

An Empirical Analysis of the Factors Affecting Real Estate Price under the Background of Loose Monetary Policy

Based on the Statistics of Chengdu in the past 15 Years

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Abstract—Chengdu, one of the fastest growing cities in China and the world, has seen a steady rise in housing prices, but in the past year it has seen explosive growth, with prices in the main urban areas almost doubling from the end of 2016 to the end of 2018. As a new first-tier city, the fluctuation of housing price in Chengdu will also reflect the change of housing price in various provinces and cities in China to some extent. Based on the price of commercial housing in Chengdu, this paper conducts a corresponding analysis and research. The purpose is to have a more comprehensive and objective understanding of the factors affecting the housing price in Chengdu, and to provide a reference for the factors affecting the housing price in various provinces and cities across the country.

In this paper, first of all, by consulting relevant books on the impact of housing prices, reference to the research results at home and abroad, to find out the factors that affect the change in housing prices, and then select the factors that have a universal impact on housing prices, and combined with the current situation of Chengdu for analysis. Finally, this paper USES multiple linear regression to analyze the selected original variables, so as to find out the factors that influence the sharp fluctuation of housing price in Chengdu. The research in this paper can help strengthen people's understanding of the causes of housing price changes in Chengdu, so as to better make the decision to buy a house and help the government set up better policies.

Keywords—Chengdu; house price; influence factors; fluctuations

I. INTRODUCTION

A. Background

With the continuous development and growth of China's economy in recent years, the real estate industry, as a pillar industry of China's economy, has also developed rapidly and become an important part of the national economy.[1] On the one hand, whether the real estate market can continue to develop healthily is of great significance to the residents and the government. It is firstly a kind of capital crowding for other physical industries, followed by high capital cost rate and high

rate of return, which leads to a disguised rise in house prices. Finally, when house prices show an uncontrollable skyrocketing trend, there must be a bubble. Once the house price falls, it will inevitably bring about a large-scale economic loss from a series of participants. This will lead the blow to the industry economy. Therefore, the analysis of macro and micro factors affecting housing prices will help people grasp the law of housing price changes, enable consumers to have a better understanding of different housing prices, adjust their consumption allocation, and also help the government to Promulgate corresponding policies to regulate the housing prices. [2]

Looking at the trend of housing prices in Chengdu over the past decade, the price level of Chengdu has been at a steady growth level for a long time. According to the price list of real estate in Chengdu which was published by Chengdu Business Daily, from 2002 annual average real estate sales price of 1975 Yuan / square meter to 2011 in 6716.71 Yuan / square meter, per year at an average of 20% of the growth rate steadily rising. During 2015, the average price of commercial housing declined. However, in recent two years the level of house prices has broken the previous steady upward development trend and explosive rising has occurred. In 2017, housing prices in Chengdu have skyrocketed, and their average price has increased by nearly 40% in one year, while the average house price in the center of city has almost doubled. In order to pursue the reasons for this phenomenon and try to find the source of fluctuations of housing prices. This paper intends to show the factors affecting Chengdu's housing prices from macro factors (national policy, national institutional, etc.) and micro factors (demographic, income, etc.). Through the collection of data from 2002 to 2016 (in the appendix), a multivariate linear regression analysis of the trend of house prices over the years, trying to find the factors that affect the price changes through the data.

B. Significance

On the whole, housing prices are related to whether the real economy can develop steadily, affecting total GDP of Chengdu. In view of this, it is very important to find out the factors that

influence housing prices. For potential buyers of housing, the research in this paper can help them predict the trend of housing prices, decide when to buy a home and make the right investment.[3] The study of housing prices is more representative of the future development of housing prices in the Southwest. This paper analyzes through multiple linear regression models to find out the main factors affecting housing prices, so as to judge the trend of future housing prices in Chengdu to better guide policies, markets and consumption. In addition, this study also hopes to find out the problems existing in the current situation of housing prices, and propose appropriate solutions to make better suggestions for consumers, improve the happiness index of residents and provide some reference for ensuring the rapid economic development of Chengdu.

II. LITERATURE REVIEW

A. Status of Foreign Research Literature Review

The first basic theory the modern capitalist land economic theory, and the other is the Marxist land economic theory. It was proposed by well-known economists Marx and Adam Smith a hundred years ago on the development of the real estate market.

At the beginning of 1800, economists represented by former Bank of England monetary policy committee member Goodhart and American economist Frank Smets believed that the price of fixed assets such as house prices and monetary policy were mutually influential. Therefore, government authorities can adjust house prices by adjusting monetary and fiscal policies.

In 1987, economist Raudall believed that the main reason for the rise in housing prices was that inflation would lead to a gap between the psychological expectations of their wealth and their actual wealth. In 2004, economist Pavlov, Wachter studied the relationship between real estate prices and interest rates, based on bank lending is defined as a deposit-taking financial institution, all loans for the purchase of real estate and valuation method using real estate market discounting future earnings On the three assumptions of value, it is concluded that the price and interest rate of real estate are positively related.

B. Status of Domestic Research Literature Review

Domestic research on the real estate market started relatively late compared to foreign countries. The concept of the real estate market became popular in 1987, real estate market research on the development of enlightenment in the 1990s until the late 1990s, economists at the same time carried out research on the real estate market bubble.

In 1998, the economist Lin Douming pointed out that the factors affecting the development of the real estate market mainly include three categories.

In 2006, scholars Liu Chuanzhe and He Lingyun concluded that the market economic output was positively correlated with M2, while the price of commercial housing was negatively correlated with the money supply. Therefore, if the government

wants to stabilize housing prices through monetary policy, it will inevitably reduce economic output.

In summary, China's economists believe that factors affecting housing prices mainly include factors such as GDP, income level, CPI , and money supply.

III. ANALYSIS OF THE FACTORS AFFECTING CHENGDU'S HOUSING PRICES

Before analyzing various factors, this paper first analyzes the changes in Chengdu's housing price trends from 2010 to 2017, as shown in Fig. 1 and Fig. 2.

It can be seen from the trend of the fold line in Fig. 1 that Chengdu's house price was in a silence during 2010-2016, with a total increase of nearly 40%, and the monthly average increase is close to 3%, but suddenly there was a large increase in 2017.

Compared with the small fluctuations of previous years, the house prices in this year have suddenly fluctuated. In order to better analyze the reasons for the changes in housing prices in 2010-2017, we explain the housing price rise in the past decade and the surge in 2017 from the above-mentioned land factors.

A. Institutional Factors

Institutional factors will not only have long-term effects on a country's overall macro-real estate market, but institutional reforms may also cause housing price volatility in the short term.

1) *The Land Factor:* Chengdu has always been trying to reform the land system. In February 2015, national carry out rural collective construction land market, three pilot reforms of rural residential land-based system and rural land expropriation system. In September 2015, all area of Pi banners village was operating in rural collective construction land auction listing. In 2017, the village collective realized income through land acquisition.

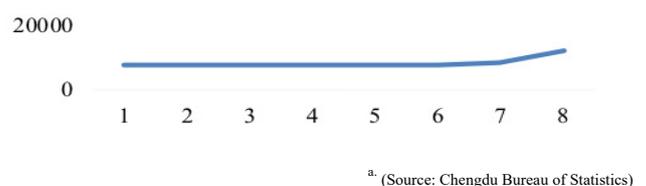


Fig. 1. Annual trends of Chengdu housing prices in 2010-2017.

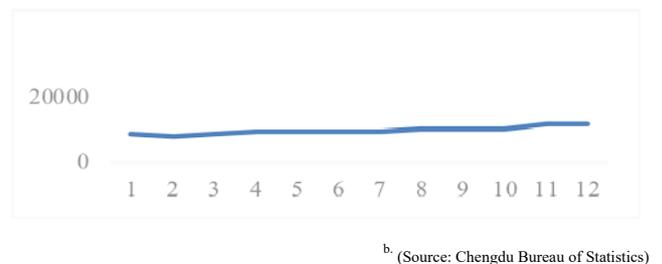


Fig. 2. Monthly trends of housing prices in Chengdu in 2017

2) *Housing System*: Before 2017, Chengdu housing in short supply, demand increased year by year, in order to meet demand “real estate development in Chengdu five-year plan” put forward in 2017. From 2017 to 2021, the city plans to build housing 160.6 million units. At the end of 2017, Chengdu had built a total of 521 million housing units, 5.01 million square meters.[4]

B. Demographic Factors

Real estate is a necessity for people's living. Therefore, the population number also determines the basic elements of the real estate economy.

Since 2015, Chengdu has successively introduced a series of talent introduction policies, talent placement policies and so on. In July 2017, the municipal government issued the “Chengdu Implementation Strategy for the Priority Development of Talents”, which is known as the talent policy with the highest gold content, the most extensive benefits, the strongest support and the most targeted talents in Chengdu over the years.

According to the data in Table I above, the population growth rate of Chengdu had increased significantly since 2014. Due to the optimization of talent policies and the retention of talents, the population of Chengdu had increased significantly and house prices had risen sharply. As a result, the increase in the number of people led to an increase in demand for housing. The increase in demand will drive house prices to grow.

C. Economic Factors

There are many economic factors, among which the main economic factors that can affect the consumer demand of the market and affect the purchasing power of the people include Per capita disposable income, money supply and CPI.

(Source: Chengdu Bureau of Statistics, 2017)

1) *Resident Income*: Income must set the level of consumption. Changes in household income directly affect the demand for commercial housing, while fluctuations in demand will cause fluctuations in the price of commercial housing price. Therefore, resident income is the main influencing factor of real estate economic activities. Fluctuations in household income affect the fluctuations in housing prices.

2) *Resident Savings*: The average family buys a house and needs to spend their savings. The amount of real estate consumption is related to national savings in the entire region. The amount of household savings in the previous period affects the housing consumption in the later period. Fluctuations in household savings will affect the residents purchasing decisions, thus affecting the demand for housing and the real estate economic development.

TABLE I. CHENGDU CITY POPULATION AND COMMERCIAL HOUSING PRICE FROM 2002 TO 2017

years	population (10 million)	Housing price (yuan/square meter)
2002	1028.48	1975
2003	1044.31	2096
2004	1059.69	2451.74
2005	1082.03	3223.95
2006	1103.4	3645.72
2007	1112.28	4276.09
2008	1124.96	4857
2009	1139.63	4925
2010	1149.07	5937
2011	1163.28	6716.71
2012	1173.35	7288.24
2013	1187.99	7197
2014	1210.74	7032
2015	1228.05	6875
2016	1398.93	7496.74
2017	1604.47	8925

^c (Source: Chengdu Bureau of Statistics, 2017)

3) *Money Supply*: Money supply affects the real estate economy in two ways. On the supply side, the real estate development and investment decide Housing estate development investment; on the demand side, the real estate consumer purchasing power determines the people's purchasing power. M2 increasing leads to a substantial increase in investment in real estate. In severe cases it can cause a speculative bubble. [5]

The money supply of Formula rise linearly. Since 2013, the increase had risen and house prices had risen. 2017 Generalized money supply Chengdu was 19,263,299.4 million, compared to last year increased by 8.2%, indicating that residents' deposits, which are a great rise, so the investment had increased.

4) *Price Level*: The price index is a basic indicator for measuring the price level. It can usually be measured by the consumer price index, which is a macroeconomic indicator that reflects the changes in the price levels of consumer goods and service items generally purchased by households. From the consumer price index, we can see the consumption level of the residents. The increase in the consumption level of the residents can drive up the demand for commercial housing and the growth of housing prices. Chengdu calendar year CPI was at relatively stable levels, due to increased income, and prices have increased, so the consumer price index remained stable. Therefore, the relationship between CPI and house prices cannot be seen through the CPI data.

D. Other Factors

1) *Housing Construction and Completion of The Area*: There are three indicators in producing process for real estate: housing construction area, housing completion area and land

transfer area. They all affect housing prices from the supply side. As shown in Table II and Fig .3

TABLE II. 2002 - 2017 OF CHENGDU'S HOUSING CONSTRUCTION AND COMPLETION OF THE AREA

years	Construction area (10,000 square meters)	Completed housing area (10,000 square meters)	Commercial housing price (yuan / square meter)
2002	4802	2472	1 975
2003	5879.8	2979.2	2096
2004	6015.4	3138	2451.74
2005	7141.6	2992.4	3,223.95
2006	10447.6	2627.9	3645.72
2007	10283.3	3333.2	4276.09
2008	10994.5	2445.7	4857
2009	11295	3472	4925
2010	12619	7151	5937
2011	15816	4617	6716.71
2012	17501.8	4869.3	7288.24
2013	23757.3	5670.7	7197
2014	22463	5871	7032
2015	23852.5	5985.5	6875
2016	23327.4	6242.7	7496.74
2017	25294.7	5837.9	8925



Fig. 3. 2002-2016 of real estate development enterprises completed housing area.

IV. ESTABLISH AND ECONOMETRIC ANALYSIS

This paper selects the data from 2002 to 2017, including the annual resident population of Chengdu, the real estate development investment in Chengdu and the consumer price index of Chengdu residents were analyzed which were affecting Chengdu's housing prices, etc.[6]

A. Variable Selection and Model

Logarithmic modeling and regression analysis

Set a multiple linear regression model:

Interpreted variable (dependent variable):

Y—the logarithm of the average selling price of the commercial house,

Interpret variables (independent variables):

X2—the logarithm of M2

X3—the logarithm of the construction area of real estate enterprises

X4—the logarithm of the area of completed real estate enterprises

X5—the logarithm of sales of commercial housing

X6—the logarithm of per capita disposable income of urban residents

X7—the logarithm of the population,

X8—the logarithm of real estate development investment

X9—the logarithm of the total consumer price index.

Data: Chengdu 2002-2017 data for the period n- = 16

B. OLS Regression Results

The results of the model estimation are:

$$\hat{Y}_t = 85.11845 + 1.530285X_{2t} + 0.822784X_{3t} - 0.006639X_{4t} - 0.358694X_{5t} - 0.106007X_{6t} - 14.00152X_{7t} + 1.388187X_{8t} - 3.323488X_{9t}$$

C. Analysis of Results

The model $R^2 = 0.99730$ $\bar{R}^2 = 0.993701$ can show a higher coefficient, F test value is 277.0645, significantly significant. However, when $\alpha = 0.05$ and $t_{0.05}(n-k) = 3.143$, X4, X5, X6, X9 coefficient t test was not significant, the model may multicollinearity.

The correlation coefficient matrix is the correlation between the explanatory variables. By correlation coefficient matrix can be seen M2 has high positive correlations between commercial sales, the city town residents' per capita disposable income and real estate development investment. The correlation coefficients of the explanatory variables are relatively high, confirming the existence of severe multicollinearity. As shown in Table III and Table IV

TABLE III. THE CORRELATION COEFFICIENT MATRIX TABLE:

	X2	X3	X4	X5	X6	X7	X8	X9
X2	1.0000000	0.7114310	0.4783280	0.9599950	0.9979400	0.9124950	0.9812650	0.1419730
X3	0.7114311	1.0000000	0.8854610	0.6899580	0.7262370	0.3716020	0.7273180	0.1198490
X4	0.4783280	0.8854611	1.0000000	0.5002330	0.4983610	0.1123050	0.4968670	0.0085420
X5	0.9599950	0.6899580	0.5002331	1.0000000	0.9568900	0.8615000	0.9853410	0.2366460
X6	0.9979400	0.7262370	0.4983610	0.9568901	1.0000000	0.9032660	0.9807240	0.1295180
X7	0.9124950	0.3716020	0.1123050	0.8615000	0.9032661	1.0000000	0.8793850	0.0708870
X8	0.9812650	0.7273180	0.4968670	0.9853410	0.9807240	0.8793851	1.0000000	0.2412040
X9	0.1419730	0.1198490	0.0085420	0.2366460	0.1295180	0.0708870	0.2412041	1.0000000

TABLE IV. VARIANCE EXPANSION FACTOR TABLE

Variance Inflation Factors			
Date: 12/24/18 Time: 12:08			
Sample: 2002 2017			
Included observations: 16			
Variable	Coefficient variance	Uncentered VIF	Centered VIF
C	482.1627	5147924.	NA
X2	0.215869	567174.5	1107.212
X3	0.041724	35903.11	236.6847
X4	0.007955	4459.547	10.86241
X5	0.021676	10,902.38	212.3981
X6	0.155317	160369.4	363.3050
X7	12.07859	6396101.	705.6386
X8	0.084723	42962.09	630.8374
X9	1.971720	451618.4	7.457737

The VIF of X2 , X3 , X4 , X5 , X6 , X7 and X8 is much larger than 10 , indicating a serious multicollinearity problem.

In order to solve the multi-collinearity problem, the stepwise regression method is adopted, and the variables are introduced into the model one by one, and the t-test is performed. When the variables introduced later make the previously introduced variables no longer significant, the previously introduced variables can be deleted to solve the multiple collinearity problems.

Respectively, for Y on X2 , X3 , X4 , X5 , X6 , X7 , X8 , X9 one yuan regression.

On the one hand the equation $\bar{R}^2 = 0.979605$ of X8 is the largest, on the other hand t-test and f-test of X8 is significant. Based on it sequential add other variables stepwise regression. As shown in Table V

TABLE V. ONE VARIABLE REGRESSION RESULTS:

variable	X2	X3	X4	X5	X6	X7	X8	X9
Parameter	0.63	-	-	0.47	0.93	5.19	0.54	7.15
t-statistic	12.8	-	-	21.0	12.7	5.60	25.9	1.11
Prob	6	3.89	2.25	9	3	5	5	1.11
	0.92	0.53	0.27	0.97	0.92	0.70	0.98	0.08
	7142	789	950	159	570	723	106	707
	0.92	0.50	0.22	0.96	0.91	0.68	0.97	0.01
	1538	234	407	940	998	471	960	684

Add X7 corrected coefficient of determination to improve the most obvious, $t_{0.025}(n-k) = t_{0.025}(11) = 2.201$ and then add other new variable regression.

Add to the X3 equation $\bar{R}^2 = 0.985147$ which is the biggest improvement. Retain X3 and then join other new variables to gradually return.

Adding regression results of new variables (3)

Add to the X2 equation $\bar{R}^2 = 0.991836$ which is the biggest improvement, furthermore the result of t-test is $t_{0.025}(n-k) = t_{0.025}(9) = 2.262$. Retain X2 and then joins other new variables to gradually return.

The \bar{R} fall after adding X4 and t-test of X4 $t_{0.025}(n-k) = t_{0.025}(8) = 2.306$ is not significant. The results of X5, X6 and X9 are same as X4. It can also be seen from the correlation coefficient that X4, X5, X6, and X9 are highly correlated with other variables, which indicates that X4, X5, X6, and X9 cause severe multicollinearity and should be eliminated.

Correct the model after severe multicollinearity effects. As shown in Table VI

TABLE VI. VARIANCE EXPANSION FACTOR TABLE

Dependent Variable: Y
Method: Least Squares
Date: 12/24/18 Time: 13:02
Sample: 2002 2017
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	32.45858	6.144949	5.282157	0.0004
X2	0.668003	0.211113	3.164204	0.0101
X3	0.323568	0.082865	3.904758	0.0029
X7	5.956151	1.398846	4.257904	0.0017
X8	0.666468	0.070146	9.501207	0.0000
R-squared	0.994169	Mean dependent var	5	8.43761
Adjusted R-squared	0.991836	SD dependent var	4	0.47226
SE of regression	0.042671	Akaike info criterion	4	3.20938
Sum squared resid	0.018208	Schwarz criterion	7	2.97336
Log likelihood	29.07038	Hannan-Quinn criterion	8	3.21189
F-statistic	426.2146	Durbin-Watson stat	0	2.56601
Prob (F-statistic)	0.000000			

At this point, the model estimates are:

$$Y_t = 32.45858 + 0.668003X_{2t} + 0.323568X_{3t} + 5.956151X_{7t} + 0.666468X_{8t}$$

Heteroskedasticity Test: White

The result as shown in Table VII

TABLE VII. HETEROSKEDASTICITY TEST

F-statistic	2.084100	Prob.F(10,4)	0.2497
Obs*R-squared	12.58464	Prob.Chi-square(10)	0.2478
Scaled explained SS	4.414812	Prob.Chi-Square(10)	0.9267

Test Equation

Dependent Variable: RESID^2

The result as shown in Table VIII

TABLE VIII. DEPENDENT VAIRABLE TEST

Variabl e	Coefficie nt	Std.Erro r	t-Statistic	Prob.
C	5.530196	5.317531	1.039993	0.3571

$$R^2 = 0.994169 \quad \bar{R}^2 = 0.991836$$

$$F = 426.2146 \quad DW = 2.566010$$

Test heteroscedasticity (White test) As

$$nR^2 = 12.58464$$

It can be seen from the auxiliary regression has a total of 15 explanatory variables, so the degree of freedom is 15, the given significance level is 0.05 and the checkpoint distribution table has a critical value is 23.6848. No reject the null hypothesis because

$$nR^2 < 23.6848$$

of .Indicating the model is the same variance. Therefore, the final model estimate of the standard is as follows:

$$Y_t = 32.45858 + 0.668003X_{2t} + 0.323568X_{3t} + 5.956151X_{7t} + 0.666468X_{8t}$$

D. Measurement Analysis Conclusion

Due to, Chengdu's M2 , real estate development enterprise construction housing area, population and real estate development investment amount are important factors affecting Chengdu's housing prices from 2002 to 2017 . The regression results of this paper found that each of the above variables rose by 1 % , and house prices would rise by 0.67%, 0.42%, 5.96%, and 0.67% respectively.

V. CONCLUSIONS

A. Summary

The data selected in this paper is the average price of commercial housing in Chengdu as the basic data. The Eviews analysis is carried out on the relevant data from 2002 to 2017. The multivariate linear regression model is used to analyze the housing prices and various possible influencing factors.

First, there are many factors affecting the price of commercial housing in Chengdu, mainly including factors such as money supply, housing construction area and completed area, urban population and real estate development investment.

Second, these factors have an impact on the fluctuation of housing prices. From the supply level, the construction and completion area of houses have increased year by year in more than ten years. This indicates that the supply of housing has increased which has broken the supply and demand relationship of existing houses and affected housing prices.

The supply of money is also increasing year by year, resulting in a substantial increase in real estate investment, strong demand for residents, and active trading. From the demand level, the increasing population of Chengdu led to the increase the demand for housing. At the same time, Chengdu's economic growth has increased people's disposable income, people have more savings and more idle funds to invest. Fixed asset investment is a better choice, like real estate. Therefore, the increase in the number of people and the increase in disposable income will affect the changes in real estate prices.

B. Policy Recommendations

1) Government Level

a) Controlling the Money Supply.

Since the money supply also has a regulating effect on housing prices, the state should also take into account the impact on house prices when formulating monetary policy. by controlling the amount of money supply, the goal of controlling house prices is achieved.

b) Adjusting the Land Policy.

Innovations in land system reform will increase the use of land, thereby increasing the supply of land, resulting in an increase in the supply of commercial housing. Reasonable land reform can regulate housing prices.

c) Reasonable Formulation of Talent Policy.

Chengdu government authorities can formulate a reasonable talent policy, in the housing prices continue to rise during the introduction of preferential talent policy, increase demand to increase housing prices, in the housing price downturn to stop the preferential policy of talent, stable housing prices, so that the real estate market formed a virtuous circle.

d) Real Estate Real estate Developers' Level

They should according to the trend of housing prices, develop reasonable housing prices and marketing strategies, reasonable real estate investment, so that they are more adapted to the market. Better than the competitor in price. At the same

time, real estate developers can seize the opportunity to fully analyze and measure their investment after adjustment, whether to increase real estate investment.

At the same time, in accordance with national policies to complete the corresponding commercial housing completed area, control the supply of commercial housing.

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