Population Age Structure and Housing Price --An Analysis Based on Panel Data from 2007 to 2019 in Zhejiang Province

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Abstract—According to the theory of life cycle, with the growth of population age, the income level and house-buying preference will change, and the housing demand will also change. The paper applied Modigliani's life cycle theory to analyze the change of population age structure and housing price in Zhejiang Province. Then selected the population age structure, urbanization rate, GDP, residents' income, population natural growth rate, development and construction costs, real estate investment of 11 cities in Zhejiang Province from 2007 to 2019 to build an econometric model of the influencing factors of house prices. It is found that the proportion of population aged 18-35 is positively correlated with housing price, and the proportion of population aged over 60 is negatively correlated with housing price.

Keywords-housing price; population age structure; life cycle theory; housing demand

1 INTRODUCTION

Housing is not only one of the indispensable conditions in human life, but also an important part of family assets, and real estate is an important factor affecting people's living standards. With the rapid development of the real estate industry, investment enthusiasm in the real estate market across the country continues to rise, resulting in rising housing sales prices. The continuous rise in housing prices has seized financial resources, resulting in a reduction in the development space of other industries, and raised the cost of living of residents. Therefore, inflated housing prices always pose a threat to the country's financial system.

The impact of population age structure on the real estate market can not be ignored. According to the life cycle theory, with the increase of population age, the income level and home purchase preference will change, and so will the housing demand. For example, the population of working age or marriage is the main demand for housing, while the needs of the elderly in providing for the aged and the financial support behavior to their children also have an impact on housing prices. Changes in the age structure of the population will also affect economic growth and savings, and both economic growth and savings growth will have an impact on the real estate

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market. For this reason, this paper takes Zhejiang Province as an example to explore the impact of population age structure on housing prices.

2 Literature review and related theories

2.1 Literature review

Population is a basic support of the real estate market, and the relationship between population and housing prices is deeply concerned by the academic circles. To judge whether housing prices will rise or fall in the future, "Analyze policy in the short term, land in the medium term, and population in the long term." Whether the population of a place is inflow or outflow, growing or declining, will profoundly affect the long-term trend of development of the real estate market. As China's population growth is about to usher in an inflection point, and the demographic dividend is gradually disappearing, various cities have successively set off a "war of robbing people" and issued preferential policies to attract fresh college graduates, professional and technical personnel, innovative and entrepreneurial talents, and so on. Young, able to pay "talent" is the key object of competition in various cities, and has become an important aspect of urban competition[1]. The empirical studies of many scholars show that the inflow of people from the "scramble" has a positive impact on housing prices. Chen et al.[2] found that urbanization accelerates the scale of population migration, which is an important factor leading to the rise in housing demand and prices. The research of Luo Yongmin[3] also shows that the growth of floating population has a positive effect on housing demand, and the more labor flows into sufficient areas, the more obvious the expansion effect of housing demand brought by urbanization. Liu Xiuyan and others[4] also believe that the population can not only directly affect housing prices through real estate demand, but also indirectly affect housing prices by providing human resources for the real estate market. This explains why local governments have issued "New policies for talents" to attract more people and increase housing demand . On the impact of population age structure on housing prices, some scholars believe that with the increase of the proportion of the elderly in the population age structure, income and purchasing power will decrease, and the demand for housing consumption will decrease, which will lead to a decline in housing prices[5]. Other scholarsbelieve that the increase in the proportion of the elderly population will boost housing consumption, resulting in a rise in housing prices. The reason is that the differences in living habits between generations encourage the elderly to more and more like to live separately from their children. under the effect of the "altruism" and savings effect of the elderly, the elderly with the ability will buy houses for their children[6]. The research of Wei Shangjin et al.[7] shows that if the house is regarded as an identity commodity, the gender imbalance leads to fierce competition in the marriage market and mother-in-law effect, which pushes up the real house prices in the city. Due to the different perspectives of researchers, there is no unified conclusion as to whether the impact of population age structure on housing prices is promoted or suppressed.

2.2 Related theories

Modigliani life cycle theory is a basic theory with strong correlation with age structure. The core of life cycle theory is the age change of population, which holds that people will plan their living consumption expenditure in a longer period of time in order to achieve the best allocation

of consumption in their whole life cycle. Therefore, it is very necessary to explore the impact of age change on economic development from the starting point of life cycle theory. The core idea of the theory is that different ages have different consumption behaviors, children have no income and do not have the ability to consume; families' income is low in youth, but they have stable jobs and their income will increase in the future. they tend to spend most of their income on consumption, or even loan consumption. Income in middle age will be used to pay off debts in youth on the one hand and save income on the other hand to prevent old age. If you have savings in your old age, consumption will rise. What the life cycle theory is related to real estate is that the young population and the elderly can promote the economy, so they will form an effective demand for housing and promote the rise of housing prices; children and middle-aged people basically do not promote the economy, have no effective demand for housing, and inhibit housing prices. Based on this conclusion, the paper carries out empirical research.

3 Data and model

3.1 Data and variable description

The paper collected related data from 2009 to 2019 of the eleven cities in Zhejiang Province, including Hangzhou, Ningbo, Wenzhou, Jiaxing, Huzhou, Shaoxing, Jinhua, Quzhou, Zhoushan, Taizhou and Lishui.

According to the existing research results at home and abroad, 11 variables were selected from three aspects: dependent variable (DV), independent variable (IV) and control variable (CV). The detailed description, quantification and expected impacts of the characteristic variables are shown in Table 1.

Table 1. Variable description, quantization, and expectation

Type	Variables	Description and quantity	Expectation
DV	Average housing price	Average annual selling price of housing (yuan/m^2)	
IV	Percentage of people under 18 years old (CDR)	Population under 18 years old / total population (%)	—
	Percentage of people 18-35 years old (EDR)	Population under 18-35 years old / total population (%)	+
	Percentage of people 35-60 years old (ADR)	Population under 35-60 years old / total population (%)	—
	Percentage of people over 60 years old (AGR)	Population over 60 years old / total population (%)	+
CV	Urbanization rate (UR)	Urban population / total population (%) completed	
	Regional gross domestic product (RDP)	Annual gross domestic product (billion yuan)	
	Residents' income (RI)	Average wages of in-service employees(yuan)	
	Natural population growth rate (NPGR)	Annual natural population growth / total population of the previous year (%)	
	Construction cost (CC)	Completed construction cost of last year (yuan/m^2)	

	Real estate investment (REI)	Total real estate investment (billion yuan)	

3.2 Model specification

The data used in this paper are panel data, and the sample size is much larger than that of time series data, so the regression results will be more stable and effective. Compared with the cross-section data, the panel data has more time continuity, the capacity is much larger than the cross-section data, and the results are more predictable. At the same time, the estimated value of panel data is more effective because of its large sample size and low collinearity. As there is some collinearity in the influencing factors of house prices, it is more scientific and effective to choose panel data to do regression in this chapter. The basic functional form is as follows:

$$y_{it} = \alpha_i + bx_{it} + \mu_{it}(\, i = 1,2,3 \cdots, N; t = 1,2,3 \cdots, T) \tag{1}$$

In the formula, y is the logarithm of the housing price, x represents multiple independent variables, i represents the number of samples, α represents the parameter is a constant term, b represents the influence degree of the IV on the DV, μ_{it} is the error term, indicates the influence degree of other explanatory variables or unobservable other factors on the explained variable, and t represents the corresponding period of all samples.

3.3 Hausmann test

In this paper, the Hausmann test is carried out by using the measurement software Stata16. After taking the logarithm of the variable, the Hausmann test is carried out, and the result shows that the critical value P is zero to reject the original hypothesis, so the fixed effect model is selected to regression the data.

3.4 Stationarity test

Before the regression, we first test the stationarity of the data used in this paper to judge whether the selected variables can meet the stationarity requirements and whether the data can be regressed. In this paper, LLC and IPS methods are used to test the stationarity of each variable. As shown in Table 2: it can be seen that the selected variables have passed the stationarity test as a whole, so the pseudo-regression can be avoided.

Table 2. Stationarity test

Variables	LLC		IPS	
	Statistic	p-value	Statistic	p-value
Average housing price	-4.2578	0.0000	-1.6803	0.0465
Percentage of people under 18 years old (CDR)	-1.4838	0.0689	5.3958	1.0000
Percentage of people 18-35 years old (EDR)	-5.3737	0.0000	2.7959	0.9974
Percentage of people 35-60 years old (ADR)	-1.5832	0.0567	2.8051	0.9975
Percentage of people over 60 years old (AGR)	-0.6872	0.2460	0.8120	0.7916

Urbanization rate (UR)	-3.5339	0.0002	-0.0858	0.4658
Regional gross domestic product (RDP)	-0.4951	0.3103	1.9414	0.9739
Residents' income (RI)	-4.3203	0.0000	-2.4818	0.0065
Natural population growth rate (NPGR)	-2.7132	0.0033	-2.1126	0.0173
Construction cost (CC)	-5.0183	0.0000	-4.5181	0.0000
Real estate investment (REI)	-2.7300	0.0032	-3.3994	0.0003

4 Result and discussion

The paper uses Stata16 to do fixed effect regression. The final regression results are shown in Table 2 and 3, t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Based on Table 3, when only considering the relationship between population age structure and house prices, the proportion of people under 18, the proportion of people aged 18-35, the proportion of people aged 35-60 and house prices change inversely, and there is a negative correlation between them. The proportion of people over 60 years old and house prices change in the same direction, and there is a positive correlation between them. For every 1 percentage point increase in the proportion of people under the age of 18, house prices fall by 0.229 percentage points; for every 1 percentage

point increase in the proportion of people aged 18-35, house prices fall by 0.147 percentage points; for every 1 percentage point increase in the proportion of people aged 35-60, house prices drop by 0.134 percentage points; for every 1 percentage point increase in the proportion of people over 60, house prices rise by 0.099 percentage points.

After adding the control variable, for every 1 percentage point increase in the proportion of people under 18 years old, house prices rise by 0.001 percentage points, but fail the test; for every 1 percentage point increase in the proportion of people aged 18-35, house prices rise by 0.023 percentage points; for every 1 percentage point increase in the proportion of people aged 35-60, house prices rise by 0.002 percentage points, but fail the test. For every 1 percentage point increase in the proportion of people over the age of 60, house prices fall by 0.035 percentage points.

Table 3. Fixed effect regression

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
CDR	-0.229***	0.001						
EDR			-0.147***	0.023*				
ADR					-0.134***	0.002		
AGR							0.099***	-0.035**
Constant	12.893***	3.858***	12.351***	2.707**	14.689***	3.722**	7.170***	1.850

Adj-R^2	0.190	0.809	0.468	0.813	0.276	0.809	0.674	0.816

It can be concluded that different ages have different effects on house price changes. Before adding the control variable, the population under 18 years old has a negative impact on the house price, while the addition of the control variable has a positive impact on the house price. Before adding the control variable, the 18-35-year-old population has a negative impact on the house price, while the addition of the control variable has a positive impact on the house price. The 35-60-year-old population has a negative impact on house prices before adding control variables, and a positive impact on house prices after adding control variables. Before adding the control variable, the population over 60 years old has a positive impact on the house price, and it has a negative impact on the house price after adding the control variable. However, after the addition of control variables, the impact of the four indicators of population age structure on house prices is significantly weakened.

5 Conclusion

The age structure of the population is the basic factor that affects the housing demand, which will have an important impact on the change of housing prices, so the complexity of the population structure and the special national conditions of China make the housing prices of domestic cities become extremely complex in the process of formation. Most scholars study the influence of population structure on house price, but seldom study the influence of population age structure on house price. According to the national conditions of our country, different age classes will affect housing prices in many ways, so the research on the relationship between population age structure and housing prices is of practical significance to the development of China's real estate industry and the formulation of government policies.

In this paper, the fixed effect model is selected for empirical test, and the conclusions are as follows: the population under 18 years old, 18-35 years old, 35-60 years old and house price change in reverse, the higher the proportion, the lower the house price; the population over 60 years old changes in the same direction with the house price, the higher the proportion, the higher the house price. It can be seen that the main reason for the rising house prices in Zhejiang Province is the accelerating aging of the population. Although children have housing demand, they have no source of income and account for most of the household expenditure, so the increase in the number of children has reduced the housing demand. Young people have a large demand for housing, but their economic capacity is far from enough to buy real estate, resulting in young people only have the desire to buy a house, but do not have the ability to buy a house. And most of the middle-aged groups have met the demand for housing, will not have a significant impact on housing prices. In addition to providing for the aged, the elderly in China are likely to help their children share the housing pressure, thus increasing the effective demand in the real estate market and driving up house price.

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