

Figure 2. Comparison between second-hand house and new house price trend 2009-2016.



Figure 3. Comparison between second-hand house and new house price trend 2009-2016.

Land supply factors: Land supply will influence market participants' expectations by affecting the scale of supply, affecting changes in house prices (Li and Lv 2015) As the trend of housing prices in recent years, the land price has also shown a rising trend. Land price is a part of housing construction cost. The rise of land price will lead to the rise of construction cost of real estate, resulting in a driving force for housing prices from cost perspective. Although land supply and land transfer price do not directly affect the second-hand housing market, it will affect the public expectation, and indirectly affect the market price of second-hand housing by anticipating the market transaction price of new houses. Taking Shenzhen as an example, the amount of land sold in the first half of the city is 36 billion 415 million, while the selling area is reduced by nearly 7. Compared with that in 2015, the amount of land sold has been reduced by only 16.4%, and the floor price has reached 24024/m², which is nearly 3 times that of 2015. In June 8, 2016, a commercial and residential land in Guangming New Area was sold by Shenzhen. It was awarded 14 billion 60 million by dragon light for a total price of 159.79%, and the premium rate was 159.79%. The floor price was 27620 /m², which refreshed the total price of the Kingdom in 2016. According to people in the real

estate industry, it is estimated that the price of the project will reach 50 thousand $/m^2$ in the future, according to the floor price of 27620/m².



Figure 4. Comparison between second-hand house and new house price trend 2009-2016.

Housing lease factors: From the perspective of use, the consumer buys a house in addition to its own use, it can also rent the house to others. The trading status of the rental market will also affect the transaction price of the second-hand housing market. Yu and Chen (2009) think: the housing market and the housing rental market are interdependent. If the expected rent return rate is low in the future, it will lead to the increase of the opportunity cost of the house purchase, which will lead to the decrease of speculative house demand and the reduction of house price. If the expected rent return rate is higher in the future, the direction of the impact on housing price will be the opposite direction. From the point of view of demand, the way users get housing is divided into two types: purchase and lease, and there is a certain substitution between the two. Therefore, when the rental demand increases, the demand for housing market will decrease correspondingly, and the price of second-hand housing will decrease correspondingly. Conversely, when the renting demand decreases, the demand for housing market will increase correspondingly, and the price of second-hand housing will rise.

EMPIRICAL TEST ON THE FACTORS INFLUENCING THE PRICE OF SECOND-HAND HOUSING IN THE FIRST TIER CITIES

Data description: This paper selects the related data of the second-hand housing price index and the new house price index of four front-line cities from 2009 to 2013 in Beijing, Shanghai, Guangzhou and Shenzhen. The data are mainly from the China National Bureau of statistics, the Guangzhou Statistics Bureau, the Shenzhen Statistics Bureau and the China real estate information network. Second hand housing price and new house price are used for each quarter of the second - hand housing price index (sechpi) and the new house price index (NHPI) respectively. To reflect the influence of second-hand housing rent on the price of second-hand housing, this paper collected monthly data of second-hand housing rent index (sehri) in various cities, and transformed it into quarterly data by a simple weighted average. In order to reflect the impact of land price on the price of second-hand housing, the land listing price (listp) of each city is used as an agent variable. In addition, in order to minimize the

omitted variable bias brought to regression analysis, we also selected the second-hand housing prices may affect other variables as control variables, such as the city's gross domestic product (GDP), the per capita disposable income (incper), commercial housing supply (suppl) etc. The description of the variables and their basic features is shown in Table 1.

Table 1. Variable and Its Basic Characteristics.						
Variabl e	Variable meaning	Mean value	Standard deviation	Min	Max	
sechpi	Second-hand	79.7449	7.8917	54.752	96.442	
	house price index(%)					
nhpi	New Housing	79.2186	9.2527	57.755	100.305	
-	Price Index(%)					
sechri	Second hand	74.2063	10.0147	54.856	95.920	
	housing rental index(%)					
supqh	Supply of commercial	34770.0600	20289.9100	4180.000	94596.000	
	housing (set)					
listp	Land listing price	2526.9460	1537.7820	105.413	8148.748	
	(RMB)					
incper	Per capita	9698.7560	1239.7110	7728.325	12888.480	
	disposable income(RMB)					
gdp	Gross production (100 million)	4026.3770	1069.1810	2073.220	6625.402	

Measurement model setting: (1) The standard measurement model set in this paper is as follows:

$$sechpi_{it} = \beta_0 + \beta_1 nhpi_{it} + \beta_2 sechri_{it} + \beta_3 listp_{it} + BX_{it} + \mu_i + \varepsilon_{it}$$
(1)

Among them, sechpi represents the second-hand housing price index, NHPI shows the new housing price index, sechri expresses second-hand housing rent, and listp indicates the price of land listing. X represents the control variables such as GDP, per capita disposable income and so on, and B is its corresponding coefficient matrix. The subscript i represents the various sections, that is, the cities. The subscript t represents the period, that is, each quarter. It represents the individual effect.

(2) Unit root test In order to avoid the pseudo regression, the unit root test is needed before the regression of the time characteristic data, that is, the stability test. Because the panel data unit root test is controversial, in order to ensure the reliability of the test results, this paper take a more rigorous way of stationarity test, namely all the time series of each section were tested, the main test methods of ADF test and PP test. The results of the test are shown in Table 2.

As can be seen from Table 2, the trend of each variable is more complex. The second hand housing price index sechpi, the new house price index NHPI and the second-hand housing price index sechri are the I (2), that is, the two order single whole process. The price of land listing listp is I (1), the first order single whole process. The sequence of other variables is I (0), that is, the stationary process.

Table 2. TEST of Variable Stability.				
Stationarity				
Nonstationary				
Nonstationary				
Stationarity				
Nonstationary				
Nonstationary				
Stationarity				
Nonstationary				
Nonstationary				
Stationarity				
Nonstationary				
Stationarity				

Table 2. TEST of Variable Stability.

(3) The final regression model is set as follows:

 $D2.sechpi_{it} = \beta_0 + \beta_1 D2.nhpi_{it} + \beta_2 D2.sechri_{it} + \beta_3 D.listp_{it} + BX_{it} + \mu_i + \varepsilon_{it}$ (2) The second-hand housing price index sechpi, the new house price index NHPI and the second-hand housing price index sechri adopt the two order differential form. The land listing price listp adopts the first order differential form, and the other variables use their horizontal form to enter the regression equation. First order difference and two order difference will make the model more difficult to explain, but it can help us find significant variables that affect the price of second-hand housing.

(4) Regression method and regression results In this paper, mixed OLS, fixed effect model and random effect model were used to carry out regression analysis. According to Wald test and Hausman test, the best choice of mixed OLS is selected. As a contrast, the results of the fixed effect model and the random effect model are presented in Table 3.

From the regression results, we can see that the other variables are not significant except that the new house price index is not zero. Because the multicollinearity between variables may lead to the variable is not significant. Therefore, the variance expansion factor of the regression variable is calculated to test whether there is serious multicollinearity in the regression model. The results are shown in Table 4.

It is known from the value of variance expansion factor that there is no serious problem of multiple collinearity in the regression model. Therefore, the estimation result of the regression model is reliable, that is, in addition to the new house price index will significantly affect the second-hand housing price index, other variables have no significant impact on the second-hand housing price index.

(5) Cointegration Analysis of the second-hand house price index and the new house price index.

Due to the two order of second-hand housing price index and the price index above the new regression model are used in the form of difference, therefore, although the launch of the new home price index will significantly affect the second-hand housing price index is still uncertain, but new housing price index specific impact on second-hand housing price index. From the test of stationarity in section (2), we can see that the second-hand housing price index (sechpi) and

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the new housing price index (NHPI) are all two order single integer processes, which can test whether there is cointegration relationship between the two variables. If there is, you can get a specific impact on the level value of the second-hand house price index by the level of the new housing price index.

	Table 3. Tes	st Results of (Cointegration	Relation of V	ariables.	
Variable	ols01	fe01	re01	ols02	fe02	re02
D2.nhpi	0.49090***	0.48993**	0.49090***	0.51181**	0.50230***	0.51181
-		*		*		***
	(5.29)	(5.19)	(5.29)	(5.03)	(4.69)	(5.03)
D2.sechri	0.11698	0.11933	0.11698	0.12129	0.14052	0.12129
	(1.19)	(1.19)	(1.19)	(1.17)	(1.27)	(1.17)
D1.listp	0.00003	0.00003	0.00003	0.00002	0.00003	0.00002
	(0.35)	(0.4)	(0.35)	(0.29)	(0.41)	(0.29)
quarter	0.02685	0.02675	0.02685	0.01988	-0.00892	0.01988
	(1.11)	(1.09)	(1.11)	(-0.42)	(0.08)	(-0.42)
incper				-0.00007	0.00002	-
						0.00007
				(-0.94)	(-0.84)	(-0.94)
supqh				-0.00001	-0.00001	-
						0.00001
				(0.97)	(1.04)	(0.97)
gdp				0.00026	0.00045	0.00026
				(0.49)	(-0.14)	(0.49)
_cons	-5.52441	-5.50546	-5.52441	-4.08336	0.2833	-
						4.08336
	(-0.58)	(-0.58)	(-0.58)	(-0.58)	(-0.58)	(-0.58)
R2	0.3783	0.3782		0.3892	0.3763	
Adjusted	0.3412			0.3224		
R2						
obs	72	72	72	72	72	72

Note: the parenthesis is a robust t statistic adjusted by heteroscedasticity. * * * * * * * (* *) indicated significant levels of 1%, 5% and 10% respectively.

In the first quarter of 2009 to the second quarter of 2016 in Beijing, the johans test of time series of second-hand housing and new housing price index is carried out. It is found that there is a cointegration relationship among the two variables. Through the Stata estimation error correction model (VECM), the long-term equilibrium relationship between the second-hand housing price index and the new house price index in Beijing is as follows:

$$sechpi_t = -104.11 + 2.01nhpi_t$$
 (3)

In the same way, we can make a cointegration analysis of the second-hand housing price index and the new house price index in Shanghai. The johans test found that there was a cointegration relationship. The cointegration relationship is as follows:

$$sechpi_t = -8.54 + 0.91nhpi_t \tag{4}$$

Tuble II vallable Commeanly Test						
Variance expansion factor of partial variable			Variance expansion factor of all variable			
re	regression			regression		
Variable	VIF	1/VIF	Variable	VIF	1/VIF	
sechri	1.15	0.872669	gdp	4.72	0.211986	
nhpi	1.14	0.876422	supqh	3.98	0.251513	
quarter	1.02	0.976096	quarter	2.81	0.355700	
listp	1.02	0.976310	incper	2.48	0.403502	
Mean VIF	1.08		nhpi	1.34	0.747064	
			sechri	1.23	0.811276	
			listp	1.09	0.916500	
			Mean VIF	2.52		

The long-term equilibrium equation of the second-hand housing price index and the new housing price index in Beijing indicates that the new housing price index of Beijing has increased by one percentage point, which will cause the second-hand housing price index to increase by about 2 percentage points. The long-term equilibrium equation of the second-hand housing price index and the new housing price index in Shanghai indicates that the new housing price index in Shanghai has increased by one percentage point, which will lead to an increase of 0.9 percentage points in the second-hand housing price index. The same method can be used to analyze the price index of second-hand housing and new housing in Guangzhou and Shenzhen, and this article is no longer to be described.

CONCLUSIONS AND SUGGESTIONS

In this paper, from January 2009 to December 2013 period based on the sample data, using panel data cointegration method and analyzes the influencing factors of Chinese first-tier cities of second-hand housing price changes; For the two cities of Beijing and Shanghai, from the first quarter of 2009 to the second quarter of 2016 second-hand housing and new housing price index time series johans test, found there is cointegration relationship between the two variables. The following conclusions can be concluded:

First, from the cointegration analysis results, first-tier cities in the real estate market, the impact of second-hand housing price index of the home price index, second-hand housing rental index, commercial housing supply, land price, per capita disposable income, GDP and other factors, in addition to the new housing price index will significantly affect the second-hand housing the price index, effects of other variables on the second-hand housing price index were not significant. Among them, the supply of housing is not second-hand housing prices have obvious influence of this theory and understanding in demand unchanged, increasing the supply of housing, will lead to the decline in prices, but also to some extent in the regulation of housing supply, regulation and control of the secondary housing market is not obvious. The impact of land prices in the secondary housing market is not significant, which to some extent to the government and society explained: "the most expensive land" and second-hand housing prices soaring Never mind too obvious to some extent; it also explains the relationship between the price of new houses and second-hand housing price mechanism and intermediary variable. "Have the most expensive land", more reflects the push up prices of new homes, new homes prices directly affect the price of second-hand housing; the price of new homes through the intermediary variables of land price of second-hand housing prices, further analyzes the

influence degree of need, to provide a basis for the precise regulation of real estate market.

Second, for the two cities in Beijing and Shanghai, from the first quarter of 2009 to the second quarter of 2016, we tested the time series of second-hand housing and new housing price index, and found that there was a cointegration relationship among the two variables in johans test. The long-term equilibrium relationship between the second-hand housing price index and the new house price index in Beijing is as follows:

$$echpi_{t} = -104.11 + 2.01nhpi_{t}$$
 (5)

The long-term equilibrium relationship between the second-hand housing price index and the new house price index in Shanghai is as follows:

$$sechpi_t = -8.54 + 0.91nhpi_t \tag{6}$$

The equilibrium equation of the second-hand housing price index and the new housing price index in Beijing indicates that the new housing price index of Beijing has increased by 1 percentage points, which will cause the second-hand housing price index to rise by about 2 percentage points. The equilibrium equation of the second-hand housing price index and the new housing price index in Shanghai indicates that the new housing price index of Shanghai has increased by 1 percentage points, which will cause the second-hand housing price index to rise by about 0.9 percentage points. Through the equilibrium relationship and equilibrium equation, it can be seen that in the real estate market of the first-tier cities, the price of the new house affects the price of the second-hand house to a certain extent. The first-tier cities are different in terms of their secondary housing rent index, commercial housing supply, land listing price, disposable income per capita and gross domestic product and so on. The impact of new housing prices on second-hand housing prices is also different. But through the co - integration analysis and johans test of two cities in Beijing and Shanghai, it shows that the price of new housing has a more obvious impact on the second-hand housing price.

According to the conclusion of the empirical analysis, we put forward the following suggestions for the accurate control of the real estate market.

First, the "stock housing era" is the main direction to regulate the second-hand housing. With China's first tier cities and more two or three tier cities entering the "stock room era", the second-hand housing market will become the leading and future direction of China's real estate market. The stability of the housing price in the second-hand housing market is directly related to the healthy development of the whole real estate market, and it is also related to the realization of the goal of "the house is used to live". As the second-hand housing market will become the hot spot of capital chase, the intermediary agencies of the second-hand housing market also have many illegal phenomena such as hype house price, false house and so on. Therefore, China's real estate market regulation should focus on the secondary housing market, reform the supply side from the secondary housing market, stabilize the real estate market, and promote the return of housing and housing attributes.

Second, the control of the second-hand housing market, in order to regulate the price of new housing as the main direction. In the first-tier cities of the real estate market, this paper selected the variables, only the new housing price index significantly affect the second-hand housing price index, so when first-tier cities second-hand housing market overheating, should first start from the new home sales price regulation, in order to control the influence factors of new home sales price as the starting point, and then the secondary regulation the housing market rose. Although from the empirical analysis, second-hand housing rental index, commercial housing supply, land price, per capita disposable income, GDP and other factors have no significant influence on the price of second-hand housing, but in real life, they are in part a direct impact on

the price of new homes, the second-hand housing prices of new homes in the market through indirect conduction. In particular, the supply of commercial housing and the price of land will directly affect the sales price of new houses to a large extent. Therefore, we should also pay attention to these factors when regulating the second-hand housing market.

Third, adhering to the city policy, the regulation policy is different. The same as the first-tier cities, Beijing and Shanghai new home prices on the second-hand housing price level is not the same, which can be seen from the results, compared the influence degree of Beijing new home sales price of second-hand housing prices in Shanghai new home sales prices on the second-hand housing price is more than 2 times (one of the reasons to be detailed investigation and analysis) that, and the degree of influence of different factors on the city of second-hand housing prices are not the same. Therefore, the real estate market regulation should not be "one size fits all", especially the second-hand housing market, and should be according to local conditions, divide the policy, strengthen the policy pertinence. For example, the implementation of different city credit policy, according to the price of new homes on the second-hand housing prices influence on the new home market, second-hand housing market difference, regional difference of second-hand housing market intervention, so as to ensure the stability and orderly development.

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The Efficiency of Chinese Regional Construction Industry Based on DEA Model: An Empirical Study from 2006 to 2016

Hua Su¹; Yulong Li²; Fanchun Meng³; and Zhou Zhou⁴

¹Undergraduate, School of Management Science and Engineering, Central Univ. of Finance and Economics, Beijing, China 100081. E-mail: sh227_cufe@163.com

²Associate Professor, School of Management Science and Engineering, Central Univ. of Finance and Economics, Beijing, China 100081 (corresponding author). E-mail: liyulong@cufe.edu.cn ³Engineer, Changbai Mountain Railway Construction Management Center, Jilin 133613, China. E-mail: 3858988@qq.com

⁴Undergraduate, School of Management Science and Engineering, Central Univ. of Finance and Economics, Beijing, China 102206. E-mail: 707625327@qq.com

ABSTRACT

China has made great changes in macro-economy recent years. It is of great importance to discuss the impact of macroeconomic environment and technological progress on the efficiency of Chinese construction industry. In order to accurately measure efficiency of Chinese construction industry from 2006 to 2016, 31 provincial level administrative regions are viewed as decision making units based on the BCC-DEA model. The evaluation model was established with enterprise assets, the number of employees, and the total power of construction machinery and equipment at the end of the year as input indicators, and gross product of the construction industry efficiency of Chinese six geographical regions and three major economic circles are analyzed from the dynamic and static viewpoints, and we study the impact of financial crisis and supply-side structural reforms on construction industry in recent years. The results showed that the overall efficiency of construction industry is rising. The construction efficiency gap among regions has narrowed but is still large. In addition, according to the current situation of Chinese construction industry, the paper puts forward some related suggestions to improve the efficiency of construction industry.

INTRODUCTION

The construction industry has a wide range of impact in Chinese macro economy, involving numerous related industries, which has become one of the basic decisive forces to stimulate the rapid growth of the national economy (Chen and Yang 2012). From 2011 to 2016, gross product of the construction industry increased from 11646.332 billion to 19356.678 billion, an increase of 66.20%. And total pre-tax profit increased from 803.261 billion to 1296.350 billion, an increase of 61.39%. The role of the construction industry in the national economy is becoming more and more important (Li and Zhao 2013). Therefore, it is of great significance to maintain the healthy and efficient development of the construction industry to enhance the economic vitality and develop the industrial ecological chain (Sun et al. 2012).

The market of the construction industry has changed violent lyunder the impact of the financial crisis and the emerging construction industry over the last 10 years (Li and Huang 2012). Most of the domestic scholars have limited the research on the efficiency of the construction industry in the last 10 years. Since the 21thcentury, many scholar shave begun to pay attention to the efficiency of the construction industry. Li and Wang (2011) researched on

the development of Chinese construction industry from1998 to 2007 by using the DEA method. Zhang and Liu (2011) put forward that the main driving force for the improvement of construction efficiency comes from the rationalization of production scale. Ren and Li (2016) researched on the efficiency of regional construction industry during 2006-2013through the three-stage DEA model. Zhuang et al. (2006) analyzed the efficiency of the overall efficiency of Chinese construction industry during 1991-2003.

Through the above literature, there are still some major differences between different literatures. The first is the difference in the method model, such as Ren and Li (2016) used the three-stage DEA model. The second is the use of different evaluation indicators in the framework of DEA model. The time span of research is also different, such as Li and Wang (2011) used Chinese regional construction industry of 1999-2008 as panel data. Based on this, this paper focuses on the study of the Chinese construction from 2006 to 2016, during which China experienced the financial crisis, the supply side structural reform and a series of events.

EVALUATION PRINCIPLE BASED ON THE BCC-DEA MODEL

Data Envelopment Analysis (DEA) was proposed by Charnes, Coopor, and Rhodes in 1978 (Wang et al. 2017). The principle of this method is mainly through maintaining decision-making units (DMU) input or output unchanged and projecting DMUs to the relatively efficient production frontier (Zheng et al. 2017).

Without any weight assumption and the explicit expression between input and output, the optimal weight is based on the actual data of input and output of decision units (Hu and Liu 2015). Many subjective factors have been excluded and it has a strong objectivity.

The basic models of DEA are divided into CCR model and BCC model. The CCR model is usually used to evaluate whether DMU are effective and effective at the same time, while the BCC model can be used to evaluate whether DMU are effective in scale or effective in technology. The BCC model can calculate the relative efficiency of the DMU, which provides the basis of decision for comparing the efficiency of different regions. Therefore, the BCC-DEA model is chosen as the research model.

BBC envelopment model: The BCC model is based on the CCR model to increase the constraint condition: $\sum_{j=1}^{n} \lambda_j = 1$. The BBC envelopment model is as below (Chen and Liang 2015):

$$\min \gamma
\sum_{j=1}^{n} x_j \lambda_j + s^- = \gamma x_0
\sum_{j=1}^{n} y_j \gamma \lambda_j - s^+ = y_0
\lambda_j \ge 0, j = 1, \dots, n, s^+ \ge 0, s^- \ge 0$$
(1)

There are *n* vectors.

 x_j represents the *jth* input vectors: $x_j = (x_1, x_2, \dots, x_n);$

 y_j represents the *jth* output vectors: $y_j = (y_1, y_2, \dots, y_n);$

 λ_i is the weight coefficient of input and output indicators;

 s^+ and s^- are slack variables, s^- represents the excess of input, and s^+ represents the insufficient of output;

 γ represents the pure technical efficiency of DMU.

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