

The Impact of Housing Demand on Housing Price Fluctuations—Taking Wuhan as an Example

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Abstract: The housing problem is related to the well-being of the people's livelihood, and the housing price problem has always been a hot topic of social concern. Since the beginning of the 21st century, the problem of expensive housing in big cities has become more prominent, and the problem of housing prices has plagued the people. With the rapid economic development of big cities, more and more people are pouring into big cities to work and buy houses, and house prices are also rising sharply. Due to the government's macro-control policies and the epidemic, housing prices have also been affected. This paper intercepts the time series data such as the average house price and the gross regional product (GDP), price index (CPI), the number of permanent residents and the per capita disposable income of residents in Wuhan from 2000 to 2020. Using multiple regression model, it is concluded that the demand-side factors such as GDP, price index and disposable income of residents in Wuhan will positively affect housing prices, and thus predict the fluctuation trend of house prices in Wuhan in the future and put forward corresponding suggestions.

Keywords: Housing prices, GDP, CPI, Disposable income of residents, Multiple regression

1. Introduction

As the center of China's economic geography and the core city of the Yangtze River Economic Belt, Wuhan has experienced rapid economic development since the beginning of the 21st century. The residents' well-being has been continuously improved, the population attraction has been significantly enhanced, and the residents' income and expenditure level has been continuously improved. Correspondingly, with the development of the economy, the price index of Wuhan has also increased, coupled with a group of real estate speculation groups from Wenzhou in 2009, resulting in a significant increase in housing prices in Wuhan. Although there is still a big gap in house prices between Wuhan and the first-tier cities of the country, the growth rate of house prices is obviously incompatible with the level of residents' income and expenditure, which has led many residents to flinch at high prices. Excessive housing prices not only make people who want to buy houses sigh, but also increase the cost of urban production and life, hindering the economic development of the city. Although the government has issued a number of macro-control policies in recent years, the results have little effect. With the outbreak of the new coronavirus epidemic in Wuhan in 2019, housing prices began to develop in a rational direction. Based on the average price of house prices in Wuhan in the 21 years since 2000, this paper studies the impact of residential demand-side data such as Wuhan's GDP, resident population, price index and residents' disposable income on house prices, and analyzes the key factors affecting house prices. Predict the future trend of house price fluctuations in Wuhan and put forward corresponding opinions for the government to regulate house price policies.

2. Literature review and research hypothesis

2.1 Literature Review

Initially, scholars' research on the influencing factors of housing prices is mostly through qualitative analysis, and most of the research focuses on the impact of market supply, government policies and other

factors on housing prices. Such as 2004 Wensheng Lu .etc published ' perspective of Nanning city real estate price change characteristics and influencing factors '. This paper summarizes the characteristics of housing price changes through qualitative analysis, and concludes that housing quality, building material price, land development cost, urban development and construction, the development of South China Expo, the increase of residents ' income and other factors affect the rise of housing price. And most of the conclusions drawn by scholars are from the market supply side, and only one resident income will also affect the rise in housing prices. [1]

With the gradual improvement of China's real estate indicators, data collection is easier, and the idea of statistics is more and more widely used in the analysis of the real estate industry. Scholars ' research on the factors affecting housing prices has mostly shifted from qualitative analysis to quantitative analysis. The literature written is mostly based on empirical research. Most of the scholars start from three aspects: consumer demand, market supply and government macro policy. The study found that housing price fluctuations are affected by many factors. For example, Guofu Zhou's " Analysis of the Influencing Factors of Commercial Housing Prices in Tianjin " published in the journal " China Prices " in 2007 [2] and Kui You 's " Analysis of the Influencing Factors of Housing Prices in the Central Region under the New Normal - Taking Wuhan as an Example " published in the journal " Light Industry Science and Technology " in 2021. [3] Scholars have first qualitatively analyzed the supply, demand factors and policy factors that affect housing prices, and selected 10-20 years of time series data to establish an econometric model of the influencing factors of commercial housing prices. Through empirical research and analysis, it is concluded that demand factors, supply factors and government policies will affect the fluctuation of housing prices, and housing supply is far greater than demand.

After 2019, due to the outbreak of the new coronavirus pneumonia, it has brought a lot of impact on China's macro economy. The disposable income and consumption expenditure of urban residents have decreased, which has also had a great impact on the real estate industry, and housing prices have been affected to some extent. Scholars have pointed out that after the new coronavirus epidemic, under the condition of "stability," the real estate market will accelerate the return to rational development, housing prices will stabilize, and the real estate market competition will become more intense. Therefore, housing prices will also be affected to a certain extent, and housing prices will return to rationality. [4]

Through combing a large number of relevant literatures and research theories of the real estate industry, it is found that most of the studies start from three aspects: consumer demand, market supply, and government macro policies, indicating that house price prices are affected by multiple factors. On the basis of the existing literature, this paper only focuses on the demand side, and makes an in-depth analysis of the impact of the demand side on the price of housing prices. Using the multiple regression model[5], this paper quantitatively studies the impact of the demand side on housing prices, such as the resident population, the urban price index and the income and expenditure level of residents, and analyzes the key factors of the demand side affecting housing prices, in order to reveal the regional GDP, the resident population and the town on the basis of the existing research.

2.2 Research hypothesis

(1) Urban resident population

The population of a region directly affects the demand for housing. With the rapid development of urban economy, the influx of urban floating population and rural population, coupled with the improvement of living standards and changes in consumption concepts, the demand for children to live alone has increased, which has stimulated the rapid increase in the demand for housing. In the case of constant supply or small growth, the rapid increase of demand will inevitably lead to the rise of housing prices.

Based on the above analysis, we get hypothesis 1.

H1: The more the number of urban resident population, the higher the demand for housing, the higher the real estate price, the resident population is positively affecting the housing price.

(2) Regional GDP

The GDP of a region can reflect the economic level of the region. The higher the economic level, the better the development of various industries, and the same is true for the real estate industry. Therefore, when a local GDP is higher, the higher the economic level, the higher the demand for housing, housing prices will be higher.

Based on the above analysis, we get hypothesis 2.

H2: The higher the regional GDP, the higher the housing demand, the higher the housing price, and GDP positively affects the housing price.

(3) Consumer price index

The consumer price index (CPI) is a relative number that reflects the changing trend and degree of consumer price changes in a certain period of time. It can not only reflect the purchasing power of consumers in a certain period of time, but also reflect the inflation of the market. When CPI rises, residents' purchasing power increases and the market inflation occurs. At this time, residents' idle funds for shopping increase, and housing prices will also rise.

Based on the above analysis, we get hypothesis 3.

H3: The higher CPI of urban residents, the higher the demand for housing, the higher the housing price, and CPI positively affects housing prices.

(4) Per capita disposable income of residents

Residents' disposable income refers to the sum of residents' final consumption expenditure and savings. The per capita disposable income of residents can reflect the willingness of residents to buy and the ability to pay in a certain period of time. With the increase of residents' disposable income, the Engel coefficient decreases, that is, the consumption of residents for food expenditure will decrease, and the expenditure for housing purchase will increase. Consumers have enough capital to buy a house to generate demand for goods. When the per capita disposable income of residents is higher, the purchasing power of housing is stronger, the demand for housing will increase accordingly, and the housing price will rise.

Based on the above analysis, we get hypothesis 4.

H4: The higher the disposable income of urban residents, the higher the demand for housing, the higher the housing price, and the disposable income of residents positively affects the housing price.

3. Data source and model design

3.1 Data source

Based on the annual data of house prices, this paper selects the average price of residential prices in Wuhan from 2000 to 2020, which comes from the National Statistical Yearbook of the People's Republic of China (<http://www.stats.gov.cn/>). The remaining explanatory variable data are selected from the Statistical Yearbook of Hubei Province of the People's Republic of China (<https://tjj.hubei.gov.cn/>). Among them, POP represents the resident population of Wuhan, GDP represents the gross domestic product of Wuhan, CPI represents the price index and consumer price index of Wuhan, calculated at 100 in the same period of 1978, INCOME represents the disposable income of Wuhan residents. These five data constitute time series data for empirical analysis.

3.2 Model design

This paper uses multiple regression model to analyze the influence of resident population, GDP, consumer price index and disposable income on housing price in Wuhan. The selected model is as follows.

$$Y = C + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \quad (1)$$

Among them, Y represents the average residential price in Wuhan, X1 represents the number of permanent residents in Wuhan, X2 represents the gross domestic product (GDP) of Wuhan, X3 represents the consumer price index (CPI), and X4 represents the disposable income of Wuhan residents. Among them, Y is the explained variable, and the remaining X is the explanatory variable. Based on the above five indicators, this paper selects a total of 21 years of data from 2000 to 2020, and uses OLS least squares method to perform regression analysis on the above related variables from 2000 to 2020.

4. Descriptive statistics and empirical analysis

4.1 Descriptive statistics

In order to achieve the results of descriptive statistics on the average price of housing, the number of permanent residents, GDP, CPI and disposable income of residents, we choose the corresponding data for analysis. The results are shown in Table 1.

Table 1: Descriptive statistical table

variable	N	mean	p50	sd	max	min
price	21	6406.095	5550	4133.838	14672	1280
pop	21	967.1471	978	123.4095	1244.77	804.81
gdp	21	6899.357	5458.35	5143.013	16223.21	1153.37
cpi	21	611.5619	600.2	95.05008	771.8	484.2
income	21	24587.69	20806.32	95.05008	51706	6760.68

It can be seen that the maximum and minimum values of housing average price, GDP and per capita disposable income are far from each other. That is to say, in the past 21 years, with the rapid economic growth of Wuhan, the per capita disposable income has grown rapidly, resulting in a rapid rise in the average housing price. And the standard deviation, as the degree of dispersion of a set of data, represents the difference between most of the values and their averages. The standard deviation of the average housing price and GDP is dozens of times that of other data, that is, the change of the average housing price and GDP in these 21 years is significant. Therefore, I preliminarily speculate that GDP is a significant factor affecting housing prices.

4.2 Correlation analysis

The correlation coefficients of the number of permanent residents, GDP, CPI, and per capita disposable income were all followed by a * number, indicating that the average housing price was significantly correlated with the number of permanent residents, GDP, CPI, and per capita disposable income at the 5 % level. By observing the correlation coefficient values, the correlation coefficient R is greater than 0, that is, there is a positive correlation between the two variables. The correlation coefficients between the average housing price and the number of permanent residents ($R = 0.9729$, $p < 0.05$), GDP ($R = 0.9875$, $p < 0.05$), CPI ($R = 0.9751$, $p < 0.05$), and per capita disposable income of residents ($R = 0.9886$, $p < 0.05$) are close to 1, indicating that there is a significant positive correlation between them, and the correlation coefficients between disposable income and GDP are relatively large, indicating that the average housing price is more relevant to disposable income and GDP. That is, GDP and disposable income of residents are the key factors affecting the average price of housing. The results are shown in Table 2.

Table 2: Correlation analysis table between variables

	price	pop	gdp	cpi	income
price	1.0000				
pop	0.9729* 0.0000	1.0000			
gdp	0.9874* 0.0000	0.9684* 0.0000	1.0000		
cpi	0.9751* 0.0000	0.9828* 0.0000	0.9825* 0.0000	1.0000	
income	0.9886* 0.0000	0.9720* 0.0000	0.9991* 0.0000	0.9863* 0.0000	1.0000

(Note: * is significant at the 5 % level, $p < 0.05$)

4.3 Multiple regression analysis

Through the regression analysis of the sample data by OLS least squares method, it is found that the coefficient of determination of the modified sample is R2. Except that the binary regression increases by 0.033 compared with the unary regression, the rest of the ternary regression increases by 0 compared with the binary regression. For the sample coefficient of determination, the ternary regression increases by 0.001 compared with the binary regression. The difference between the two is 0.001, which is due to

the increase in the number of explanatory variables. Therefore, the modified sample determination coefficient reflects the relationship between the dependent variable and the independent variable more accurately than the sample determination. By observing and correcting the coefficient of determination of the sample, the univariate regression $R^2 = 0.944$ and the multivariate regression $R^2 = 0.977$. With the increase of independent variables, the modified sample determination coefficient will increase and the determination coefficient of each sample is close to 1, indicating that the fitting level of the model is very good for both single variables and multiple variables. The details are shown in Table 3.

Table 3: Multiple regression analysis

	(1)	(2)	(3)	(4)
	price	price	price	price
pop	32.59*** (18.33)	8.959* (1.97)	11.96* (1.92)	11.75* (1.90)
gdp		0.585*** (5.38)	0.656*** (4.43)	-0.130 (-0.18)
cpi			-7.722 (-0.71)	-14.03 (-1.15)
income				0.304 (1.11)
cons	-25111.5*** (-14.49)	-6297.7 (-1.72)	-4961.2 (-1.19)	-2960.7 (-0.66)
N	21	21	21	21
r2	0.946	0.979	0.980	0.981
r2 a	0.944	0.977	0.977	0.977
F	336.0	429.3	278.6	212.0

(t statistics in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$)

After data analysis, it is necessary to eliminate the data of explanatory variable X3. After excluding the interference of the data of explanatory variable X3, the coefficient of determination R^2 is 0.98, indicating that the model has a good fitting level. When a single analysis of the explanatory variable permanent resident population X1, GDPX2, residents' disposable income X4 on the explained variable housing average price regression analysis, the explanatory variables are with three *, it is significant at the 1% level. And the absolute values of the T test are 18.33, 27.23, 28.58, which can pass the significance test of the regression parameters. The details are shown in Table 3.

According to the above multiple regression analysis and test results, the regression equation from 2000 to 2020 can be determined, as shown in Table 4.

$$Y = 7.597X_1 + 0.153X_2 + 0.156X_4 - 5832.3 \quad (2)$$

Table 4: Multiple regression analysis after eliminating variable X3

	(1)	(2)	(3)
	price	price	price
pop	32.59*** (18.33)	8.959* (1.97)	7.597 (1.49)
gdp		0.585*** (5.38)	0.153 (0.22)
income			0.156 (0.64)
cons	-25111.5*** (-14.49)	-6297.7 (-1.72)	-5832.3 (-1.53)
N	21	21	21
r2	0.946	0.979	0.980
r2 a	0.944	0.977	0.976
F	336.0	429.3	276.8

(t statistics in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$)

5. Research recommendations

Excessive housing prices are not conducive to social and economic development. Excessive housing

prices will increase the burden on residents to buy a house. Even if residents pay a down payment for buying a house, the increase in household debt ratio will inhibit other aspects of residents' consumption. Its excessive growth will also lead to an increase in the gap between the rich and the poor in society. The rich buy real estate, the house price rises, the rich benefit becomes richer, and the house price rises. The poor are more unable to afford house prices, so the gap between the rich and the poor will become larger and larger. Based on the various hazards of high housing prices, it is urgent to alleviate the rise in housing prices. Therefore, according to the above analysis of this article, the following suggestions are made.

5.1 Towns need to properly control the population growth rate

The increase in the number of permanent residents is one of the reasons for the increase in the average price of housing. With the continuous growth of the big city economy, the continuous improvement of urbanization construction, the continuous improvement of corresponding facilities and social well-being, more and more jobs are provided, and more and more people will flood into the big city. [6] With the rapid growth of population, the demand for housing has also increased. In the case of constant or small increase in housing supply, demand is greater than supply, and housing prices will grow rapidly. Therefore, we need to adjust the population structure, the government to take housing control policies to avoid too many people into the town in the short term.

5.2 Improve the income level of residents

Housing prices are too high, residents cannot afford to buy a house. We can solve the problem from the root, can improve the income of residents to match the current level of housing prices. [7] China has repeatedly proposed 'common prosperity'. When more people get rid of low-income people and become middle-class people, they can solve the problem of buying houses and promote China's economic growth.

5.3 Limit the number of purchases

One of the reasons why China's housing prices have been high is that many people have the mentality of investing in real estate. Their purpose is not to buy a house for daily living,[8] but to sell the house when the house price rises, so as to benefit from it. When those speculators bought a number of houses, resulting in housing in short supply situation, resulting in rising prices. When the purchase restriction policy is introduced, the fact that the real supply exceeds demand in the market housing will be exposed by cracking down on the real estate speculation group and developing rental housing.[9] According to the basic laws of economics, housing prices will naturally be rationalized step by step.

6. Research conclusions

Through the above analysis, it can be seen that the average housing price is affected by many factors. Among them, the demand-side factors such as urban resident population, gross regional product (GDP), consumer price index (CPI), and per capita disposable income of residents are all positively affecting the average housing price, and the gross regional product GDP is the key factor affecting the average housing price. Through the analysis of the data, it is found that since the outbreak of COVID-19 in Wuhan at the end of 2019, compared with 2019, the regional GDP and per capita disposable income of residents in 2020 have declined slightly. Although the average housing price is still rising, the increase is significantly reduced compared with previous years, and the housing price is returning to the rational direction step by step. Although the epidemic has been effectively controlled in 2020, the epidemic has been repeated in the past two years, which has brought a lot of shocks to China's economy and real estate industry. Therefore, according to the above analysis, it is predicted that the future housing price will still increase with the increase of the number of permanent residents, regional GDP, consumer price index and disposable income of residents. However, due to the impact of the epidemic, the growth rate of housing prices will decline significantly.

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