

Study on the Effect of Population Drain on Housing Price in Shrinking Cities

Binyan Bai^{1, a}, Murong Ren^{2, b}

¹School of Public Administration (MPA Education Center), Shanxi University of Finance and Economics, Taiyuan, China.

²School of Accounting, Shanxi University of Finance and Economics, Taiyuan, China.

^aStandstillsanmu@126.com, ^bEvelynshurmr@163.com

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Abstract: At present, part of the domestic urban population loss is serious, and "shrinking city" has become the focus of scholars. In this paper, 26 shrinking cities with three years net population outflow from 2015 to 2017 are taken as the research object, and a multiple regression model is constructed to explore the impact of population outflow on housing prices. It is found that the scale of net population inflow has no obvious effect on housing price, while the speed of net population inflow has significant negative effect on housing price. Finally, based on the results of empirical analysis, this paper puts forward some policy suggestions on the management of real estate market in shrinking cities.

1. Introduction

In recent years, in some areas where resources are exhausted and the industrial structure is unreasonable, the population of the city has been continuously flowing out, the scale of the resident population has been decreasing, and the problems of the production efficiency and the stock of human capital in the city have appeared. According to the latest study published on the website of Beijing Urban Laboratory, 180 cities in China have experienced contraction of varying degrees out of 654 cities. According to a study by Zhang M D et al (2019), there were 26 prefecture-level cities in China from 2015 to 2017, accounting for 8.84% of the total number of prefecture-level cities. At the same time, residential housing prices in these cities continue to fall, even down to the rock-bottom price, having a strong impact on the local real estate market and the urban economy. In Hegang, for example, the total population of Hegang fell from 1,091,200 at the end of 2010 to 995,000 in 2018, while housing prices in Hegang rose to 6,000 yuan per square meter in 2010 and are now around 2,000 yuan per square meter. Under this background, this paper takes 26 shrinking cities in 294 cities in China from 2015 to 2017 as the research object (Zhang M D et al, 2019), and explores the changing characteristics and effect of population outflow and housing price. Based on this, the paper puts forward some policy suggestions on urban planning and real estate market regulation.

2. Literature Review

The price and fluctuation trend of urban housing has been an important topic in the fields of urban economics and public management, which has aroused many scholars' research. At present, there are some classical theories and models, such as the characteristic price model (Ridker, 1967), the model and the comprehensive evaluation price model (Lu P F, 2002), and the partial equilibrium model (Zhou J K, 2005).

Foreign scholars mainly studied the price distribution and price fluctuation of urban housing, and discussed the influence of economic and social factors such as disposable income (Abelson et al, 2010) and infrastructure (Mathur, 2008) on housing price. For example, Abelson et al (2010), based on data from 1970 to 2003 in Australia, explored the factors influencing the change of house price, and found that house price was positively influenced by disposable income and CPI in the long run.

The paper of Mathur (2008), based on the data of Washington from 1991 to 2000, discussed the impact of transportation infrastructure and services on housing prices, and drew the conclusion that community infrastructure and services would affect housing prices. In contrast, domestic scholars' research on urban housing price started relatively late, but a lot of research results have been formed at present. Domestic scholars mainly focused on housing affordability, the relationship between housing prices and land prices and other research topics. They have found that real estate investment (Tu J H, 2005) , GDP (Xu J, 2013) and other economic and social factors have effect on housing prices. For example, Tu J H et al (2005), based on the monthly data of the Shanghai Real Estate Market from July 2000 to March 2004, explored the main factors influencing the movements of the Shanghai Composite Index of the real estate market. It is found that the proportion of real estate investment in fixed asset investment has an important influence on the fluctuation of the Shanghai Composite Index. Based on the data of 35 large and medium-sized cities in China from 2001 to 2010, Xu J (2013) discussed the decoupling state, changing process and stability of housing price rise and economic growth, and drew the conclusion that the decoupling coefficient of housing price and GDP was on the rise, and the housing price would continue to rise with economic growth.

However, with the continuous loss of population in some small and medium-sized cities in recent years, housing prices in these cities have dropped sharply, which has impacted on the urban economic development and the stability of the real estate market. At present, there are still few studies on the relationship between population loss and urban housing price, and most of the existing studies focus on the population flow and the fluctuation of housing price, and the impact of population migration on housing price, et al. However, few papers use quantitative methods to measure the effect of population loss on housing prices. Besides, there is no consistent conclusion among those existing studies. For example, Zou J et al. (2018) explored the impact of population migration and aging on housing prices based on housing market data from 2002 to 2015, and found that increased population migration would increase housing prices. Based on panel data of 35 large and medium-sized cities in China from 2005 to 2014, Bai J X et al. (2016) found that the impact of population mobility on housing prices was shown as an inverted U-shaped relationship.

To sum up, current studies on the effects of population loss on housing prices have not been explored. Based on the data of 26 shrinking cities from 2014 to 2018, this paper discusses the influence of population loss on housing price and the degree of intensity, in order to make up for the insufficiency of the previous research.

3. Research Data and Methods

3.1 Research Data

This paper mainly uses the statistical data of China Urban Statistical Yearbook, Heilongjiang Statistical Yearbook, Jilin Statistical Yearbook, Liaoning Statistical Yearbook, Sichuan Statistical Yearbook, Shaanxi Statistical Yearbook and Inner Mongolia Statistical Yearbook from 2014 to 2018, including residential sales and area, registered population size and natural growth rate, regional gross product, residential development investment intensity, average wages and other indicators.

At present, there is no accurate definition about the concept of shrinking city in academic circles. Domestic studies generally identify cities with a continuous net population outflow of 3 years or more as shrinking cities (Wu K et al., 2015; Zhang M D et al., 2019). Zhang M D and others (2019) identified a total of 26 shrinking cities with a net outflow of population for three consecutive years. These shrinking cities are located in less developed regions such as the northeast and southwest. Specifically, there are 21 cities in northeast China, including eight in Heilongjiang, seven in Jilin and six in Liaoning. Besides, the shrinking cities in Sichuan Province is Bazhong, Neijiang and Guangyuan. Tongliao in Inner Mongolia and Ankang in Shaanxi are shrinking cities, too. This article takes these 26 cities as the research object and carries on the concrete analysis, discussing the influential effect of population outflow on real estate prices.

3.2 Research Method

Based on the data, this paper uses the following multiple regression model to identify the impact of population loss on housing prices:

$$Y_{it} = \alpha + \beta Popin_scale_{it} + rPopin_rate_{it} + mX_{it} + \varepsilon$$

Among them, Y_{it} is the housing price of the t year in i city, $Popin_scale_{it}$ is the net inflow scale of the t year in i city, $Popin_rate_{it}$ is the net inflow speed of the t year in i city, and X_{it} is the control variable. α is an intercept term, ε is an Error term, and β , r and m are parameters to be estimated.

4. Influencing Factors of Housing Price in Contracting Cities

4.1 Variable Selection

(1) Dependent variable.

Housing prices were selected as the explanatory variables in 26 shrinking cities from 2014 to 2018. According to the data of Heilongjiang Statistical Yearbook, Jilin Statistical Yearbook, Liaoning Statistical Yearbook, Sichuan Statistical Yearbook, Shaanxi Statistical Yearbook, Inner Mongolia Statistical Yearbook, these data are calculated from the ratio of residential sales to residential sales area (Jingkui Zhou, 2005).

(2) Core variables.

The scale and speed of net population inflow will affect local housing demand and thus housing price, which is the core explanatory variable in the model. The net inflow of population is the difference between the number of population at the end of this year, the number of population at the end of last year and the product of the number of population at the end of last year and the natural growth rate of population. The net inflow rate is the ratio between the net inflow of population and population at the end of this year. In the calculation of the net inflow rate of population, this paper uses Li T et al. (2015) for reference.

(3) Control variables.

In the aspect of economic development, this paper selects two variables: Regional Gross Domestic Product and residential development investment. The regional gross product is a symbol of the economic development level of a region. The higher Regional Gross Domestic Product usually means that the local economy is more vigorous and the real estate market is more active, which leads to the increase of housing price. On the one hand, the amount of investment in real estate development promotes the growth of fixed asset investment and regional gross product, which affects housing prices. On the other hand, the amount of investment in real estate reflects the quantity of real estate supply, affecting housing prices by influencing supply and demand.

In the aspect of residents' employment, this paper selects two variables: employment density and average wage of the employees in the municipal district. The employment density is the ratio of the number of employees in secondary and tertiary industries to the completed area of the municipal district. From the supply aspect, the higher the employment density, the scarcer the land supply will be. At the same time, the employment density is also an indicator of the relative relationship between demand and supply. From the demand aspect, the higher the employment density, the stronger the city's absorption ability to the population will be, and the higher the housing demand (Lu M et al., 2014) will be. In this paper, the average wage of on-the-job employees is taken as the measurement index of the employment situation. The high wage reflects the good employment situation in the city and affects the potential purchasing power of residents for housing. (Wang C Y et al., 2007).

In the aspect of infrastructure, this paper selects two variables: the green coverage rate of built-up area and the number of actual buses and trams at the end of the year. With the continuous advancement of urbanization, the ecological consciousness of the whole people has gradually strengthened, and the demand for the construction of urban greening supporting facilities has

gradually increased. A good urban environment can meet people's needs for a good quality of life, attracting people to move in and driving up housing prices (Bai J X et al., 2016). In addition, as public goods, infrastructure reflects the welfare level of the city. Cities with well-equipped infrastructure often have higher housing prices. (Lan F et al., 2018).

The variable settings for the model are shown in Table 1 and the descriptive statistics are shown in Table 2.

Table 1 Variable setting and index design

Variable class		Variable setting	Variable name	Method of calculation
Dependent variable		Average house price	<i>House_price</i>	Residential sales/residential sales area (yuan/square meter)
Core variable		Net inflow of population	<i>Popin_scale</i>	Population at the end of this year - population at the end of last year - population at the end of last year * Natural growth rate of population (Ten thousand)
		Net inflow rate	<i>Popin_rate</i>	(Population at the end of this year - population at the end of last year - population at the end of last year * Natural growth rate of population)/population at the end of this year
Control variable	Economic Development	Gross regional product	<i>GDP</i>	The gross domestic product of a city in that year (a hundred million Yuan)
		Completed investment in residential development	<i>Invest</i>	Completed investment in residential development (a hundred million Yuan)
	Employment of residents	Employment density	<i>Employ</i>	Number of employees in secondary and tertiary industries in municipal districts/area of completed municipal districts (10,000 persons/square kilometers)
		Average wage of on-the-job staff and workers in municipal districts	<i>Wage</i>	Average salary of staff and workers on duty in municipal district (yuan/year)
	Infrastructure	Green coverage of built-up area	<i>Environment</i>	Completed area green coverage rate (%)
		Number of buses and trams actually operating at year-end	<i>Infrastructure</i>	Number of buses and trams actually operating at the end of (Vehicles)

Table 2 Descriptive statistics

Variable class	Variable name	Sample size	Mean	Standard deviation	Minimum	Maximum
House prices	<i>House_price</i>	130	3729.14	741.82	2279.09	5635.9
Population Drain	<i>Popin_scale</i>	129	0.96	5.68	-28.66	28.8
	<i>Popin_rate</i>	129	0	0.15	-1.47	0.6
Economic Development	<i>GDP</i>	128	389.66	312.7	28.98	1442.78
	<i>Invest</i>	129	27.62	26.51	0.26	133.05
Employment of residents	<i>Employ</i>	126	1652.05	608.51	377.65	4362.43
	<i>Wage</i>	125	51366.85	9349.28	24631.43	78117
Infrastructure	<i>Environment</i>	117	38.33	6.69	1.02	57.34
	<i>Infrastructure</i>	122	570.49	384.08	87	1790

4.2 Research Results

The results of the regression analysis are shown in Table 3. The Model (1) adds core explanatory variables such as net inflow size, net inflow rate, and the model (2) to (4) adds three control variables such as economic development, employment of residents and infrastructure. This article takes Model (4) as the analysis object, and discusses the population flow to the housing price influential effect. The mean value of the variance expansion factor is 3.01 and the maximum value is 5.01, which means that the model has no serious collinearity problem.

Table 3 Results of multiple regression analysis

Variable class	Variable name	Model(1)	Model(2)	Model(3)	Model(4)
Population Drain	<i>Popin_scale</i>	-11.32	-21.42*	-19.67*	-14.75
	<i>Popin_rate</i>	758.60	934.10***	793.20**	636.90*
Economic Development	<i>GDP</i>		1.08***	1.06***	1.18***
	<i>Invest</i>		5.91**	3.508	1.38
Employment of residents	<i>Employ</i>			0.118	0.23**
	<i>Wage</i>			0.02***	0.02***
Infrastructure	<i>Environment</i>				-8.50
	<i>Infrastructure</i>				-0.04
Constant		3732***	3171***	1909***	1901***
Observations		129	126	118	103
R-squared		0.01	0.39	0.46	0.48

Notes: *Significant at 10%. ** Significant at 5%. *** Significant at 1%.

(1) Population loss and housing prices.

It is found that the regression coefficient of the net inflow of population is negative and not significant, that is, the influence of the scale of population loss on the house price is not obvious. This may be due to the fact that the indicator of net population inflow is closely related to the size of the local population, and the larger the city, the larger the size of the floating population. Therefore, this indicator can not accurately reflects the intensity of population outflow from a city, and does not show a significant effect on housing prices in the regression model. In contrast, the net inflow rate of population excludes the influence of the size of urban population.

The coefficient of the net inflow rate is significantly positive, which is in line with expectations. Other things being equal, for every unit of change in the net inflow rate, house prices will rise by 637 yuan. The impact of net population inflow rate on housing prices is greater than that of other variables, which reflects that population is still one of the main factors in the rise of urban housing prices. On the one hand, the steady outflow of population leads to the decrease of the rigid demand for housing, and the lower economic growth rate and the loss of population in the shrinking cities aggravate the downward trend of the economy, and the consumption capacity of the permanent residents is insufficient. On the other hand, the outflow of population from cities tends to be dominated by traditional industries, the economic aggregate and growth rate lags behind other regions, and the advantages of geographical location are poor. Heihe and Suihua in Heilongjiang Province, for example, are at the northernmost tip of the country, with a harsh climate, poor transport and communications, and a poor industrial structure. As a result, cities can provide fewer jobs, and facilities and public services such as health care and education lag behind, making it difficult to attract and retain migrants, leading to a loss of population and lower housing prices.

(2) Economic development and housing prices.

From the regression results, the coefficient of regional GDP is always significantly positive. In the Model(2), R-squared is 0.39, that is, the level of economic development has a high impact on housing prices, indicating that in the cities with high GDP, the housing demand of residents is also relatively strong, thus promoting the rise of housing prices. And contrary to expectations, investment in real estate development for the impact of house prices is not significant. The possible reason is that, on the one hand, real estate prices are influenced by the expectations of real estate developers in the future, and the continuous investment of real estate developers in the property market makes the market present a prosperous scene. The increase in housing prices is driven by the confidence of residents

and other investors in the booming real estate market, while on the other hand, the increase in the scale of real estate investment may result in an oversupply of housing and a depreciation of the value of housing, the price of housing fell with it.

(3) Employment and housing prices.

According to the regression results, the fitting degree of the model is improved by 7% when the employment situation is added, which shows that the explanation degree of Employment situation to housing price is good. Employment density can promote the rise of housing price, which reflects the relative relationship between urban housing supply and demand. After controlling for the amount of investment in real estate development, which reflects the housing supply, the housing demand factor reflected by the employment density will push up the housing price. The influence coefficient of the average wage of on-the-job workers on housing price is significantly positive, that is, higher wage level represents a higher consumption level of local residents to some extent. Residents for real estate strong consumption capacity to promote the rise of housing prices, this conclusion and the existing research is consistent (Bai J X, 2016).

(4) Infrastructure and housing prices.

According to the regression results, the impact of urban infrastructure, namely green coverage and the number of actual buses and trams on housing prices at the end of the year is negative and not significant. On the one hand, the living conditions characterized by urban infrastructure and natural environment reflect the living needs of residents, and good living conditions can attract residents to real estate consumption and investment and promote housing prices. On the other hand, good living conditions can not be separated from government management and maintenance, which may mean higher local taxes and higher costs for living conditions, thus reducing residents' consumption levels and willingness to pay for housing.

5. Conclusion

In recent years, some cities with exhausted resources and unreasonable industrial structure have become shrinking cities due to the continuous outflow of population. At the same time, the falling prices of housing in these cities have had a strong impact on the local real estate market and the urban economy. At present, there are few researches about these contracting cities, and the relationship between population loss and urban housing price is not discussed. Few articles use a quantitative method to measure the effect of population loss on housing price. Under this background, this paper takes 26 shrinking cities as the research object, based on the statistical data from 2014 to 2018, constructs the multiple regression model, discusses the influence of population loss on housing price and the degree of strength and weakness. Based on this, the author puts forward some policy suggestions, such as city planning, real estate market regulation, etc. .

This paper constructs a regression model and finds that the scale of net population inflow has no obvious effect on housing price, but the speed of net population inflow reflects the intensity of population outflow and has a significant negative effect on housing price, that is, the higher the rate of population loss, the lower the price of housing. In addition, economic development, employment of residents, infrastructure and other factors will have an impact on housing prices. For instance, the gross domestic product (GDP) has a significant positive impact on housing prices, and the average wage of workers has a significant positive impact on housing prices.

Based on the research results, this paper puts forward the following policy recommendations. Firstly, the government departments of shrinking cities should, based on their actual development situation, scientifically evaluate the comparative advantages of cities, determine the new economic growth points of cities, and optimize the industrial structure, in order to increase the attractiveness of cities to the population. Secondly, to ensure the healthy development of the urban economy, urban planning, land development and housing construction should be formulated scientifically based on the results of population size projections. Thirdly, to avoid practical problems such as land finance, we should regulate and control the real estate market, guide enterprises and residents to make rational investment in the real estate market, and promote the balance of supply and demand structure in the

real estate market.

The innovation of this paper is that it focuses on the real estate market of shrinking cities and uses quantitative method to measure the effect of population loss on housing price. Based on this, the author puts forward some policy suggestions, such as city planning, real estate market regulation, etc. At the same time, this paper has many shortcomings, including not considering the interaction among the factors, the model may be set up missing variable bias, etc.

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