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Research on the Impact of Aging and New Generation in the Population Structure on China's Real Estate Price Volatility

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ABSTRACT

To clarify the internal mechanism of the influence of the aging population and the new generation on housing prices is helpful to scientifically analyze and predict the trend of housing prices and the aging population and the new generation. This paper uses the intergenerational overlap model of the two periods as the theoretical basis, and uses the provincial panel data from 1998 to 2018 to study the impact of the elderly population and the new generation on the price fluctuations of commercial housing. The results of the study show that on the whole, both the aging population and the new generation have promoted the rise in commodity housing prices. However, the regional heterogeneity is significant. The aging population has the most significant impact on housing price increases in developed and general developed areas, and has no significant impact on housing price increases in other places. The new generation has a negative impact on housing prices in backward areas and a positive impact on housing prices in other areas. Looking further, using the ARIMA model to predict housing prices in the next 10 years, it is concluded that housing prices will show a slow upward trend in the next 10 years. Therefore, the government can ensure the stable development of the real estate market by revitalizing the second-hand housing market and implementing housing projects.

1. Introduction

Since 1998, when the country implemented the reform of urban housing system, the real estate industry entered a period of rapid development, but at the same time, it also brought inevitable contradictions and problems, such as the mismatch between residents' ability to pay and housing prices due to the rapid increase of housing prices, the regional development of the real estate industry and speculative house purchase, etc. All these problems have brought great impact to the steady development of China's economy. Although the state has issued corresponding systems and policies to regulate the real estate market in view of high housing prices, the results have been minimal, and the sustained and rapid rise of commercial housing prices has become one of the hot issues in China [1]. At the same time, influenced by the national family planning policy. At present, the aging population is increasing and the new generation is relatively small, which is the reality of China's population structure. What impact will the changes of the aging population and the new generation have on the fluctuation of house prices? Does this influence have regional heterogeneity? With the deepening of the aging population, the comprehensive second-child policy has been liberalized. Will the influence of aging population and new generation change on house price change continue? An in-depth study of this issue will help to clarify the factors behind the rise of housing prices in China and provide help for the healthy development of the real estate industry.

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2. Literature Review

Analyzing the reasons behind the sharp rise of commercial housing prices in China is very important for understanding the current situation of China's real estate market and whether the government can adopt effective control policies. At present, a large number of scholars have studied the factors that affect the fluctuation of house prices from different aspects, and made beneficial analysis on it. This paper summarizes it as the following viewpoints: (1) Factors influencing money. From the perspective of direct influence, He Qing and Qian Zongxin (2018) think that the real estate price decreases with the increase of interest rate, and both of them change in the opposite direction. From the perspective of indirect influence, the change of national monetary policy can affect the change of house prices [2]. (2) Influencing factors of urbanization. Luo Yongmin (2011), Wang Jiating and Xie Yu (2016) think that the acceleration of urbanization and the acceleration of population flow between rural and urban areas are the main reasons for expanding housing demand, and the increase of housing demand drives up house prices [3,4]. (3) Influencing factors of residents' income. Ding Zuyu (2013) concluded that residents thought that the reason for the rapid increase in house prices was the high ratio of house prices to income [5]. (4) Influencing factors of land price [6]. For land development, developers must first obtain land through land transfer by the government, and the government obtains the transfer fee as the government's income through land transfer, while developers develop real estate after obtaining the right to use the land, and then sell it to buyers to make profits from it, so the transfer price of land is positively related to the house price.

In addition to the above four factors, the influence of population factors on house price changes is increasing in recent years, especially the influence of the elderly population and the new generation on house price has been widely concerned. For the elderly population, many studies have been made at home and abroad, but the situation in developed countries is quite different from that in China. Hamilton (1991) and others used 22 developed economies, such as Britain and the United States, to conduct empirical research [7]. Finally, the results showed that the elderly population would have a negative effect on housing prices. Xu Jianwei et al. (2012) based on international experience and Chinese data research, proved the influence of population structure, and the dependency ratio of the elderly population is negatively correlated with house prices in developed countries. However, using the panel data of China's provinces from 1999 to 2009, it shows that there is a positive correlation between the elderly dependency ratio and housing prices [8]. Li Tong Ping et al. (2017) established a housing price model including the aging population, and based on the provincial panel data from 1999 to 2015, made an empirical study on the effect of the aging population on housing price changes, and concluded that the aging population promoted the housing price increase [9]. However, it is consistent with the research results of Zou Jin (2017). The research shows that the proportion of the elderly population has a positive effect in all regions, and the elderly population has not led to the decline of house prices [10]. The key factor leading to the decline of house prices is the ability of young people to realize housing demand. Although the correlation is inconsistent, it all shows that the elderly population has a correlation with house prices. Compared with the new generation, another group of elderly people who buy houses, the influence of the new generation on house prices is also growing. The new generation refers to the new generation of house buyers represented by graduates who are about to enter the society. With the increasing savings of parents and the appearance of their own demand characteristics. The proportion of parents helping their children buy the first house and the proportion of new generation buying houses for work or marriage is on the rise. However, the influence of the new generation on housing prices has only been mentioned in a few literature. Zou Jin (2014) studied the influence of the elderly population on housing prices, and also studied that the population aged 15-65 years old has a rising effect on housing prices. The new generation, as a new housing group in recent ten years, can not be ignored, so it is necessary to study the influence of the new generation on housing prices [1].

In fact, after studying the relevant literature, we found that the population structure variables used by many scholars in empirical analysis are the population dependency ratio, that is, the ratio of the population aged over 65 to the total social population and the ratio of the population aged 0-15 to the total social population, which are used for empirical analysis in regression and current housing price data. For example, Gu Hejun et al. (2017) used the child dependency ratio to refer to the ratio between the number of children and the number of working-age people in a certain population, and the old dependency ratio refers to the ratio between the number of elderly people and the number of working-age people in the population [11]. The two dependency ratios were used as explanatory variables to regress, and the influence of the elderly population and children population on housing prices was obtained. Zou Jin (2014) is studying the positive correlation between the elderly population and housing prices. Among them, the elderly population is explained by the proportion of people over 65 years of age in the total society. However, we

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believe that the dependency ratio as the proxy variable of population structure may be biased in explaining the influence of population structure factors on housing prices, because the dependency ratio of population usually indicates the characteristics of population structure at a given time point. The influence of current population dependency ratio on current house price is usually indirect. Take that child dependency ratio as an example, the ratio is the proportion of 0-15 year-old population to the total population or working-age population, but it is impossible for 0-15 year-old population to have direct housing demand, and only when they reach adulthood will they have the demand for house purchase. Secondly, buying real estate requires certain economic ability. If the economic ability is not reached, it will have little impact on the house price. Therefore, we need to find more suitable variables to represent demographic factors, which can have a direct impact on current house prices [12]. In this paper, the new generation is represented by the number of graduates of this specialty and graduate students. The aged population is represented by the retired population in the basic old-age insurance for urban workers, who have a certain source of income.

To sum up, most literature focus on monetary factors, urbanization factors and so on, but since the 21st century, these changes are not very significant. Because the real estate policy, fixed assets investment and other factors have existed all the time during this period, and have not changed much, the urbanization process is also slowing down. However, in the last decade or so, due to the deepening of the aging society and the liberalization of the comprehensive second-child policy, the population structure has undergone great changes. Therefore, in combination with the realistic background of rising house prices in China, this paper puts the elderly population and the new generation into a framework for discussion, uses panel data for empirical analysis, and discusses the regional heterogeneity. On the basis of the results, the real estate market price, the elderly population and the new generation in the next 10 years are predicted, and the policy suggestions contained in the research conclusions are deeply explored, which will provide useful suggestions for the stable and healthy development of the real estate market.

3. Theoretical Analysis

Based on the Diamond model based on the life cycle hypothesis and the consumer equilibrium theory, this paper constructs a two-period intergenerational overlapping model. First, assume that everyone lives for two periods, namely the Cenozoic era (*M*) and old age (*O*), at *t*. The period is the Cenozoic era, *t*+1 is the old age. In the new generation, there was no capital. When he first entered the society, he had to obtain labor income by providing labor to the labor market, and use this income to determine consumption and savings. However, because there was no income in the old age, he provided capital acquisition to the capital market through his savings in his youth and consumed all his capital principal and interest income. Assume that the assets are only housing, and other assets are not considered. Everyone is exactly the same individual.

$$U = \ln(C_t^y) + \beta \ln(C_{(t+1)}^o) \tag{1}$$

C_t^y, y^y refer to the consumption in the new generation and the consumption in the old age respectively. β refers to the discount coefficient, which refers to the ratio of the expected consumption of the elderly population into the consumption of the new generation in the future.

Explain the conditions of budget constraint under the condition of maximizing utility:

$$C_t^y + (C_{(t+1)}^o)/(1+r_t) \le y_t^y \tag{2}$$

Consumption in the Cenozoic era C^y and consumption in old age, C^o the sum of discounted value of should be less than or equal to the income of the new generation period y^y. r_t is the savings rate, which can be used to describe the price change of assets, assuming that the total assets are used. *K* said, in *t* unit price of the period p_t, unit price used in Cenozoic era p_t to buy asset shares a_t, so the budget constraint can become:

$$y_t^y = C_t^y + p_t a_t \tag{3}$$

According to the hypothesis in the intergenerational overlapping model of the two periods, everyone is the same, and there is no difference. When the income and consumption are balanced, the total income is equal to the total consumption, so a person's assets in the new generation period are equal to the total asset price. *t* unit price of the period $p_t * k$, set the number of new generations to n_t, so you can put (3) rewrite as:

$$y_t^y = C_t^y + p_t(K/(n_t)) \tag{4}$$

Exist $t+1$ during this period, people in the old age will $P_{(t+1)}$ price to sell their assets for consumption:

$$C_{(t+1)}^o = P_{(t+1)}(K/n_t^y) = (1+r_t)(p_t K/n_t^y) \tag{5}$$

Formula (5) describes that the consumption in the old age is made up of the savings in the new generation. $P_t(K/n_t^y)$ and income from savings. $(P_t(K/n_t^y))r_t$ decided by. According to the first-order condition pair of consumer utility maximization (1) Derivation of formula is available:

$$\partial u/(\partial C_t^y) = 1/(C_t^y) + \beta/(C_t^y)(dC_{(t+1)}^o)/(dC_t^y) = 0 \tag{6}$$

Before solving the intergenerational overlap model, we should first introduce two basic variables:

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The first is d_t, which means in t. The ratio of the new generation to the old population:

$$n_{t+1}^{y} = (1+d_t)n_t^{y} \tag{7}$$

The second is g_t, indicating the growth rate of population income in the Cenozoic era:

$$y_{t+1}^{y} = (1+g_t)y_t^{y} \tag{8}$$

will (2) Type brought into (6) Type, available:

$$C_{t+1}^{0} = \beta(1+r_t)C_t^{y} \tag{9}$$

will (9) Type brought into (2) Type, available:

$$C_t^{y} = (y_t^{y})/(1+\beta) \tag{10}$$

will (10) drag-in (4) In, in $t+1$The period can be written as:

$$y_t^{y}(1-(1/(1+\beta))) = p_t K/(n_t^{y}) \tag{11}$$

Similar, tPeriod can be written as:

$$y_{(t+1)}^{y}(1-(1/(1+\beta))) = (p_{(t+1)}k)/(n_{(t+1)}^{y}) \tag{12}$$

will (11)、(12) Type simultaneous, use (11)/(12) Available:

$$(y_{(t+1)}^{y})/(y_t^{y}) = ((p_{(t+1)}k)/P_t)*((n_t^{y})/(n_{(t+1)}^{y})) \tag{13}$$

according to (7)、(8) Type, right (13) Simplify the formula, get

$$p_{t+1}/\ p_t = (1+g_t)+(1+d_t) = 1+r_{t+1} \tag{14}$$

Combined with the hypothesis premise and the derivation of the theoretical model, we can draw the following assumptions and inferences:

Inference 1: The aging population changes in the opposite direction to the fluctuation of assets, because in the hypothesis, the assets are only housing, and other assets are not considered, and everyone is exactly the same individual. Therefore, with the deepening of the aging population and the increase of the aged population, house prices will show a downward trend.

Inference 2: The Cenozoic era and asset fluctuation are changing in the same direction. Because when the total income and quantity of the new generation increase, the price level of assets will increase. That is, the value of assets will rise. Therefore, with the liberalization of the comprehensive second-child policy and the increase of the new generation, house prices will show an upward trend.

4. Measurement Model Setting and Variable Description

(1) Measurement model setting

In this paper, a total of 651 sample data are selected from China Statistical Yearbook and China Statistical Yearbook of Population and Employment, which focus on the influence of the elderly population and the new generation on housing prices. Using the data panels of 31 provinces, autonomous regions and municipalities directly under the Central Government from 1998 to 2018, the following two measurement models are established. In order to ensure that the data are closer to normal distribution, logarithm the variables with horizontal values, as shown in the following formula:

$$\ln p_{i,t} = \alpha_i + \beta_1 ap_{i,t} + \beta_2 \ln la_{i,t} + \beta_3 \ln pcgdp_{i,t} + \beta_4 ur_{i,t} + \beta_5 cpi_{i,t} + \varepsilon_{i,t} \tag{1}$$

$$\ln p_{i,t} = \alpha_i + \beta_1 ng_{i,t} + \beta_2 \ln la_{i,t} + \beta_3 \ln pcgdp_{i,t} + \beta_4 ur_{i,t} + \beta_5 cpi_{i,t} + \varepsilon_{i,t} \tag{2}$$

(i=1,2,…; 31； t=1998,1999,…; 2018)

Subscript I represents different provinces, t represents time, α for intercept term, the explained variable lnp is house price, the explained variable is ap elderly population, ng is the new generation, lnla is the land purchase area of real estate developers, lnpcgdp is the per capita GDP, ur is the urbanization rate, and cpi is the consumer price index.ε Refers to the error, which refers to the influence of psychological factors, policy factors and other influencing factors on the price of commercial housing.

(2) Variable description

Explained variable: house price. Expressed by the average selling price of commercial housing, that is, the sales/sales area of commercial housing in all provinces, autonomous regions and municipalities directly under the Central Government in China.

Explanatory variables: In this paper, the elderly population is expressed by the number of retirees. Because buying real estate requires certain economic ability, most literature classify this group as people over 65 years of age, and the setting is relatively broad. Therefore, this article selects the elderly population with certain economic resources-urban retirees for analysis, and the crowd setting is more accurate. Cenozoic refers to the new generation of house buyers relative to the elderly population. Because there is no accurate personnel data in the relevant statistical yearbook to represent this group of people, this paper selects the number of graduates from secondary specialized schools and institutions of higher learning from 1998 to 2002 and the number of graduates from this specialty and graduate students from 2003 to 2018. Because students have stepped into the society step by step since graduation. Housing is a rigid demand for them.

Control variables: This paper selects real estate developers' land purchase area, per capita GDP, urbanization rate and consumer price index to express.

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Table 1. Statistical description results of main variables

Variable name	Symbol	Sample number	Standard deviation	Average value	Minimum value	Maximum
Commodity house price logarithm	lnp	620	0.72	8	6.2	10.44
aging population	ap	620	141.45	20.79	13	778
Cenozoic era	ng	620	16.45	192.12	0.6	87.52
Land purchase area	lnla	620	0.83	8.01	6.20	10.44
Urbanization rate	ur	620	16.63	45.87	17.44	89.6
consumer price index (CPI)	cpi	620	18.02	117.65	92.57	177.34

Note: The consumer price index was 100 in 1997; All data of is reserved with two decimal places.

5. Empirical Analysis Results

(1) Smoothness test

In order to avoid the occurrence of pseudo-regression, firstly, the panel data should be tested for stationarity, and the most suitable method for stationarity test is the unit root test. In this paper, LLC and IPS tests are adopted, which can be obtained from the test results in Table 2. All variables pass the unit root test, that is, a stationary sequence, which avoids the occurrence of pseudo-regression.

(2) Panel data form test

Before building the panel model, you need to select the panel type, which can be divided into mixed data model or variable intercept model, so this paper uses F test to distinguish them. From the results of F test, the F statistics corresponding to the two models are significant at 1% level, rejecting the original hypothesis and accepting the alternative hypothesis, so this paper chooses the variable intercept model. Variable intercept model is divided into fixed effect model and random effect model, which should be distinguished and judged by Hausman test. From the Hausman test results, the chi-square value corresponding to the two models is significant at 5% level, rejecting the original hypothesis and accepting the alternative hypothesis, so this paper chooses the fixed effect model.

(3) National estimated results

According to Table 4, the change of the aged population

Table 2. Stationarity test of variables

Test variable	Type	Test result p value	Test conclusion
lnp	LLC IPS	0.001*** 0.011**	Stationary sequence
ap	LLC IPS	0.056* 0.007***	Stationary sequence
ng	LLC IPS	0.000*** 0.061*	Stationary sequence
lnla	LLC IPS	0.000*** 0.002***	Stationary sequence
lnpcgdp	LLC IPS	0.000*** 0.015**	Stationary sequence
ur	LLC IPS	0.000*** 0.000***	Stationary sequence
cpi	LLC IPS	0.007*** 0.086*	Stationary sequence

Table 3. Inspection results of panel data form

Model	Variance ratio	Prob>F	Conclusion	Prob>chi2	Conclusion
ap-lnp	29.7	0.000***	Variable intercept model	0.029	fixed effects model
ng-lnp	43.8	0.000***	Variable intercept model	0.020	fixed effects model

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has a positive impact on the price of commercial housing, and has passed the 1% significance test to simulate the goodness of fit within the group. When R^2 is 0.9447, the overall fitting effect is very good. However, it is inconsistent with inference 1, probably because the theoretical analysis considers the influence of all the changes of the aged population on the price of commercial housing without considering the actual situation. The aged population that affects the price of commercial housing refers to the aged population with a certain source of income, so the empirical conclusion is inconsistent with the theoretical analysis. However, this is consistent with the reality that China's housing prices are rising with the deepening of the aging population. Nationally, the aging population has promoted the rise of commercial housing prices, which can be attributed to the following reasons: first, the existence of housing welfare distribution system, which gave people the opportunity to accumulate wealth rapidly at the beginning of the 21st century. The elderly population has enough financial ability to provide housing consumption for their children. Second, commercial housing is a kind of commodity with dual attributes of consumption and investment. In order to increase the old-age security, when the elderly have extra spare funds, they will consider buying commercial housing to achieve the purpose of wealth appreciation and preservation. Third, with the deepening of population aging, the number of elderly people living alone is increasing. Affordable housing for the elderly has increased.

According to Table 4, the change of the new generation has a positive impact on the price of commercial housing, and it passed the 1% significance test, and simulated the goodness of fit within the group. When R^2 is 0.9450, the overall fitting effect is very good, and it is consistent with inference 2. The new generation has promoted the price increase of commercial housing, which can be attributed to two reasons: first, after graduating and working, the new generation is faced with the demand of marriage and house purchase, which increases the rigid demand for housing, thus promoting the price increase. Secondly, because of the concept of intergenerational transmission. Parents will give their children property by buying houses for their children, which not only solves the housing problem of the new generation itself, but also reduces the depreciation of family property caused by the price increase brought by inflation. Third, because of the prevalence of the new generation's concept of independence, they are unwilling to live with their parents and family members, which increases the demand for housing and promotes the rise of house prices [12].

Table 4. Overall regression results

Variable name	(1) FE	(2) FE
ap	0.101*** (0.006)	
ng		0.309*** (0.002)
lnla	–0.036*** (0.001)	–0.035*** (0.001)
lnpcgdp	0.575*** (0.000)	0.536*** (0.000)
ur	0.103*** (0.001)	0.103*** (0.000)
cpi	0.104*** (0.001)	0.096*** (0.000)
Constant	2.237 (0.000)	2.458 (0.000)
R-sq	0.9447	0.9450
Observation	651	651

Note: *, * * and * * * are significant at 10%, 5% and 1% levels (both sides) respectively.

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(4) Division of regional heterogeneity

In order to study whether there is heterogeneity in the influence of house prices among different regions, this paper will explore the factors that influence house prices by classification method. When most scholars study the problem of regional division, they basically use geographical division, but the classification method based on geographical division can not accurately reflect the regional development level between regions. Thereby causing errors to the empirical results. Because per capita GDP can reflect the economic development to a certain extent, this paper uses per capita GDP clustering index to systematically cluster 31 provincial administrative regions in China. After clustering analysis, in order to ensure the accuracy of clustering effect, the results are effectively tested by distance discrimination method. Using the means method to test, the index is significant, so the clustering method is effective. For better heterogeneity analysis, the clustering results are converted into Table 5. Because the development of different regions in China is unbalanced, according to the division of regional heterogeneity in Table 5, Beijing, Shanghai and Tianjin have a high level of economic development. However, the development levels of Yunnan, Gansu, Tibet and Guizhou are lagging behind, and the differences of population structure in different places are also quite different. Therefore, in order to have a more comprehensive understanding of the impact of population structure changes on housing prices, it is necessary to return to different regions.

According to the estimation of the fixed effect model in Table 6, we can see that the R^2. The results show that the overall fitting effect of the four models is very good, but the impact of the elderly population on housing prices is more regional differences. The aging population has a positive impact on housing prices in economically developed areas and generally developed areas, and all pass the 1% significance test. However, in the backward areas and underdeveloped areas, the impact of the elderly population on housing prices is not significant or the impact is small. The reasons are as follows: firstly, compared with the underdeveloped areas and backward areas, the old people's pension security in developed areas and general developed areas is more perfect, and there is no need to worry about the pension problem. The elderly population has enough economic capacity to provide housing consumption for their children. Second, the income of the elderly population in developed areas and generally developed areas is higher than that in underdeveloped areas and backward areas. When there are spare funds, we can buy commercial housing to achieve the purpose of wealth appreciation and value preservation.

On the four regression models of Cenozoic R^2, the value is also large, indicating that the overall fitting effect of the four models is very good, but the impact of the new generation on housing prices is more regional differences. The new generation has a positive impact on housing prices in economically developed areas, generally developed areas and underdeveloped areas, and all pass the 1% significance test. However, in backward areas, the new generation has a negative impact on housing prices. First, with the increasingly close international division of labor and the continuous improvement of transportation convenience, the new generation of employment is not limited to the location, but the employment opportunities in different places are increasing, and the demand for purchasing houses in different places is increasing. Second, because the new generation in the backward areas go to school in other places, the living environment in economically developed cities is better, and the employment conditions and income are better than those in the backward areas. As a result, the new generation promotes the housing prices in the areas with better economic environment, but has a negative impact on the housing prices in the backward areas.

Table 5. Classification of real estate market

Division of economic development level differences	Names of provinces, autonomous regions and municipalities directly under the Central Government
economically developed region	Beijing, Shanghai, Tianjin
Generally developed areas	Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Inner Mongolia and Liaoning
less-developed regions	Jiangxi, Sichuan, Anhui, Guangxi, Hainan, Qinghai, Hunan, Henan, Xinjiang, Ningxia, Hebei, Heilongjiang, Shanxi, Hubei, Chongqing, Shaanxi, Jilin
backward areas	Yunnan, Gansu, Tibet, Guizhou

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Table 6. Regression by Region

Variable name	Developed region		Generally developed areas		Less-developed regions		Backward areas	
ap	0.303*** (0.000)		0.121*** (0.002)		0.002** (0.046)		0.001 (0.724)	
ng		0.413** (0.042)		0.301*** (0.013)		0.307*** (0.003)		–0.314** (0.038)
lnla	–0.055 (0.118)	–0.072** (0.079)	–0.16*** (0.000)	–0.11*** (0.000)	0.002 (0.836)	0.007 (0.555)	–0.045 (0.133)	–0.034 (0.189)
lnpcgdp	0.751*** (0.000)	0.487*** (0.001)	0.804*** (0.000)	0.763*** (0.000)	0.561*** (0.000)	0.507*** (0.000)	0.364*** (0.000)	0.365*** (0.000)
ur	–0.008* (0.070)	–0.007 (0.202)	0.009*** (0.000)	0.008*** (0.000)	0.005*** (0.000)	0.005*** (0.000)	–0.000 (0.745)	–0.000 (0.725)
cpi	0.002*** (0.589)	0.019*** (0.000)	–0.008* (0.081)	–0.008** (0.028)	0.003*** (0.024)	0.005*** (0.003)	0.012*** (0.002)	0.015*** (0.000)
Constant	1.281 (0.058)	2.868 (0.007)	2.154 (0.000)	2.514 (0.000)	1.785 (0.000)	2.059 (0.000)	3.764 (0.000)	3.351 (0.000)
R-sq	0.9638	0.9520	0.9634	0.9653	0.9611	0.9617	0.9724	0.9745
Observation	60	60	140	140	340	340	80	80

(5) Endogeneity test

There may be endogenous problems such as reverse causality or missing variables in the above regression estimation, which may cause the estimation results to be biased. Therefore, we look for instrumental variables for endogenous test. Considering that commercial housing prices may depend on past price levels. It has a certain continuous feature. That is, the current commodity housing price may be affected by the price level of the previous period, and there is an endogenous problem. Therefore, this paper uses the dynamic panel analysis method and introduces the first-order lag variable of commercial housing price to solve the endogenous problem.

$$\ln p_{i,t-1} = \alpha_i + \beta_1 ap_{i,t} + \beta_2 \ln la_{i,t} + \beta_3 \ln pcgdp_{i,t} + \beta_4 ur_{i,t} + \beta_5 cpi_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$\ln p_{i,t-1} = \alpha_i + \beta_1 ng_{i,t} + \beta_2 \ln la_{i,t} + \beta_3 \ln pcgdp_{i,t} + \beta_4 ur_{i,t} + \beta_5 cpi_{i,t} + \varepsilon_{i,t} \quad (4)$$

Adding the lag term also brings about the endogenous problem. Therefore, we use the differential generalized moment (diff-gmm) to ensure the stability of the panel data first, so the unit root test is carried out, as shown in Table 2. Model 1 to model 2 in Table 8 are the estimated results in the case of diff-gmm. Results the first-order lag were positive, and the significance level reached 5%. There was first-order autocorrelation in both models, and there is no second-order autocorrelation. Sargan test is passed, which shows that the dynamic panel regression estimation of sys-gmm model is reasonable and the basic conclusion remains unchanged.

Table 7. Endogeneity test

Variable name	DIF-GMM (1)	DIF-GMM (2)
L.lnp	0.139** (0.012)	0.106** (0.035)
ap	0.121** (0.014)	
ng		0.289** (0.027)
lnla	–0.019*** (0.001)	–0.021*** (0.001)
lnpcgdp	0.166*** (0.010)	0.1501** (0.026)
ur	–0.001** (0.496)	–0.003 (0.109)
cpi	–0.005** (0.018)	–0.005** (0.013)
Constant	–0.889 (0.018)	–0.663 (0.073)
AR(1)	–2.134 (0.033)	–2.259 (0.024)
AR(2)	0.994 (0.3204)	–0.904 (0.366)
P value of sargan test	0.181	0.182

(6) Variable substitution method

Considering the complexity of the composition of commercial housing price, the price of commercial housing not only refers to the sales price of residential buildings, but also the sales price of office buildings and commercial premises. Therefore, by replacing the explained variables

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to further test, the average selling price of commercial housing is replaced by the average selling price of residential housing and see if the influence of the old population and the new generation still exists. Table 8 shows the regression results after replacing the explained variables. The regression results show that there is a positive correlation between the old population and the new generation on the housing sales price, which is very significant and has the same direction. That is to say, the influence of the old population and the new generation on the price of commercial housing is universal. It can be seen that the conclusion has strong robustness.

Table 8. Robustness test

Variable name	(1) FE	(2) FE
ap	0.211*** (0.002)	
ng		0.217*** (0.003)
lnla	–0.028** (0.017)	–0.027** (0.020)
lnpcgdp	0.649*** (0.000)	0.611*** (0.000)
ur	0.167*** (0.000)	0.040*** (0.000)
cpi	0.054 (0.176)	0.032** (0.034)
Constant	1.533 (0.000)	1.747 (0.000)
R-sq	0.9412	0.9411
Observation	651	651

6. Conclusions and Countermeasures

Based on the model of overlapping generations in two periods, this paper theoretically analyzes the influence of the aging population and the new generation on the price of commercial housing, and further constructs the measurement model of the aging population and the new generation on the price of commercial housing. On this basis, it empirically tests the influence of the aging population and the new generation on the price of commercial housing by using the panel data of 31 provinces in China from 1998 to 2018. The test results show that both the elderly population and the new generation have promoted the price increase of commercial housing. After that, this paper divides the regional heterogeneity of 31 provinces, and concludes that the elderly population has promoted the rise of commodity prices in developed areas and generally developed areas, but has no significant impact on the prices of commercial housing in other areas. The new generation has a negative impact on the price of commercial housing in backward areas. It has a positive impact on the prices of commercial housing in other areas.

Based on the above research, this paper puts forward the following suggestions:

(1) The government should really revitalize the second-hand housing market by optimizing market information communication and reducing taxes and fees, so that the housing needs of the elderly people who really have housing needs can be met through stock housing. Real estate enterprises should enhance their sense of social responsibility, and increase a part of affordable housing for the elderly population to meet their housing needs and curb the rise of house prices.

(2) The government can greatly ease the pressure of the new generation to buy houses by increasing the construction of housing projects and increasing the supply of small units. And reasonably guide the "real estate consumption view", advocate the "tailor-made" consumption view, gradually develop the social atmosphere of "buy and rent", and relieve the pressure of buying houses by renting houses.

(3) For the elderly population in developed areas and general developed areas, we should refine the purchase policy and restrict the purchase of "two sets" housing qualification for the elderly population. For the new generation in backward areas, the talent purchase plan can be adopted. For the new generation returning to the city for employment, a certain amount of housing rental subsidies and house purchase subsidies can be given. For high-end talents such as graduate students, the first purchase of houses is preferential. Increase subsidies and other ways to improve the conditions for new generations to buy houses in backward areas.

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