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Discussion on the Influencing Factors of Housing Prices in Shandong Province

-- Based on Multiple Regression Model

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Abstract

Aiming at the influencing factors of commercial housing prices in Anhui, based on the relevant data of the 2000~2020 Shandong Statistical Yearbook, three explanatory variables of actual GDP, actual per capita disposable income of urban residents and total population were selected, and a multiple linear regression model was established by Eviews software, and econometric test methods such as multicollinearity, heteroscedasticity and autocorrelation were tested and the model was modified. The results show that the per capita disposable income and total number of urban residents have a positive impact on the price of commercial housing in Shandong Province. Based on the research conclusions, it is proposed to provide a reference for the stable development of the commercial real estate industry in Shandong Province.

Keywords

Commodity Housing Prices; Real GDP; Actual Disposable Income of Urban Residents; Population; Multiple Regression.

1. Research Background

The Report on the Work of the Government 2020 pointed out that we should ensure people's housing needs. As a pillar industry of China's national economy, the real estate industry is one of the driving forces of China's economic growth in the future [1]. It opens up a new road for China's economic growth and has a great impact on promoting economic growth, urbanization construction and residents' consumption level. However, while the real estate industry is driving the rapid development of the national economy, the soaring housing price has had a wide and profound impact on the sustainable development of our economy and the basic life of the residents.

How to scientifically understand the commercial housing market, introduce relevant policies to control the stable development of the commodity housing price, the life of Shandong residents, investment in the overheated commercial housing market in Shandong Province, the excessive increase will hinder the development of local economy, lead to a series of negative effects that can affect social stability, affect the high living standards of residents, has become a hot topic of public concern. The price of commercial housing is regulated by the national economic policies, the market and other factors. However, due to the short supply of commercial housing market and the rising expectation of people for fixed asset investment, the rapid rise of housing price, especially in the first and second tier cities with good development, the housing price has

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increased dramatically in decades. In the absence of strong regulation and control of the unhealthy and bad commercial housing investment market, it will seriously affect people's expectations of the society and the degree of happiness in life, which is of great significance.

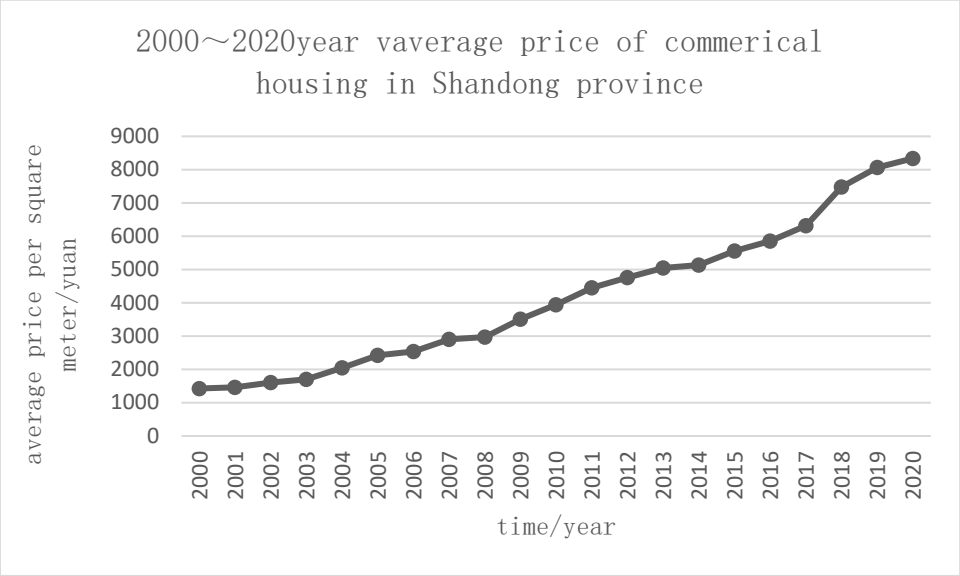

Figure 1. Average price of commercial housing in Shandong Province

2. Data Collection and Influencing Factors of Commercial Housing Prices

2.1. Data Collection

Table 1. Average price of commercial housing and its influencing factors in Anhui Province from 2000 to 2019

time	average selling price of commercial housingY/yuan	realGDPX1/100 million yuan	real disposable incomeX2/100 million yuan	total populationX3/ ten thousand people
2000	1427	82.61536926	64.04191617	8997
2001	1457	89.15736739	68.71316306	9041
2002	1605	101.4755287	75.25679758	9082
2003	1698	107.8459941	81.22650841	9125
2004	2045.29	128.4563707	88.71621622	9180
2005	2425.22	156.8093412	102.4778761	9248
2006	2540.5	187.8	116.6336634	9309
2007	2904.14	217.6059387	131.4750958	9367
2008	2970	257.4189934	148.4140551	9417
2009	3505	295.408	170.06	9470
2010	3944	329.6646259	184.3634597	9579
2011	4447.73	372.0469524	206.4571429	9665
2012	4763.01	420.7376102	239.9216454	9708
2013	5049	463.2517613	263.0332681	9746
2014	5135	498.2810599	286.7713445	9808
2015	5560	546.331917	311.7094862	9866
2016	5855	575.5382958	333.1243879	9973
2017	6319	620.808867	362.453202	10033
2018	7481	650.232878	385.8439024	10077
2019	8070	683.5317829	410.1647287	10106
2020	8338	711.3715953	425.3501946	10165

Data source: Statistical Yearbook of Shandong Province 2000-2020

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There are many factors affecting the average price of commercial housing. Through the data search of the statistical yearbook of Shandong Province from 2000 to 2020, five related data are collected, including the average price of commercial housing in Shandong Province, the gross domestic product of Shandong Province, the per capita disposable income of urban residents, the total population of Shandong Province and the general index of residential sales price. Through analysis, it is found that it is necessary to convert the GDP and disposable income of urban residents of Shandong Province into actual data, that is, real GDP = GDP/CPI, and real disposable income = disposable income of urban residents/CPI. The collected data are shown in Table 1[2] after corresponding processing.

2.2. Influencing Factors of Commercial Housing Price

(1) Gross Domestic Product of Shandong Province

Housing price is a component of GDP, and the housing price is centered on GDP. The increase of GDP can reflect the improvement of people's living standards to a certain extent, and then the demand for real estate will increase and the average price of commercial housing will rise.

(2) Disposable income of urban residents

The level of demand depends directly on the income level of consumers. As a commodity, commercial housing is also significantly affected by income. The increase of per capita disposable income increases people's ability to pay and consume, which promotes the increase of investment demand or housing demand, leading to the rise of the average price of commercial housing (as shown in Figure 2).

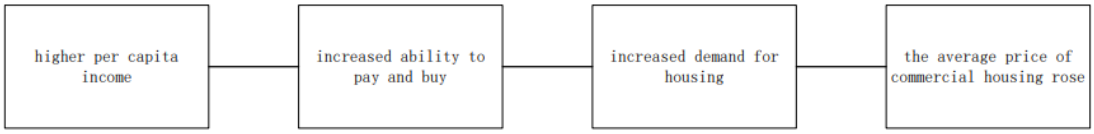

Figure 2. The influence logic of per capita disposable income of urban residents on commodity housing prices

(3) Total population

Population density is the driving force behind housing prices. The increase of urban population will bring a large rigid housing demand, which will have a significant impact on the commercial housing market. The increase of urban population is a direct factor affecting the demand for commercial housing. In more developed cities, where education and medical resources are abundant, people tend to move there, which will greatly increase the demand for housing [3]. Therefore, resident population is an important factor affecting the housing price (as shown in Figure 3).

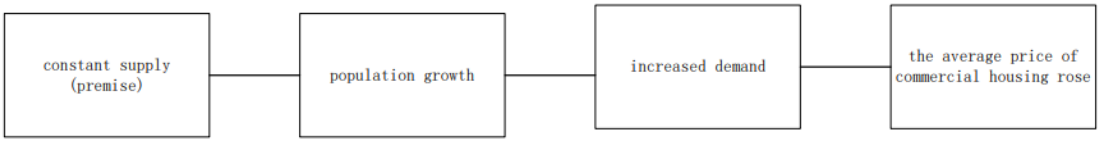

Figure 3. The effect of population on the price of commercial housing

(4) Consumer Price Index of Shandong Province

The level of regional economic development is reflected by the consumer price index, and the consumption level and ability of residents will also affect the price of commercial housing (as shown in Figure 4). Therefore, CPI is chosen as the base and the first two are converted into real GDP and real per capita disposable income of urban residents.

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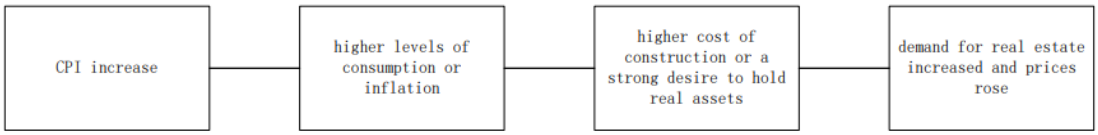

Figure 4. Logical relationship between CPI and housing price

3. Research Theory and Statistical Empirical Analysis

3.1. Model Construction

In general, when an economic variable is affected by multiple factors, multiple linear regression models are commonly used to analyze socio-economic phenomena [3]. According to the actual situation, the average price of commercial housing in Shandong Province (Yt) was selected as the explained variable, the actual GDP(X1t), the per capita disposable income of urban residents (X2t) and the total population (X3t) were selected as the explanatory variable, and other factors were set as the random disturbance term μ. The time was t. Based on the above analysis, a multiple regression model (1) is preliminarily established:

$$Yt=c+\beta 1X1t+\beta 2X2t+\beta 3X3t+\mu \quad (1)$$

Input the data in Table 1 into Eviews for parameter estimation, model test and correction [4].

3.2. Statistical Empirical Analysis

Put the processed data into the multivariate linear regression model established above, and use the least square method to perform OLS regression estimation on the data in Table 1. The results are shown in Table 2.

Table 2. Parameter estimation results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-36494.75	16871.47	-2.163105	0.0451
X1	-15.32343	7.408884	-2.068251	0.0542
X2	32.18951	8.713824	3.694074	0.0018
X3	4.107025	1.880100	2.184471	0.0432

R-squared	0.987974	Mean dependent var	4168.519
Adjusted R-squared	0.985852	S.D. dependent var	2195.349
S.E. of regression	261.1309	Akaike info criterion	14.13756
Sum squared resid	1159219.	Schwarz criterion	14.33652
Log likelihood	-144.4444	Hannan-Quinn criter.	14.18074
F-statistic	465.5268	Durbin-Watson stat	0.918221
Prob(F-statistic)	0.000000		

Based on the data in Table 2, the linear regression equation between the average price of commercial housing and its influencing factors can be preliminarily obtained:

Y=-36494.7481776-15.323430076X1t+32.189507266X2t+4.10702457178X3t

t=(-2.1631) (-2.0683) (3.6941) (2.1845)

R2=0.9880, F=465.5268, DW=0.9182

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4. Test and Correction of the Model

4.1. Economic Significance Test

According to the estimation results of the regression equation, real disposable income (X2t) and total population (X3t) are positively correlated with the average price of commercial housing (Yt) in Anhui Province, indicating that the increase of variables X2t and X3t will promote the growth of the average price of explained variables of commercial housing, which is consistent with the theoretical analysis. Real GDP (X1t) is negatively correlated with the average price of commercial housing in Shandong Province, indicating that the increase of real GDP will lead to the decline of the average price of commercial housing in Shandong Province, which is not in line with economic significance. Therefore, it is speculated that there may be some measurement problems in the model, and it needs to be corrected.

4.2. Statistical Test

R2 is used to measure the overall fitting degree of the model to the samples. It can be seen from Table 2 that R2 = 0.9880 and the modified coefficient of determination is 0.9859, indicating that the overall fitting degree of the model to the samples is good and the interpretation degree of the model is more than 95%.

The F-test can be used to infer whether there is a significant linear relationship between the explained variable and all explanatory variables. When the significance level α = 0.05, Prob (F-statistic) = 0.0000, indicating that the regression equation is significant as a whole, and the model passes the F-test.

The T-test can be used to test the significance of each explanatory variable respectively. When the significance level α = 0.05, the corresponding probability of the coefficient of each explanatory variable in Table 2 is observed. When other explanatory variables remain unchanged, real disposable income (X2t) and total population (X3t) have significant effects on the explained variable Yt respectively. The accompanying probability of the t test of variable X1t is greater than 0.05, indicating that the real urban disposable income has no significant influence on the price of commercial housing in Shandong Province.

4.3. Econometric Recommendations

According to the results of economic significance and statistical test, the overall model is significant, but some parameters (X1t) do not pass the t test. It is speculated that the established model may have serious multicollinearity. Next, the model is tested by measurement to find out and solve the problems existing in the model.

(1) Test and correction of multicollinearity

Φ Test of multicollinearity

The premise of the least squares estimation method adopted in this paper is that there is no multicollinearity. The correlation coefficient of the model is tested by Eviews software to obtain the value of the phase relationship between each explanatory variable. The results are shown in 3. The correlation coefficients among all explanatory variables were greater than 0.9, indicating a high degree of correlation and possibly serious multicollinearity. The variance inflation factor method was used for further test.

Table 3. Phase relation number table

	Y	X1	X2	X3
Y	1	0.9890981074555462	0.9922117099053872	0.9836560091111212
X1	0.9890981074555462	1	0.9976059882927776	0.9947321391573788
X2	0.9922117099053872	0.9976059882927776	1	0.9880295093656125
X3	0.9836560091111212	0.9947321391573788	0.9880295093656125	1

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VIFj is the variance inflation factor of variable Xj. Since R2j measures the linearity between Xj and other explanatory variables, the stronger the correlation is, the more serious the multicollinearity between variables is, and the larger VIFj is. Experience shows that when VIFj≥10, there is serious multicollinearity between explanatory variables and other explanatory variables, and this multicollinearity may excessively affect the least squares estimation. It can be seen from Table 4 that the variance inflation factor of each variable is much higher than 10, indicating that the model does have serious multicollinearity.

Table 4. Test results of variance inflation factor method

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	2.85E+08	87661.42	NA
X1	54.89157	2907.729	753.5883
X2	75.93073	1385.712	332.7501
X3	3.534777	99842.01	151.4382

2 Modification of multicollinearity

In this paper, the stepwise regression method is used to correct multicollinearity. The stepwise regression method can eliminate the statistically insignificant explanatory variables, and finally the multicollinearity among explanatory variables retained in the model is not obvious, and has a good contribution to explain the explained variables. Eviews software is used to operate, and the results are shown in Table 5.

Table 5. Stepwise regression results

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	387.0504	124.9391	3.097913	0.0059
X2	17.82027	0.513242	34.72101	0.0000
R-squared	0.984484	Mean dependent var		4168.519
Adjusted R-squared	0.983667	S.D. dependent var		2195.349
S.E. of regression	280.5631	Akaike info criterion		14.20187
Sum squared resid	1495597.	Schwarz criterion		14.30135
Log likelihood	-147.1196	Hannan-Quinn criter.		14.22346
F-statistic	1205.549	Durbin-Watson stat		0.681781
Prob(F-statistic)	0.000000			
Selection Summary				
Added X2				

The revised model is as follows:

Y=387.050388747+17.8202702544X2t

t=(3.0979) (34.7210)

R2=0.9845, F=1205.549, DW=0.6818

(2) Heteroscedasticity test

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Heteroscedasticity means that random error terms have different variances. One of the premises of OLS method adopted in this paper is that there is no heteroscedasticity, which will cause the variance of the estimator to be invalid and the parameter estimator to be invalid. The White test can not only test whether the model has heteroscedasticity, but also determine which variable causes the heteroscedasticity. It can be seen from Table 6 that at the 95% confidence level, nR2=7.3803 is less than the critical value, P=0.0607 > 0.05. There is no heteroscedasticity in this model.

Table 6. White test results

Heteroskedasticity Test: White				
F-statistic	3.070693	Prob. F(3,17)		0.0559
Obs*R-squared	7.380325	Prob. Chi-Square(3)		0.0607
Scaled explained SS	5.094059	Prob. Chi-Square(3)		0.1650
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Date: 12/04/22 Time: 16:08				
Sample: 2000 2020				
Included observations: 21				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	557295.3	1032483.	0.539762	0.5964
X1^2	2.884182	2.723895	1.058845	0.3045
X2^2	-6.742548	6.677575	-1.009730	0.3268
X3^2	-0.006527	0.012240	-0.533255	0.6008
R-squared	0.351444	Mean dependent var		55200.90
Adjusted R-squared	0.236993	S.D. dependent var		82095.70
S.E. of regression	71710.82	Akaike info criterion		25.36831
Sum squared resid	8.74E+10	Schwarz criterion		25.56727
Log likelihood	-262.3673	Hannan-Quinn criter.		25.41149
F-statistic	3.070693	Durbin-Watson stat		1.995823
Prob(F-statistic)	0.055919			

(3) Autocorrelation test

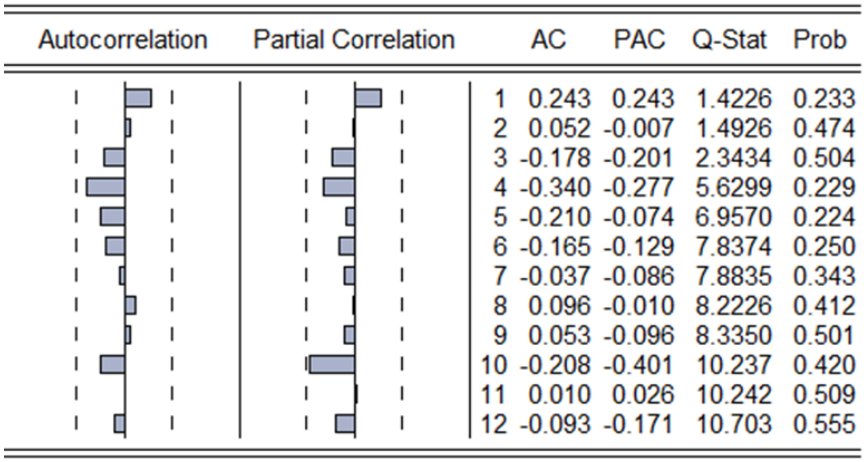

Figure 5. Test results of partial correlation coefficient

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Autocorrelation means that the model does not meet the assumption that the random error terms have no autocorrelation. When the model has autocorrelation, if the ordinary least squares estimation parameter is still used, the standard error of the coefficient may be underestimated, the reliability of the t test may be reduced, the estimation error may be increased, and the least squares estimation is invalid. In this paper, partial correlation coefficient is used to test autocorrelation. The results in Figure 6 show that the partial correlation coefficient does not exceed the dotted line, indicating that the model does not have autocorrelation problem [5].

Therefore, the final estimated result of the model is:

Y=387.050388747+17.8202702544X2t

t=(3.0979) (34.7210)

R2=0.9845, F=1205.549, DW=0.6818

The model results show that for every unit increase of X2t real disposable income, the average price of commercial housing in Shandong Province increases by 17.82 units.

5. Conclusion and Suggestions

According to the revised model, the average price of commercial housing in Shandong Province is significantly affected by the real disposable income and has a positive correlation. In fact, the price of commercial housing is also affected by the introduction of policies, the relationship between supply and demand and other factors that are difficult to quantify. Therefore, the housing administration needs to coordinate the development to ensure the stable and healthy commercial housing market. Based on the results of the above metrological analysis, the following suggestions are proposed.

(1) The government guides investment rationally to ensure a rational rise in housing prices

The urban development in Shandong Province is not balanced, and the housing price is mainly affected by the economic development level of GDP and urban residents' disposable income. In view of this situation, the government should reasonably guide the healthy development of the real estate market, ensure the rational rise of housing prices while developing the economy, seek a relatively balanced relationship between economic growth and housing price rise, and accelerate economic development. The government should reasonably guide investment to pull in the development gap with other regions, give full play to the government's macro-control role, and coordinate the development of cities. Rational allocation of resources to promote economic development.

(2) Formulate land supply according to local conditions

Due to the population growth, economic development level, policy introduction and other different cities have different demands for commercial housing, and the urban housing market is seriously differentiated. How to plan the land supply of urban commercial housing is particularly important. Although blind increase can increase the government revenue in a short time, it will cause a waste of resources, which is not conducive to the long-term construction and development of the city. For the phenomenon of large urban area and small population in Shandong Province, the administrative department should conduct in-depth research, rationally plan urban construction according to the number of resident population and economic development status, scientifically supply commercial housing land, and promote the low-income housing project. The actual situation of residents and the city should be fully taken into account, and the waste of social resources should be put an end to.

(3) The government should play its role and guide the public to buy houses rationally

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Due to the difficulty of quantitative research on policy and other influencing factors, this paper does not include them in the research influencing factors, but it does not mean that policies and other factors do not have an impact on the housing price. In fact, the introduction of policies will directly affect people's concept of house purchase and then affect the fluctuation of housing price. Therefore, the government should give full play to its functions, formulate and issue policies beneficial to the city and the people, pay attention to the popularization and dissemination of policies, reduce policy asymmetry as far as possible, and reduce the occurrence of speculation. The government expands the channels of information announcement, releases relevant policy impact indicators, provides valuable open and transparent information and services to real estate developers and residents, and correctly guides the public to purchase houses rationally.

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