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# THE IMPACT OF POPULATION AGING ON HOUSING PRICES IN SHAANXI PROVINCE: A COMPREHENSIVE ANALYSIS OF NONLINEAR RELATIONSHIP.

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**Abstract**

This study aims to investigate the impact of population aging on housing prices in Shaanxi Province by analyzing data from 1994 to 2020 using a multiple regression model. The results show that per capita GDP has a significant positive effect on housing prices in Shaanxi, while the impact of CPI on housing prices is not significant. The increase in real estate investment completed this year also promotes the rise of housing prices. Moreover, aging population has a restraining effect on house price increases, but with the increase of aging, population aging gradually shows a positive effect on housing prices, which can be explained by intergenerational transfer. Based on the findings, we suggest that the government should promote the development of the real estate industry in Shaanxi Province by implementing "rent-purchase equal rights" policies, relaxing population policies, and collecting real estate taxes. The study also highlights the importance of considering the nonlinear relationship between aging population and housing prices in future research, as well as the regional heterogeneity of this relationship. Overall, this study provides valuable insights for both residents and policymakers in making house purchase decisions and regulating and controlling house prices.

## 1. Introduction

Since the "housing reform" in 1998, the real estate industry in Shaanxi Province has made great progress, with a wider variety of residential housing styles and higher quality; During this period, Shaanxi's old-age dependency ratio is increasing, the aging of the population is deepening, and housing prices are also rising, but the change of population structure will have an impact on the demand side of the housing market, whether the aging of the

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population has promoted the rise of housing prices in Shaanxi or not? The impact of population aging on housing prices has also become a social event.

At present, the research on the impact of population aging on housing prices at home and abroad has achieved fruitful scientific research results, but there is no consensus. Existing research mainly analyzes the relationship between population aging and housing prices from the macro and micro levels. Some scholars believe that the age of the buyer of the household has an "inverted U-shaped" relationship with the possibility of buying a house, that is, the age of the buyer of the household will decrease when it reaches a certain value.[1] Some scholars believe that intergenerational interaction promotes the housing consumption of children, but the aging population will increase rental consumption, which will inhibit housing purchase consumption and investment consumption.[2] China's aging will promote house prices in the long term and inhibit house price increases in the short term, [3]and some scholars believe that there is regional heterogeneity in the impact of population aging on housing prices.[4] This part will mainly focus on the relationship between population aging and residential commodity housing prices.

People's demand for housing can be divided into two types: consumption demand and investment demand, and the change of population age structure mainly affects the housing market by affecting housing demand, thereby changing housing prices. At present, the empirical research results on the old-age dependency ratio and housing prices are mainly divided into three types: one is for the elderly to buy a house for their children and the elderly to buy a house for the elderly, so the old-age dependency ratio and the house price change positively, or aging drives the rise in house prices, in the central and western regions of China this trend is more obvious[5], but the increase in housing demand for aging population will weaken with the increase of divorce rate;[6] The other is the rise in the old-age dependency ratio to inhibit the rise in house prices, and the current dominance of the housing price trend is because of the expected "herd effect" and the huge demand for housing increased urbanization, the increase of the old-age dependency ratio and the juvenile dependency ratio will pull down the house price, but the old-age dependency ratio has a greater impact;[7] There is also a view that the impact of population aging on the real estate market in the short and long term is different, for example: in the short term, population aging inhibits house price rise, but in the long term, the real estate market is less affected by aging.[8] For the elderly population who have just entered the old age, in order to pursue a higher quality of life, many elderly people choose to move out, which generates additional housing demand, resulting in rising house prices, but for the elderly, because they need family care and other reasons to return to the family, then the demand for housing will decrease, and house prices will fall.[9]Based on this, the conclusions drawn by the above scholars may be related to data selection and analysis processing.

The existing studies mainly use multiple provinces or cities as samples to quantitatively analyze the impact of population aging on housing prices, but few studies analyze the impact of population structure changes on housing prices in Shaanxi Province, and analyze the impact of population aging on housing prices in Shaanxi Province plays an important role in the development of Shaanxi's real estate industry. In addition, previous studies mostly analyzed the linear relationship between population aging and housing prices, and rarely studied the nonlinear relationship between aging and housing prices. With the aging of the population, the proportion of the population of the right age to buy a house will change, the family structure and purchase preferences will change, and the change of these factors will affect the residential commercial housing market, so this paper comprehensively analyzes the impact of aging on housing prices in Shaanxi by introducing the square term of the old-age dependency ratio, hoping to make reasonable suggestions for residents when making house purchase decisions, and can provide reference for the government to regulate and control house prices, the empirical analysis

concludes that the initial aging of the population has a significant inhibitory effect on the rise of housing prices. Then it showed a significant boost to house prices.

## 2. Theoretical analysis and hypothesis

The increase in house prices in Shaanxi Province is mainly divided into four stages: small house price increases from 1994 to 2004, accelerated growth from 2004 to 2011, slowed growth from 2011 to 2016 and faster growth from 2016 to 2020. Shaanxi's real estate market is mainly divided into three parts: Guanzhong Province, Northern Shaanxi and Southern Shaanxi: the Guanzhong Plain urban agglomeration centered on Xi'an occupies the first echelon, and its supply of residential commercial housing is also the largest, and the supply scale of southern Shaanxi is second, again northern Shaanxi; And brand real estate developers are also mainly concentrated in Guanzhong City. For example, in 2020, the house price in Xi'an was 13104.37 yuan/$m^2$, while Weinan, Shangluo and other cities were less than 5000 yuan/$m^2$. From January to August 2022, the growth rate of real estate development investment in Shaanxi Province declined, and due to the downturn of the national real estate industry, real estate development investment and sales in Shaanxi Province also remained sluggish. There are two characteristics in the age structure of Shaanxi's population: 1. The degree of aging is serious, and the proportion of the population over 65 years old has risen sharply from 5.26% in 1994 to 13.32%, an increase of 8 percentage points; 2. The total number of elderly people has increased significantly, with the total number of people over 65 years old more than tripling from 1,694,000 in 1990 to 5,268,100 in 2020.

The aging population curbs house price growth by reducing the proportion of homebuyers of the right age. Aging is manifested in the increase in the proportion of the elderly population, thereby reducing the working-age population, reducing the overall rigid demand for housing, and reducing the total demand for residential commercial housing in the real estate market, resulting in a decline in house prices.

Population ageing curbs house price increases by reducing social savings. Aging is manifested in the increase in the proportion of the elderly population, the decrease in the working-age population, the reduction of the working population makes the social savings decrease, so that the proportion of bank loanable funds decreases, which will increase the cost of bank loans, increase the cost of residents' loans to buy houses, thereby inhibiting residents to buy houses through loans, and the total demand for residential commercial housing in the real estate market will also decrease, resulting in a decline in house prices.

An aging population lowers housing prices by lowering workers' incomes. Aging is manifested in the increase in the proportion of the elderly population, the reduction of the working population makes the social savings decrease, when the conditions such as technology remain unchanged, according to the Solow model and the entire social output decreases, which means that the distribution of income per worker decreases, and the decrease in income level means the reduction of purchasing power, thereby reducing the demand for residential commercial housing, thereby reducing housing prices.

An aging population drives house prices up through generational shifts. Population aging will also change the family structure, population aging makes three generations in the same household, four generations in the same house more common, because our country has the tradition of parents transferring wealth to children, which increases the purchasing power of children for residential commercial housing, and the father for the child to buy a house is currently the main way for young people to obtain housing, and the phenomenon of parents helping children to buy houses is very common[10], so that aging increases the demand for housing through intergenerational transfer, and this intergenerational transfer to buy houses is more common when the degree of aging is higher. Because the deepening of aging is due to the decline in the birth rate, it means that when the degree of aging is very high, there may be three generations and four generations living in the same household

but only one or two children, and the accumulation of wealth by several generations will increase the purchasing power of the children for residential housing, and the demand for improved and just-needed housing for the children will increase, thereby promoting the rise in housing prices. Based on this, the core hypothesis is put forward: the aging of the population first suppresses the rise in house prices, and then promotes the rise in house prices.

## 3. Study design and empirical testing

### *3.1.* Model specification

Based on the speculation in this paper, a multiple regression model is established for the time series data of Shaanxi Province from 1994 to 2020, and then the square term of ODR is added to compare and verify: the impact of population aging on housing prices is different to different degrees of aging. $\ln P = \beta_0 + \beta_1 * ODR + \beta_2 * \ln PGDP + \beta_3 * \ln INV + \beta_4 * CPI + \varepsilon$ (1) $\ln P = \beta_0 + \beta_1 * ODR + \beta_2 * ODR^2 + \beta_3 * \ln PGDP + \beta_4 * \ln INV + \beta_5 * CPI + \varepsilon$ (2)

Among them, ODR represents the old-age dependency ratio, and lnPGDP represents the logarithm of GDP per capita; P is the average price of residential commercial housing; CPI means Consumer Price Index, lnINV represents the logarithmic value of the amount of real estate investment completed this year; ε represents random perturbation terms that satisfy independent homogeneous distributions.

### *3.2.* Data source

This paper mainly studies the relationship between population aging and housing prices in Shaanxi, so the time series data from 1994 to 2020 in Shaanxi Province are used as an observation sample to explore the impact of population aging on the price of residential commercial housing. In this paper, the average price of residential commercial housing is taken as the explanatory variable, and the core explanatory variable is the old-age dependency ratio, that is, the ratio of the population over 65 years old to the population aged 15-65. According to the previous research literature, consumer price index, gross domestic product, real estate investment and other factors also have an important impact on housing prices, so this paper also selects consumer price index, per capita GDP, real estate investment completed this year and other variables as control variables, and the consumer price index is based on 1994. Table 1 shows the definitions of each variable and their measurement,and the descriptive statistics of the variables are shown in Table 2.

Among them, the data on the average price of residential commercial housing after 2000 are from the "China Real Estate Statistical Yearbook", the proportion of the population over 65 years old, the old-age dependency ratio, the consumer price index and per capita GDP after 2000 are from the "Shaanxi Statistical Yearbook", and the data before 2000 are all from the "New China 50-year Statistical Data Compilation". Considering the dimensionality between variables P, GDP per capita, lnINV and other variables, this paper takes the logarithm of P, the amount of real estate investment completed this year and GDP per capita to ensure that the data are closer to the normal distribution.

Table 1: Variable symbols and definitions

| Variable | symbol | definition |
|---|---|---|
| The logarithmic logarithmic value of the average price of a residential commercial house | lnP | The logarithmic value of the average price of a real home sold |
| Old Age Dependency Ratio | YDR | Number of people over 65 years old |
| The logarithmic value of the amount of real estate investment completed in the current year | lnINV | The logarithmic value of the amount of real estate investment completed during the current year |
| Consumer Price Index | CPI | Consumer Price Index (based on 1994) |

| | | | |
|---|---|---|---|
| Proportion of population over 65 | | ODP | Population over 65 years old / total population |
| The logarithmic value of GDP per capita | | lnPGDP | Logarithmic value of GDP per capita |

Table 2: Descriptive statistics for variables

| variable | mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|
| lnP | 7.87 | 0.74 | 6.90 | 9.17 |
| ODR | 11.83 | 2.51 | 7.91 | 19.21 |
| CPI | 157.0 | 30.06 | 100.0 | 209.6 |
| lnINV | 6.04 | 1.79 | 2.9 | 8.39 |
| ODP | 8.53 | 2.02 | 5.26 | 13.32 |
| lnPGDP | 9.59 | 1.11 | 7.79 | 11.10 |

### *3.3.* Empirical results

According to model (1), it can be seen that the core explanatory variables ODR and the three control variables of lnPGDP, CPI and lnINV can explain 98% of the average price change of residential commercial housing. Both lnPGDP and lnINV were positively correlated with the explanatory variables and were statistically significant at the level of 0.1%, while CPI was negatively correlated with house prices but not statistically significant.

After adding the square term of the core explanatory variable ODR, the coefficients of lnPGDP and lnINV terms are still positive and statistically significant, the coefficients of the ODR term are still negative, and the coefficients of the ODR2 term are positive, that is, the core hypothesis is verified.

According to model (2), the partial derivative of the logarithmic pair of the ODR of the average

$\frac{\partial \ln P}{\partial ODR} = -0.1878 + 0.013632 * ODR$ price of residential commercial housing can be obtained , so that the equation = 0 can obtain ODR=13.78, from which it can be obtained: when the old-age dependency ratio is lower than 13.78, the house price decreases with the increase of the old-age dependency ratio; Conversely, when the old-age dependency ratio is higher than 13.78, the house price rises with the increase of the old-age dependency ratio. Shaanxi's old-age dependency ratio exceeded this value in 2016, so the increase in the aging degree of Shaanxi Province will promote the rise in housing prices.

Table 3: Regression results

| | Model (1) | Model (2) |
|---|---|---|
| Constant term | 3.2599542<br>(0.3578672) *** | 3.448<br>(0.345) *** |
| ODR | -0.0079235<br>(0.0177833) | -0.1878<br>(0.0848)* |
| lnPGDP | 0.5043736<br>(0.0704793) *** | 0.5967<br>(0.07797) *** |
| CPI | -0.0023860<br>(0.0036253) | -0.001341<br>(0.003391) |
| lnINV | 0.0002027<br>(0.0000531) *** | 0.000167<br>(0.00006324) . |
| $ODR^2$ | | 0.006816<br>(0.003153) * |
| $R^2$ | 0.99 | 0.99 |
| Adjusted $R^2$ | 0.98 | 0.99 |
| F Statistical value | 378 | 358.3 |

Concentrate:. , *, **, *** refers to passing the significance level test of 10%, 5%, 1%, and 0.1%, respectively, and the standard error is in parentheses

### *3.4.* Robustness test

In order to test whether the impact of population aging on the average price of residential commercial housing causes regression bias, the old-age dependency ratio in the model (1), (2) and (3) is replaced with the proportion of the population over 65 years old, and the regression analysis is carried out again.In the transformation of jia Zhangke's film aesthetic style, symbolic style is an important feature.

Table 4: Robustness test regression results

| | Model (1) | Model (2) |
|---|---|---|
| Constant term | 3.175 (0.3485) *** | 3.11 (0.3107) *** |
| ODP | -0.02008 (0.02994) * | -0.3867 (0.1426)* |
| lnPGDP | 0.05257 (0.08011) *** | 0.6945 (0.09609) *** |
| lnINV | 0.0002074 (0.00005204) *** | 0.00004203 (0.00007832) |
| CPI | -0.002688 (0.003653) | -0.00151 (0.003278) |
| $ODP^2$ | | 0.02074 (0.007926 ) * |
| $R^2$ | 0.99 | 0.99 |
| Adjusted $R^2$ | 0.98 | 0.99 |
| F statistic value | 382.3 | 388.5 |

Note: *, **, **** refers to passing the significance level test of 10%, 5% and 1% respectively, and the standard error in parentheses is the standard error

As shown in Table 4, model (2), the coefficient of ODR is negative, the coefficient of $ODR^2$ is positive, find the logarithm of the average price of residential commercial housing to the proportion of population over 65 years old ODP partial derivative, when , that is, the proportion of population over 65 years old is less than 9.32, with the increase of the proportion of population over 65 years old, house prices will fall, when the proportion of population over 65 years old is greater than 9.32, with the increase of the proportion of population over 65 years old, house prices will rise. This is consistent with the conclusion drawn in Table 3, that house prices first fall and then rise as they age. Per capita GDP also has a significant role in promoting the rise in house prices, and the increase in real estate investment completed this year has also promoted the rise in house prices, but the CPI didn’t has significant impact on house prices.

## 4. Conclusions

Using the panel data of Shaanxi Province from 1994 to 2020, this paper constructs a multiple regression model and makes an empirical analysis of the impact of aging on commercial housing.

The main conclusions are:

1) Aging first inhibits and then significantly promotes the rise of housing prices in Shaanxi Province, showing a "U" shape. Starting from 2017, the aging population in Shaanxi Province will drive up housing prices. This is because aging is manifested as an increase in the proportion of the elderly population and a decrease in the proportion of the labor force. The decrease in the labor force leads to a decrease in social savings. When other conditions remain unchanged, according to the Solow model, the output of the entire society decreases, which means that each person The income obtained by the distribution of laborers is reduced, and the reduction of income level means the reduction of purchasing power, thereby reducing the demand for residential commercial

housing, which leads to the decline of housing prices. However, as the level of aging increases, the phenomenon of three or four generations living under one roof is more common. The wealth accumulated by the three or four generations of the family will be transferred to the offspring, which will increase the wealth of the offspring and the ability to purchase commercial housing, thereby increasing The overall effect of aging on housing prices lies in whether the increased demand offsets the reduced demand for housing due to the decrease in the proportion of the right-age population.

2) Per capita GDP has a very significant role in promoting the rise of house prices. The amount of real estate investment completed this year also has a significant role in promoting the rise in house prices. The negative effect of CPI on house prices is not significant. The higher the per capita GDP means the better the economic development of a place. On the one hand, the demand for labor will also increase, which will increase the population of the area, thereby increasing the demand for housing; on the other hand, the increase in GDP will promote the increase in wages. This increases the purchasing power of the labor force, which also increases the demand for residential commercial housing to a certain extent, thus causing housing prices to rise. The amount of real estate investment completed this year reflects the cost of residential commercial housing, which can push the supply curve upward, thereby driving up housing prices.

The main recommendations are:

1) Carry out the policy of "same rights for renting and purchasing" to gradually change people's preference for renting and purchasing, thereby reducing the purchase demand for residential commercial housing. Aging only promotes the rise of housing prices when the level of economic development is relatively high. However, if renters and buyers are given equal rights to public resources, such as the right to education for children, medical care, and urban infrastructure, etc.[11], when a region attracts labor inflows as the level of economic development increases, part of the rent will increase. The relatively small demand for housing purchases has increased, which has restrained the rise in housing prices to a certain extent. The implementation of the policy of "same rights for renting and purchasing" will not only help to strengthen labor mobility in Shaanxi Province, but also reduce the demand for housing purchases. It will have a certain effect on the short-term impact of family size miniaturization and urbanization on the housing market, thereby weakening the aging population at this stage. A boost to house price increases.

2) Implement a loose population policy. Since 2017, the increase in the degree of aging has promoted the rise of housing prices in Shaanxi. Therefore, a loose population policy should be implemented, and the cost of raising children should be reduced by reducing tuition fees and housing security policies, so as to slow down the impact of aging on the real estate market in Shaanxi Province.

3) Face up to the impact of population aging on housing prices and levy real estate taxes. The aging degree of Shaanxi Province continues to increase, which will inevitably promote the rise of housing prices in Shaanxi, but the reason behind it is the increase in demand for house purchases. Therefore, policies such as the collection of real estate taxes and the increase in the down payment ratio of second homes are implemented to curb the demand for house purchases, and the expected tax payment The more, the greater the possibility that the family's willingness to buy a house will decline.[12] Under the change of times, Jia Zhangke's film aesthetic style has been criticized to some extent, especially some people think that his observation of life is not sensitive, and he has lost the vitality of youth. But Mr. Jia said, "Reality is a rock. It stands there naked and will not move." His films still insist on highlighting the reality and presenting the most objective life of the bottom people from a documentary perspective. At the same time, Jia zhangke's films are constantly expanding the field of self-expression and changing the style of films. The transformation of narrative mode, the development of symbolic style, and the

transition from realism to the combination of the virtual and the real all contain obvious characteristics of The Times. The analysis of the development and change of Jia Zhangke's film aesthetic style can provide more diversified thinking space for Chinese film creation.

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