Influencing Factors of Commodity Housing Prices in China: An Empirical Analysis Based on Eviews Multiple Linear Regression Model

Jiancheng Liu(✉)

Beijing Jiaotong University Public Administration Haidian, Beijing, China
1976608888@qq.com

Abstract. Real estate is one of the main industries in the development of the national economy, and the housing price problem that the people are concerned about is not only an economic problem, but also an important livelihood problem that affects social stability [3]. There are many influencing factors of commercial housing prices, this paper selects relevant data for research from the perspective of economic factors, uses EVIEWS software to analyze and test the economic influencing factors of commercial housing prices, and finally establishes a suitable multiple linear regression model. Through empirical analysis, it is found that the price level of commercial housing has a strong positive correlation with the consumer price index, the narrow money supply, and the real GDP per capita. On the basis of empirical research, relevant policy recommendations are proposed.

Keywords: Commercial Housing · Sales Price · Influencing Factors

1 Introduction

Since 2016, China has proposed the positioning of "houses are used to live, not to speculate", and in 2017, it proposed to "curb the excessive rise in housing prices in hot cities" [2]. Therefore, under the current domestic situation, the future development direction of the commercial housing market is a matter of concern to everyone. Compared with foreign countries, China's research on the influencing factors of commercial housing prices started relatively late and developed rapidly in the past decade [1]. The research of Chinese scholars on the influencing factors of commercial housing prices mainly summarizes many factors from the two aspects of supply and demand, and the scope is mainly from the three aspects of consumer demand and supply of commercial housing market, policy and macro-economy. However, most of them are limited to static and qualitative research, and quantitative research is insufficient [4]. In this paper, the relatively representative housing prices in Hebei Province are selected as the research objects, combined with EVIEWS software for quantitative analysis, and on the basis of the previous research, the influencing factors of commercial housing prices are deeply analyzed by establishing a measurement model.

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2 Materials and Methods

2.1 Sources of Data

The data in this study are from the Statistical Yearbook of Hebei Province and the Statistical Yearbook of China in the relevant years, and the relevant data of various variables from 1997 to 2018 are selected. Among them, Y is the sales price of commercial housing (yuan/square meter); X1 is the consumer price index; X2 is the narrow sense of money supply (100 million yuan); X3 is the actual average GDP per capita (yuan); X4 is the per capita disposable income of urban residents (yuan).

2.2 Variable Selection

Real estate is one of the main industries in the development of the national economy, its influencing factors are more, this paper only from the economic point of view to study, select the following four main influencing factors for quantitative analysis:(1) consumer price index; (2) narrow money supply; (3) per capita real GDP; (4) per capita disposable income of urban residents.

2.3 Data Descriptive Statistics

The statistical results of the survey sample show that the minimum sales price of commercial housing in Hebei Province from 1997 to 2018 was 995.0 yuan/square meter, and the maximum value was 6237.0 yuan/square meter, and the average value was 3007.773 yuan/square meter The minimum value of the consumer price index is 238.1, the maximum value is 594.8, the average is 451.564 yuan; the minimum value of the narrow money supply is 1173.15 billion yuan, the maximum value is 33729.11 billion yuan, the average is 11639.1732 billion yuan; the minimum value of the per capita real GDP is 808.84 yuan, the maximum value is 5155.09 yuan, the average is 2412.3914 yuan; the minimum value of the per capita disposable income of urban residents is 2016.6 yuan, the maximum value is 26955.1 yuan, and the average is 10628.659 yuan.

2.4 Model Building

The EVIEWS software is used to make scatter plots of the explanatory variables Y and explanatory variables X1, X2, X3, and X4, respectively, see Figs. 1, 2, 3 and 4. As can be seen from the scatter chart, the influencing factors X1, X2, X3 and X4 increase with the rise of commercial housing prices Y, and are approximately linear.

In order to analyze the impact of the selected factors on the price of commercial housing, we consider establishing a multivariate linear regression equation. Assuming that the model and its random perturbation term UI satisfies the classical assumptions, the OLS method is used to estimate the parameters, and the EVIEWS software is used to estimate the model parameters, and the regression results are shown in Table 1.

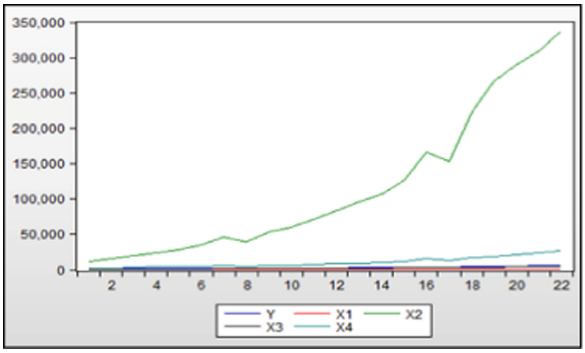

Fig. 1. Data graph of commercial housing prices and influencing factors. (author self-drawn)

Table 1. Multiple linear regression results.(author self-drawn)

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	42.97580	236.9843	0.181345	0.8582
X1	2.291318	0.764515	2.997087	0.0081
X2	0.007705	0.002782	2.769726	0.0131
X3	0.472295	0.241712	1.953960	0.0674
X4	−0.009978	0.053031	−0.188159	0.8530
R-squared	0.995048	Mean dependent var		3007.773
Adjusted R-squared	0.993883	S.D.dependent var		1550.575
S.E.of regression	121.2735	Akaike info criterion		12.63069
Sum squared resid	250023.3	Schwarz criterion		12.87865
Log likelihood	−133.9376	Hannan-Quinn criter.		12.68910
F-statistic	853.9994	Durbin-Watson stat		1.714042
Prob(F-statistic)	0.000000			

From the data in Table 1, the results estimated by the original model are written as:

$$\hat{Y} = 42.9758 + 2.2913X1 + 0.0077X2 + 0.4723X3 - 0.0099X4$$
$$(236.9843)\quad (0.7645)\quad (0.0028)\quad (0.2417)\quad (0.0530)$$
$$t = \quad (0.8582)\quad (0.0081)\quad (0.0131)\quad (0.0674)\quad (0.8530)$$

$$R^2 = 0.995408 \quad \overline{R}^2 = 0.993883$$

$$F = 843.9994 \quad DW = 1.7714042$$

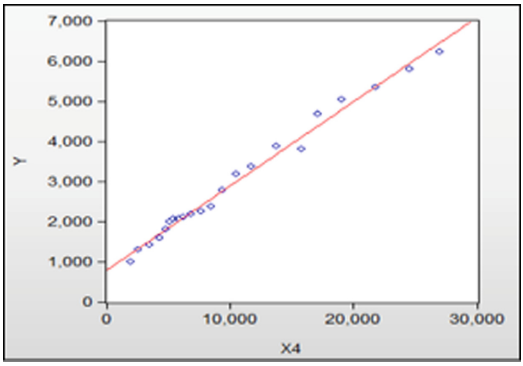

Fig. 2. Scatter plot of X4 and Y. (author self-drawn)

3 Testing and Adjustment of Results

3.1 Statistical Tests

3.1.1 T-Test

For $H_0 : \beta_j = 0(j = 0, 1, 2, 3, 4)$ given the significance level $\alpha = 0.05$, the degree of freedom of the t distribution table is the critical value of n−k = 17, $t_{0.025} = 2.11$. From the data in Table 1, it can be obtained that the absolute value of $\overline{\beta}_1$, $\overline{\beta}_2$ is greater than $t_{0.025} = 2.11$, which means that at the significant level $\alpha = 0.05$, $\overline{\beta}_1$, $\overline{\beta}_2$ can reject $H_0 : \beta_j = 0(j = 1, 2)$. From the scatter plot of X4 and Y, it can be seen that the two are positively correlated, indicating that the model may have problems such as multicollinearity and autocorrelation.

3.1.2 Goodness of Fit

Table 3 knows: This shows that the model fits the sample very well. . $R^2 = 0.995408$ $\overline{R}^2 = 0.993883$

3.1.3 F-Test

For, given the significance level, the critical values of k−1 = 4 and n−k = 17 were found in the F distribution table, which were obtained from Table 3, and the null hypothesis should be rejected, indicating that the regression equation is significant, that is, the explanatory variables included in the model "consumer price index (X1), narrow $H0 : \beta1 = \beta2 = \beta3 = \beta4 = 0\alpha = 0.05F_{0.05}(4, 17) = 2.96F = 843.994 > F_{0.05}(4, 17) = 2.96H0 : \beta1 = \beta2 = \beta3 = \beta4 = 0$ money supply (X2), real average GDP per capita (X3), per capita disposable income (X4) "combined to indeed be interpreted variable" The sales price of commercial housing (Y)" There are significant implications.

Table 2. Adjusted multiple regression results.(author self-drawn)

Dependent Variable:Y Method:Least Squares Date:06/27/19 Time:02:55 Sample:1 22 Included observations:22				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	61.58176	209.5181	0.293921	0.7722
X3	0.445071	0.188365	2.362814	0.0296
X1	2.240544	0.695879	3.219732	0.0048
X2	0.007395	0.002181	3.390164	0.0033
R-squared	0.995038	Mean dependent var		3007.773
Adjusted R-squared	0.994211	S.D.dependent var		1550.575
S.E.of regression	117.9793	Akaike info criterion		12.54186
Sum squared resid	250544.0	Schwarz criterion		12.74023
Log likelihood	−133.9605	Hannan-Quinn criter.		12.58859
F-statistic	1203.128	Durbin-Watson stat		1.724958
Prob(F-statistic)	0.000000			

3.2 Testing and Tuning of Multicollinearity

3.2.1 Variance Amplification Factor Test

First of all, the correlation coefficient test is carried out, and the correlation coefficient between the variables is high, so there may be a serious multicollinearity problem. In order to further determine the properties of multicollinearity, the variance amplification factor test is performed, the results show that the coefficient of determination of the auxiliary regression of X2, X3, X4 is very high, experience shows that when the variance enlargement factor VIF $\geq$ 10, there is usually a serious multicollinearity between the explanatory variable and the rest of the explanatory variables, where the variance amplification factor of X4 is much greater than 10, indicating that there is a serious multicollinearity problem.

3.2.2 Remedies for Multicollinearity-Stepwise Regression Analysis

First, the least squares method is used to make the explanatory variable Y perform univariate linear regression on the explanatory variables X1, X2, X3, and X4, respectively. As can be seen from the results of univariate linear regression, the corrected coefficient of determination of the equation is the largest when X3 is added, so based on X3, other variables are added sequentially to gradually regress. After a comprehensive comparison of various aspects of each new variable model, the model with the greatest improvement and without affecting the significance of the original variable is retained, and the final result is shown in Table 2 $\overline{R}^2$. For this model, X4 makes neither the t-value nor the

P-value conform, so the X4 variable is excluded. The final commodity price function should be Y = f(X1, X2, X3) as optimal, and the fitting result is as follows:

$$\hat{Y} = 61.5818 + 2.2405\text{X1} + 0.0074\text{X2} + 0.4451\text{X3}$$
$$(209.5181)\ (0.6959)(0.0022)(0.1884)$$
$$\text{t} = \ (0.2939)(3.2197)(3.3902)(203628)$$

$$\text{R}^2 = 0.995038\ \overline{R}^2 = 0.994211$$

$$\text{F} = 1203.128\ \text{DW} = 1.724958$$

3.3 Heteroscedasticity Test

3.3.1 Residual Plot Test Method

Although the random error term cannot be observed, the residuals of the sample regression reflect some of the distribution characteristics of the random errors to some extent, and the heteroscedastic difference can be observed through the graph of the residuals. As can be seen from Fig. 3, the scatter plot of the residual square pair explanatory variables is mainly distributed in the lower triangle part of the graph, which roughly shows the trend of the residual square changing with the change. Therefore, it is likely that the model has heteroscedasticity. However, whether there is indeed heteroscedasticity should be tested further $e_i^2 X_i e_i^2 X_i$.

3.3.2 White Inspection

The Returning Model is tested for heteroscedasticity using the White test method, and the obtained test results are shown in Table 3. As can be seen from the data in the table, as known by the White test, in the next, look up the distribution table, get the critical value, compare the calculated statistic with the critical value, because $\text{nR}^2 = 9.728025$, $\alpha = 0.05$, $x^2_{0.05}(9) = 16.919$, $x^2_{0.025}(9) > nR^2$, and the probability is greater than 0.05, the null hypothesis is not rejected, the alternative hypothesis is rejected, indicating that the model does not have a heteroscedasticity problem.

3.4 Autocorrelation Test

3.4.1 BG Inspection (LM Inspection)

In the output result of EVIEWS regression, select hysteresis order 2, and the BG test results are shown in Table 4. As can be seen from the table, $\text{LM} = \text{TR}^2 = 22{*}0.181911 = 4.002042$, $\text{P} = 0.1352$, check the distribution table x^2, in the next $\alpha = 0.05$, $\chi^2_{0.05}(2) = 5.99147$, $\text{LM} < \chi^2_{0.05}(2)$ and the P value is much greater than 0.05, accepting the null hypothesis, indicating that the model does not have autocorrelation and does not need to be corrected.

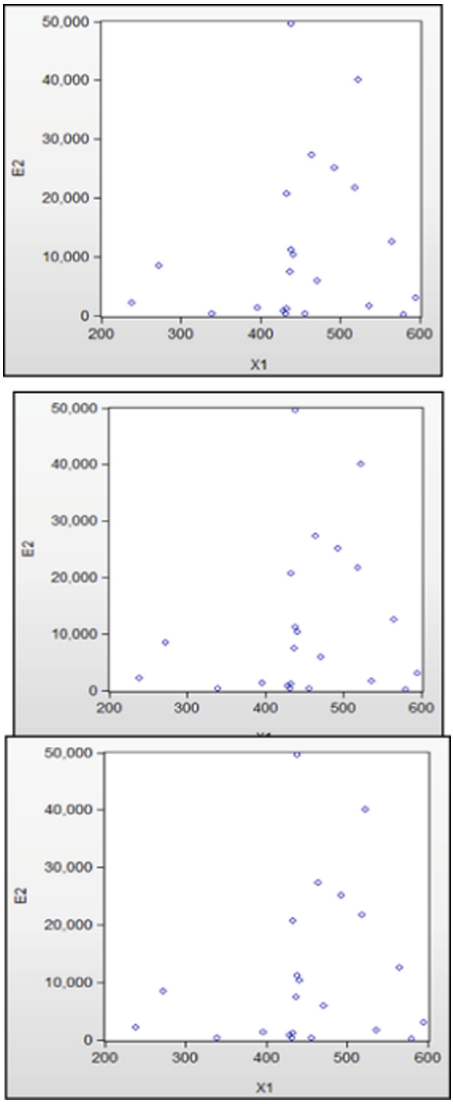

Fig. 3. e_i^2 Scatter plot X_i. (author self-drawn).

4 Results and Discussion

In this paper, the optimal model is obtained by constructing a multivariate linear regression model, then performing the economic significance test and statistical test respectively, and then performing the multicollinear, heteroscedastic difference and autocorrelation tests and adjusting the model. In summary, it can be seen that the final model

Table 3. White test results.(author self-drawn)

Heteroskedasticity Test White			
F-statistic	1.056937	Prob.F(9,12)	0.4535
Obs'R-squared	9.728025	Prob.Chi-Square(9)	0.3729
Scaled explained SS	4.612614	Prob.Chi-Square(9)	0.8667

Test Equation:
Dependent Variable:RESID^2
Method:Least Squares
Date:06/27/19 Time:03:05
Sample:122
Included observations:22

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	56650.43	424226.0	0.133538	0.8960
X1^2	−0.946647	3.728216	−0.253914	0.8039
X1*X2	−0.003333	0.043334	−0.076921	0.9400
X1*X3	0.611122	3.357092	0.182039	0.8586
X1	91.18797	1226.469	0.074350	0.9420
X2^2	−1.11E−05	2.82E−05	−0.391828	0.7021
X2*X3	0.001484	0.005495	0.270109	0.7917
X2	0.589649	12.93572	0.045583	0.9644
X3^2	−0.069818	0.272035	−0.256650	0.8018
X3	−126.2463	891.3063	−0.141642	0.8897
R-squared	0.442183	Mean dependent var		11388.36
Adjusted R-squared	0.023820	S.D.dependent var		13873.61
S.E.of regression	13707.38	Akaike info crterion		22.19221
Sum squared resid	2.25E + 09	Schwarz criterion		22.68814
Log likelihood	−234.1143	Hannan-Quinn criter.		22.30904
F-statistic	1.056937	Durbin-Watson stat		2.842318
Prob(F-statistic)	0.453481			

established is:

$$\hat{Y} = 61.5818 + 2.2405\text{X1} + 0.0074\text{X2} + 0.4451\text{X3}$$
$$(209.5181)(0.6959)(0.0022)(0.1884)$$
$$\text{t} = (0.2939)(3.2197)(3.3902)(203628)$$

$$\text{R}^2 = 0.995038\ \overline{R}^2 == 0.994211\ \text{F} = 1203.128\ \text{DW} = 1.724958$$

Table 4. White test results(author self-drawn)

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.77892	Prob.F(2.16)	0.2006
Obs·R-squared	4.002051	Prob.Chi-Square(2)	0.1352

Test Equation:
Dependent Variable:RESID
Method:Least Squares
Date:06/27/19 Time:03:32
Sample:122
Included observations:22
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	−22.61253	201.3654	−0.112296	0.9120
X1	0.093151	0.672004	0.138617	0.8915
X2	8.79E−05	0.002117	0.041529	0.9674
X3	−0.012599	0.182898	−0.068883	0.9459
RESID(−1)	0.180200	0.231322	0.779001	0.4473
RESID(−2)	−0.414417	0.230570	−1.797354	0.0912
R-squared	0.181911	Mean dependent var		1.14E−13
Adjusted R-squared	−0.073741	S.D.dependent var		109.2276
S.E.of regression	113.1833	Akaike info criterion		12.52289
Sum squared resid	204967.2	Schwarz criterion		12.82045
Loglikelihood	−131.7518	Hannan-Quinn criter.		12.59299
F-statistic	0.711557	Durbin-Watson stat		1.937418
Prob(F-statistic)	0.623594			

5 Conclusions and Recommendations

Consumer price index (CPI), M1 and per capita real GDP have significant effects on commercial housing prices in Hebei Province. CPI is the main indicator for the central bank to determine the change of interest, and interest will affect the price of real estate, so CPI has an indirect impact on house prices; The increase of M1 supply promotes investment in the real estate market through the wealth effect of residents, thus affecting house prices; The per capita real GDP reflects the level of economic development and has a direct impact on house prices. When the per capita real GDP is higher, it will stimulate the rise of house prices. Therefore, based on the results in this paper, the following recommendations are made: First of all, the government should guide the reasonable expectations of housing consumers on housing prices and promote the rational development of the real estate market. Avoid the surge in real estate prices caused by real

estate flipping and false bubbles in the real estate industry. Secondly, the government should improve the real estate information disclosure system, strengthen the monitoring of real estate information disclosure, so that consumers can accurately and timely understand the real information of the real estate industry, and ensure the rights and interests of consumers. Finally, the government should strengthen the macro-control of the real estate market. Relevant management departments should fully learn from the advanced management concepts of other countries and focus on the macro-control of the real estate market.

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