The Structural Analysis of the Determinants of Shanghai Real Estate Price

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Abstract

What are the factors that play the most significant role in affecting Shanghai real estate price? This essay has established an econometric model and uses the perspective of structural analysis to substantiate the real factors that affect the housing price in Shanghai during the 1994— 2015. The essay first collects data from multiple authoritative sources according to potential factors. Then, the essay selects several optimal factors and conducts verification on them. The result is being analyzed. Finally, a conclusion has been reached: factors on the supply side of housing individually have small impact on the price while factors on demand side and policy demonstrate strong impact statistically. This conclusion further suggests that policy implemented by the government with respect to housing price problem in Shanghai could restrain the unreasonable growth to some extent.

Keywords: Shanghai, housing price, least square method , stepwise regression

Introduction

Shanghai is an metropolis that serves as the economic, financial and shipping center within China's Yangtze River economic belt. Due to the significance of real estate industry in Chinese economic development, its growth would result in the positive development of Chinese economy. This significance is especially apparent in Shanghai, since the start-up of Shanghai real estate market in 1992, it has witnessed a tremendous growth—— overall squares of estate sold rises, while selling prices increases steadily. Since 2000, despite that the money put in the construction of housing estates and areas constructed both doubled in five years, the price still soared and according to official statistics, the average selling price in Shanghai went from RMB 3226 per Square-meter in 2000 to RMB 7054 per Square-meter in 2005, which reached an apex. That is to say, between 2000-2005, Shanghai real estate price increased 121% (Shanghai Statistics Yearbook 2005). This drastic increase

brought broad discussion and attention from the society as well as the academic field. Nowadays, we are experiencing the historical intensity of urban land use. The conflict between limited land resources and the speedy development of economy seems more evident on a daily basis. The question of what exactly affects the price of Shanghai real estate is being continually brought up and discussed. Only by thoroughly and precisely evaluating several potential factors in terms of their real impact and significance, could we take right measures to rationalize the future price of real estate in Shanghai and further prevent the negative consequences of real estate bubble. Therefore, using a systematical selection of factors to build an economic model whose significance could be analyzed by Eviews software seems to be optimal.

Literature Review

There are numerous researchers devoted into real estate price and the factors affecting it. There are three kinds of attribution: demand for real estate investment and general supply-side condition, governmental regulation and urbanization.

Effect of Demand

Firstly, many scholars suggest that the demand for real estate investment is the true factor that pushes the price. In his research in the cycle and fluctuation of the market, Liu(2015) uses SPSS software to establish model whose applicability is proved through KMO and Bartlett examination. Finally, the research reached a conclusion: After every cycle of real estate fluctuation, the market becomes more steady and mature. The expectation of capital gain becomes more rational and thus produce betterment to the inner structure of the real estate industry. Using Factor Analysis Method, Ding (2016) built up a factor analysis with respect of the price, then the conclusion indicates that an investing market of finance is the major propellant. Building up a positive correlation between the overall GDP growth of Shanghai and the quantity of houses demanded, Shi (2014) indicates that the wealth accumulation within Chinese domestic economy strongly fuel the demand of real estate. Specially, Glaeser, Huang, Ma, & Shleifer (2016) compares the trend of growth of the price between China and the US and on the basis of that, further summarize several traits of Chinese market. Those traits suggest that currently, due to excessive speculating investments in some local real estate markets of China, the housing price, typically in Shanghai, would have a increasing trajectory whether in short-term or long-term future. In another research, Wang & Jiang(2016) claims that because of the cycle effect of the huge demand booming and abnormal supply side condition, the price is steadily high. Similar result has been reached by Wang(2014) in her research.

Government regulation

Secondly, academics focus on governmental regulation concerning the real estate price and trying to see if those policies applied have resulted in observable positive effect on the market. Whether it is domestic or foreign research made in this topic, the conclusion made could be categorized into three kinds: one holds a positive attitude suggesting that government intervention in the means of tightening policies are very effective at restraining the soar of the price, and the overall benefit outweigh the harm. (Wang *& Murie* 1999; Zhang, 2009; Chen, 2010; Yang,2013) The second kind suggests that different policies have different effectiveness (Wang, 2006; Zhang, 2012 ; Yin & Wei, 2014). The last kind, however, completely deny the validity of government policy and claims no net positive effect could be created with those measures. (Wu, 2014; Wang, 2007).

Urbanization

Besides, there are also scholars thinks that the main pushing factors of the price this the process of urbanization on and the development of big cities themselves. Ding (2013) explicitly points out that Shanghai is within the latter stage of urbanization now. During this stage, urbanization provides vast space of development for real estate sector and in return, real estates serves as the carrier for various functioning entities inside the city. Feng Ding also provides explanation of what causes the fast urbanization——demographic shift from rural area to the city, increase of citizens' income are the two factors that contribute the most.   Using membership function, Xie (2017) probe into the degree of mutual coordination between spatial, demographic as well as economic urbanization with the development of real estate industry in Shanghai. He indicates that between 2000-1014, all three types of urbanization have shown overall rising trend with slight short-term fluctuation, but whether viewing within short-term fluctuating motion or long-term rising trend, the results are the same: among three of them, demographic and economic urbanization could bring development to the industry while spatial urbanization could only produce negative impacts. Similar results could be seen in the research of Wang （2012), and Gottschalch (2015).

Summary

If we sum up the relevant researches of this topic, we could find that existing researches have already dive deep into the factors affecting real estate price, results shown are diverse and well-covering, but several things are worth noticing: those researches conducted only could be considered as just focusing on several apparently significant aspects while most of their timely applicability are weak, few of them could adopt an unique perspective to put newly-appeared potential factors into consideration and further using regression models to analysis the scale of influence of those factors in the background of the current situation. They also haven't been able to satisfyingly reach an all-around conclusion and provide advice conducive to the public knowledge and government's policy-making. Based on these observations above, this essay chooses factors from three categories: supply side, demand side and government policies. This essay intended to chose reasonable factors from these categories as many as possible for comparison and analysis.

Data Collection and building of model

Sources of Statistics

There are three main sources of statistics within this essay: National Bureau of Statistics of China（NBSC）, China Real Estate Yearbook, and Shanghai Statistics Yearbook.

The Database of the NSBC incorporates statistics with various time scale including monthly, quarterly and yearly. They also differ in local, national and international scale of collection. The Database has over 8 million pieces of data and all of them are from authoritative statistical sources and provides detailed and precise information about multiple sectors of the society in different regions. In the statistics gathered, factors including population employed in Shanghai over the years, squares of estate constructed annually, GDP of Shanghai as well as GDP per capita, tax income of government and finally, the overall population of Shanghai by the end of each year are all been collected from the Database.

Another source is the <Shanghai Statistic Yearbook>, which is a reference book with high information density. This yearbook collects and records the social and economic indices of Shanghai since the implementation of Chinese Reform and Opening policy. In the statistics gathered, squares constructed in some particular years and population with or above graduate degree in education both come from this yearbook.

<China Real Estate Yearbook> is a comprehensive document of real estate industry in China. It is a reference book dedicated to the spread of real-estate facts such as policies, market indices, urban and corporation development as well the condition of security housing. Authority and objectivity could be clearly seen in this reference book. Therefore, statistics of the annual average selling price of Shanghai real estate is being collected from the yearbook.

After investigating those databases, the author collected the following statistics correspond to the potential factors the essay intends to study.

Chart 1 Statistics of potential factors

	GDP (in 100 million RMB)	Average Selling Price (RMB/square meter)	GDP per capita (in RMB)	City government tax income	Population (in 10 thousand)	Population employed (in 10 thousand)	Area constructed (in 10 thousand square kilometers)	Population with or above bachelor degree (person)	Policy
1994	1990.86	2627	14328	175.33	1298.81	5.94	2519.09		
1995	2499.43	2768	17779	226.72	1216.7	6.2	3093.93	42955	
1996	2957.55	2913	20647	271.28	1304.43	7.12	3254.57	42860	
1997	3438.79	3074	23397	303.64	1305.46	7.95	3614.19	43475	
1998	3801.09	3228	25206	339.34	1306.58	8.48	3364.43	40842	monetization of the allocation of housing
1999	4188.73	3422	27071	365.29	1313.12	8.78	3257.57	45911	
2000	4771.17	3565	30047	410.63	1321.63	9.33	3266.52	46768	
2001	5210.12	3866	31799	458.28	1327.14	8.77	3215.12	49617	
2002	5741.03	4134	33958	554.7	1334.23	8.79	3102.54	63126	

2003	6694.23	5118	38486	863.68	1341.77	28.87	3582.34	81279	
2004	8072.83	5855	44839	842.74	1352.39	28.94	4891.92	102069	
2005	9247.66	6842	49648		1360.26	28.96	4837.83	120141	" Eight Real Estate Regulation Measure "
2006	10572.24	7196	54858		1368.08	29.95	4901.48	130431	
2007	12494.01	8361	62040	1975.48	1378.86	31.48	5082.771	142426	
2008	14069.86	8195	66932	2223.43	1391.04	37.38	3924.49	147853	
2009	15046.45	12840	69164	2368.45	1400.7	36.55	2978.26	155191	
2010	17165.98	14464	76047	2707.8	1412	35.94	2776.2	161907	
2011	19195.69	14603.24	82560	3172.72	1419.36	35.59	3054.23	169816	" New Eight Real Estate Regulation Measure "
2012	20181.72	14061.37	85373	3426.79	1426.93	33.36	2836.32	174406	
2013	21818.15	16420	90092	3797.16	1432.34	48.38	2698.55	169469	
2014	23560.94	16787	97343	4219.05	1438.69	48.64	2682.2	168972	
2015	25123.45	20949	103796	4858.16	1442.97	49.84	2923.14	161907	

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Construction of Model
Introduction to variables

The dependent variable we study in this research is the average selling price of commercial housing in Shanghai each year. Commercial housing is defined as the housing which is constructed and developed by real-estate company, then being rented and sold in the open market. Commercial Housing usually refers to the general real estate which suggests its over-whelming majority of market share and its selling follows the market price. Nowadays in China, the economy fo commercial housing is largely representative of the entire real estate economy. Therefore, it is reasonable to say that the price of commercial housing is distinctively representative of the overall housing price as well. We could say that research regarding this variable is closely related to the general consumer due to its significance and representativeness.

In the process of building this model, we specifically focus on putting a pile of factors that could be reflective of every significant aspect of the society, this could make the model possess a universal significance.

Division of variables

In the process of analyzing variables, we divide the factors selected into three aspects : Demand, supply, and policy. The variables we selected inside the spectrum of demand are the population employed and the squares constructed annually, variables which are reflective of the supply side condition are GDP and GDP per capita, tax income, population and population above or with a graduate degree. In supply-side variables , according to the theoretical relationship between market equilibrium price and supply curve, the expansion of supply will lowering the equilibrium price, vice versa, Thus, the essay suggests the following postulation that under the circumstance of unchanging demand side, these supply-side variables would have a negative correlation with the real estate price in Shanghai. In demand side variables, according to the theoretical relationship between equilibrium price and demand curve, the expansion of demand will raise the equilibrium price, vice versa. Thus, postulation is further suggested that under the circumstance of unchanging supply side, these demand-side variables would have a positive correlation with the real estate price in Shanghai. In policy variables, under the assumption that the government policy is being successful in regulating market, tightening policy has a negative correlation with real estate price while stimulating policy has a positive correlation with the price.

Variables under background

In order to have a deeper insight into these variables proposed, we will introduce them specifically under social and economic background of China and sees why these variables have been selected in spite of their belonging to those three major categories mentioned above. Because the dependent variable we study in this research is the housing price, thus there exist an unarguable correlation with the overall development of the real estate market. It is for that reason that the author has included several indices that could reflect the overall development condition——population employed by real estate sector and squares constructed. The development of real estate company and investment conjuncture could be evaluated explicitly from these two indices. Secondly, in order to represent the regional economic condition, the author selected GDP and GDP per capita and city tax revenue to be the indicator of the local economy. Next, the authors focus on purchasing power of the society, it is commonly believed and been substantiated that demographic change and growth have strong effect on purchasing power, in order to reflect this change in the purchasing power of real estate, the author selected the overall population of Shanghai and population with and above bachelor degree . Finally, this research especially concentrates on the effect of policies, the author thus puts significant policies implemented since China's Opening and Reform into consideration. This research attempts to delve into the degree of effectiveness of both tightening and stimulating policies and see if the final outcome is positive.

Establishment of function

In brief, we could see that not only have the variables been selected according to demand, supply, and places side, but they also been selected regard for their importance as strong indicators of China's economic and social circumstance. As a result，the function of variables the author constructed is shown as function 1 :

$y=C+aX_1+bX_2+cX_3+dX_4+eX_5+fX_6+gX_7+hX_8+iX_9+jX_{10}$（function 1）

In this function, representation of each variable is provided below:

y—the average selling price of commercial housing Shanghai each year

x_1—population employed by real estate industry in Shanghai

x_2— areas of commercial housing constructed each year

x_3—GDP of Shanghai each year

x_4— GDP per capita of Shanghai each year

x_5—city tax income each year

x_6—overall population of Shanghai by the end of each year

x_7—population of Shanghai with or above bachelor degree in education

x_8, x_9, x_{10}—-national housing estate policies

(x_8—monetization of the allocation of housing in 1998)

(x9—" Eight Real Estate Regulation Measure" in 2005)
（x10—" New Eight Real Estate Regulation Measure" in 2011）

Structural positive analysis of the variables

In this section, the author would firstly use stepwise regression in Eviews to sift out variables that could be brought into the final model, this eliminates the problem of multicollinearity between variables. Next, the author would test the goodness of fit, significance and have residual analysis to fully guarantee the scientific value of this final model。Finally, the author would draw a positive analysis of the coefficient of variables in the final model.

Screening of variables

To start with, let us first conduct a regression of function 1 using the least square method in Eviews, results are shown below:

Chart 2: indices of the least square method regression of function 1

	C	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
Coefficient	-4226.44	-69.051	-0.172	1.506	-0.372	4.24	6.612	0.043	305.717	-4210.02	-3956.598
t-stats	-0.175	-0.806	-0.176	0.728	-0.641	0.981	0.32	0.8	0.177	-1.398	-1.671
Prob.	0.865	0.444	0.865	0.467	0.54	0.355	0.757	0.447	0.864	0.2	0.133
Rsquared	0.984408										
F-statistic	50.5093										

According to Chart 2, R-squared of function one is relatively high which means the function has a fine overall goodness of fit of variables brought in. F-statistic of the function is 3.01 which is greater than the number indicated by the critical value table. This suggests the overall significance of the function is quite good. But not all the variables in the function is significant, in the aspect of individual significance, according to Critical Values of the t-Distribution (one tail), if each individual variable is significant under the 10% bar t-stats degree of freedom, the absolute value must reach 1.372 or above. While in Formula 1, only X9 and X10 meet the level from X1 to X10. Most of the variables don't meet this requirement, so the significance of individual variable is not high. Additionally, in terms of P values, the express under 0.1 among X1-X10 gives further evidence for this conclusion.

Concerning the above, we need a screening of the independent variables of the model so as to provide a scientific and overall guarantee of significance to the final model. Also, to avoid multicollinearity, the research chooses to use stepwise regression method in Eview software to filter out several data which is the most remarkable. By putting them into consideration of the model, through stepwise regression, the results are shown in Chart 3:

Chart 3 Stepwise Regression Equation

	Coefficient	t-stats	prob.
X3	2.0688	4.42907	0.0003
X6	2.8668	2.940333	0.0087
X4	-0.3373	-2.879353	0.01
X10	-2033.07	-1.820863	0.0853
R-squared	0.978652		
F-stats	195.9102		

Thus the formula in the model is altered as;

$$y=B_0+cX_3+dX_4+fX_6+jX_{10}+\mu_i \quad (\text{Function 2})$$

Before further empirical analysis of the result, testing on the model in dealing with the goodness of fit, significance evaluation, and the residual test is required in our research.

Test on Goodness of Fit and Significance

Shown by Chart 3, in Function 2, with the premise of the degree of freedom is 16, the t-stats of each variable owns absolute value higher than the critical value 1.337, which proves that the individual variable has universal significance. In terms of P value, all variables have values below 0.1, the error area of the original formula stays within an acceptable range. In general terms, R-squared is higher, which is very close to 1, the goodness of fit is better than before than that of function 1 and F-statistics is much higher than the critical care at 2.98. It shows sufficient guarantee for the significance of the formula.

Residual Test: Test of Autocorrelation and Heteroscedasticity
Test of Autocorrelation the Formula

The autocorrelation of the function refers to the correlation exists among each expected value in the stochastic error terms, especially in the linear regression model, the related problems on the sequence of the stochastic error terms is relatively common. The existence of autocorrelation in the function will cause big variance to the estimator of the coefficient, thus lead to the insignificance of T-test on the coefficient. Therefore, to identify and solve the problem of variance is important to our model.

For testing whether or not exists the autocorrelation of the model, the research adopts two methods in Eviews Model to complete the inspection: Durbin-Watson Test and LM Test. In DW Test, DW stat =2.019356 in the model composed of mentioned four variables, which indicates that, based on the DW statistics table, UD<DW<4-UD, the original consumption is accepted, there is no first-order autocorrelation of error term within the function and DW value is close to 2, proving the function has large possibility no autocorrelation. The result of LM Test is shown in Chart 4.

Chart 4 Result of LM Test

F-statistic	1.028535	Prob（2，16）	0.38
Obs*R-squared	2.506232	Prob. Chi-Square (2)	0.2856

It is shown on LM Test in Chart 4, prob F （2,16) = 0.3800, Prob Chi-Square(2) =0.2856. Two probability index is higher than the original hypothesis at 0.05, which proves autocorrelation is not accepted or exists, hence the function in the LM Test is proved to be no autocorrelation.

In general, in the two autocorrelation tests，the model both present superiority on data. Therefore，we can make a reasonable inference that the original function has no autocorrelation.

Heteroscedasticity Test on the Model

In the econometric model, random error terms show homoscedasticity, but many econometric data in the practical analysis present unstable status on random error terms, therefore a heteroscedasticity is performed. Because heteroscedasticity makes a great negative impact on the universality of the economic model，the recognization and correction of heteroscedasticity become particularly important.

Two methods of Breusch Pagan - Godfrey Test and White Test are adopted in our research to determine the existence of heteroscedasticity. In BP Test, the result is shown in Chart 5, P-value is generally higher than 0.05, accepting the lack of existence of heteroscedasticity as presumed originally.

Shown in Chart 6 is the White Test's result, the Obs * R - squared = 0.145, higher than 0.05 in the stepwise regression function, so the original hypothesis is accepted. It is tested that heteroscedasticity does not exist.

BP Test Indicates			
F-statistics	2.006	Prob.F(4,17)	0.14
Obs*R-squared	7.053	Prob. Chi-Squared (4)	0.133
Scaled explained SS	9.184	Prob. Chi-Squared (4)	0.0567
White Test Indicates			
F-statistics	2.193	Prob. F(10,11)	0.107
Obs*R-squared	14.65	Prob. Chi-square(10)	0.145
Scaled Explained SS	19.079	Pro. Chi-squared(10)	0.04

Result Analysis
Implication of coefficients

The test on the goodness of fit, significance and residual, all verified the scientific nature of the model, proving the precise result of the model. Model is detailed in Function 3 below:

$$Y=C+2.0688X_3+2.8668X_6-0.3373X_4-2033.07X_{10} \quad （Function\ 3）$$
$$t= \quad (4.4291) \quad (2.9403) \quad (-2.8794) \quad (-1.8209)$$

In Function 3, the coefficient of each of the independent variables interpret the meanings of their changes on the real estate price. When the other conditions keep unchanged, with just a single changing factor, 100 million on the annual GDP growth (X3) is accompanied by 2.0688 Yuan on the average real estate price according to the model; Growth by 100 thousand on the population of Shanghai by the year end(X6) is stepped with increasing 2.8668 Yuan/ Square Meter on average real estate price; Increase by 1 Yuan on Shanghai average GDP(X4), the average real estate price will decrease by 0.3373 Yuan/Square Meter. The above analysis indicates that if we structuring the variables, demand factors overall place a drastic influence on the real estate price of Shanghai. Typically, the GDP of Shanghai and the total population play vital roles in the uprising of the real estate price of Shanghai. But on the influence of Per Capita GDP, an interesting result is reached in the research, Per Capita GDP shows a negative correlation with the price of real estate of Shanghai. This unique finding gives an expression of features of local economy and problems in itself.

Explanations

We make a further suggestion that growth of Per Capita GDP of Shanghai does not bring an evenly distributed wealth growth. The wealthiest minority have rising gain, while the middle class and poor people have not witnessed a considerable income growth or even remain stagnant with their income. This unhealthy growth still has a seemingly positive effect on Per Capita GDP data, but will lead to wealthy people numerously invest their spare money into real estate market to fight against inflation or to have capital gains. Hence, products available in real estate market become less, and speculative purchasing acts lead to price uprising. As a result, we could conclude from the rising GDP per capita that, the uneven allocation of Shanghai economic prosperity is the main factor on booming of Shanghai real estate price.

Furthermore, we can see from the result of the Function 3, since the New Eight Rules on Real Estate Market (X10) implemented across the country, the average housing price in Shanghai mitigates growth by 2033.03 Yuan/Square Meter by each year.

Conclusion

Structural analysis is conducted on the influencing factors of Shanghai real estate price in this research through three aspects: supply, demand, policy. By establishing an econometric model based on Shanghai, and using various of measurements tests and empirical analysis, a conclusion is reached:

Firstly, in general, the author finds that the variables on demand and policy have a prominent influence on the price, while the variables on supply side have no remarkable influence.

Secondly, concerning the influence of demand variables, the empirical analysis shows the author that three variables are predominant among the selected five demand variables. They are GDP of Shanghai, Per Capita GDP of Shanghai, and Total Population by the Year End of Shanghai. Specifically, GDP of Shanghai, total Population by the Year End both have positive correlations with the real estate price, which is coordinated with the presumption brought up in Section 3. Per Capita GDP has a negative correlation with the real estate price, which disagrees with the presumption. However, the research also gives a reasonable explanation in the result analysis.

At last, in the respect of policy, the research chooses three national policies. They are, respectively, monetization policies of the allocation of housing in 1998, Eight National Regulations on Real Estate Market in 2005, and New Eight National Regulations on Real Estate Market in 2011. The results show that the New Eight National Regulations has the most influence on Shanghai Real Estate Price. This policy covers orders of adjusting and perfecting the tax policies, intensifying the differentiation on credit rules policy, as well as controlling strictly on residential land supplement. The coefficient of these variables reaches -2033.070. With the policy's econometric significance, it suggests the New National Control Regulations on Real Estate has considerable control power on the current price of Shanghai Real Estate.

In conclusion, the author believes, if measures are to truly mitigate the increase of Shanghai Real Estate price, it is ideal to consider the process from two aspects. Firstly, measures ought to eliminate the income gap, which will improve the even distribution of purchasing power in Shanghai. Meanwhile, the author suggests the government impose policies to control the increasing immigrant population in Shanghai. Finally, if the government intends to further control the real estate price through direct real estate policy, it is recommended to increase the proportion of direct payment within the purchasing price, increase the loan interest rate, and to decrease the loan limit.

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