on housing prices will gradually weaken, and the negative impact will begin to be exposed. This is similar to the United States [16] and OECD countries [19,22], both of which believe that severe aging will lead to a decline in housing demand, home ownership rate, and housing prices. However, this is contrary to the situation in South Korea [24]. This is because each country has certain differences in the degree of aging, economic development, and residents' consumption preferences. For example, the elderly in South Korea prefer to live in large-area housing. In addition, the conclusions obtained in this study are similar to the experiences of many other Chinese scholars [29–31], but they often ignore the negative impact of aging, and also ignore the spatial spillover effect of aging on housing prices.

6. Conclusions

Aging and housing prices have always been two hot topics concerning scholars and governments of various countries. The change in population age structure plays a key role in the change in housing demand, which cannot be ignored. With the implementation of China's multi-child policy and the transformation of the concept of marriage and childbearing, the age structure of the population is bound to undergo new changes, and its impact on the development of the real estate market has always been the focus of attention of various countries. Due to the different social backgrounds of different countries, the conclusions obtained from the analysis are different to some extent. Taking China as an example, this study firstly analyzes the housing demand changes in the population at different ages based on the micro perspective and the life cycle theory, and then analyzes the impact of China's aging population on housing prices from the macro perspective through the spatial Dubin model. With the dividend of last century's welfare housing allocation system gradually released, the fading of China's demographic dividend and the accelerated arrival of aging will have a certain impact on China's housing market. In the irreversible form of aging in China, the real estate supply side needs to be transformed to meet the real housing needs of residents, to ensure the healthy and sustainable development of the real estate industry, and to further safeguard the sustainable development of the country's overall economic construction. The conclusions of this study will provide the theoretical basis for the relevant departments in China to make decisions to cope with the impact of the change in population age structure.

In the face of the impact of aging on the housing market, firstly, in order to improve the aging phenomenon, it is necessary to ease the burden of family support and improve the willingness to have children. Relevant departments should improve the housing welfare and education welfare system for multi-child families, and the rent, housing price, or tuition for multi-child families should be reduced reasonably. Second, women's concerns about childbearing and child rearing should be eased, the construction of child-care institutions should be expanded and standardized, residents should be provided with convenient child-care services, and women's rights and interests at work should be protected from the impact of childbearing problems. Third, in the face of the irreversible aging phenomenon, it is necessary to proceed from the needs of the elderly, accelerate the construction of the elderly welfare system, and encourage developers to build housing to meet the needs of the elderly and residential infrastructure, such as medical care facilities. Additionally, the problem of the time and cost needed to replace the housing of the elderly should be addressed, so as to prevent the excessive supply of housing in the late aging period from causing an impact on the real estate market. Fourth, under the background of gender ratio imbalance, the elderly's intergenerational gift psychology is even more serious. Therefore, more attention should be paid to the housing consumption behavior of the marriageable population, and young people should be guided to establish a correct view of marriage to avoid the excessive economic burden brought to their parents. Moreover, gender equality should

be vigorously encouraged and propagated, and all sectors of society should strengthen the protection of women's rights in employment and promotion in the face of women's increased education and awareness of freedom.

Finally, this study only focuses on the influence of age structure on housing prices, but changes in fertility attitudes and fertility policies in China affect not only the age structure of the population, but also the gender structure of the population. Therefore, it is necessary to forecast the age structure of China's population in order to make more informed suggestions for the real estate market, and it is also necessary to conduct a more in-depth supplementary analysis of the relationship between gender structure and house prices. Finally, the aging of the population in China is greatly related to the long-standing one-child policy, while families choosing to have fewer or only one child has become a trend in many countries. So we will also look forward to a comparative study of the impact of the age structure of the population on the housing market in multiple countries.

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