EFFECTS OF LAND LEVERAGE AND REAL ESTATE INVESTMENT DEMAND ON HOUSING PRICE VOLITILITY: EVIDENCE FROM CHINA'S 35 LARGE AND MEDIUM CITIES

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ABSTRACT

The paper uses monthly data from year 2005 to 2012 of China's 35 large and medium cities, constructs a housing price volatility (measured by the standard deviation of the real growth rate of housing price index) model, to investigate the positive effects of land leverage and real estate investment demand on housing price volatility. We also found that housing price volatility is affected by macroeconomic policies in different periods (time effect), and is affected by regional heterogeneity (regional effect).

Keywords: housing price volatility; land leverage; real estate investment demand

1. INTRODUCTION

Housing price volatility has direct influence on many sides, such as the buying(renting) decision of household, the development project selection of real estate enterprises, the credit evaluation of mortgage providers and the risk forecast and prevention over the real estate market of government, etc. Based on past experience, in the real estate market boom, it is very easy to appear the problems of fast virtual asset expansion and speculation rampant, etc. And when entering the downturn, the real estate market will generate some new problems, such as investment demand waning, housing price declining, mortgage assets devaluation, bank's bad debts increasing and even financial crisis (Liang Yunfang etc. 2007). Therefore, to explore the factors of house price fluctuation has practical significance. It helps to guide the behaviors of government, developers, residents, banks, and any other participants in the real estate market and to maintain the real estate market stability.

The present domestic research focuses on the factors of housing price (or the growth rate of housing price, first-order moment) or the interactive relationship between the economic fundamentals and housing price. And there is almost no research on factors of price fluctuations (the standard deviation of house price or house price growth rate, second-order moment). According to the data availability in China, this paper uses the 2005-2012 monthly data of 35 large and medium cities in China to build commodity house price volatility models, and mainly discusses the influence of land leverage and real estate investment demand proportion on the commercial housing price fluctuations. This paper uses the definition of Zhou Yu (2014) for reference, that is the standard deviation of actual house price index growth rate to measure house price fluctuations and a bigger standard deviation means bigger house price volatility. The data sources include the National Statistics Bureau, Ministry of Land and Resources, China's Real Estate statistics Yearbook and China's City Statistical Yearbook.

By using the micro data of the United States in 1985-2011 (data of individual housing level) and the data of New Zealand respectively, Zhou Yu (2014) and Bostic, etc. (2007) have verified the positive influence of land leverage on house price volatility: the higher the land leverage is, the larger housing

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price fluctuation will be, and in the housing market boom, high land leverage housing's appreciation rate will be bigger, but in the housing market downturn, high land leverage housing's depreciation rate will also be greater. Malpezzi and Wachter (2005) mentioned that investment demand is the main factor of price changes, and when the real estate supply is inelastic, the investment demand will play a dominant role in housing changes. But there is no empirical research or discussion on how the investment demand proportion influences the house price fluctuations at home and abroad.

Unlike Zhou Yu (2014), the data used in this article is the medium level panel data of Chinese cities, rather than the micro data of American individual building level. China and the United States have different land systems, such as private land ownership, permanent property and single-family detached homes in the United States; While in China: state-ownership of land, tenure of 70 years, the share of apartment property right by all the households in the whole building, etc. So the empirical result based on American data has little reference value for China. In addition, the result drawn from the micro data of the individual building level is not necessarily correct at macro or meso level. This paper directly uses the medium level data of Chinese cities, and the empirical results would have more reliable reference value for participants in China's real estate market. In addition, as to the empirical method, this paper uses the panel data model rather than the cross section data model; as to the regression method, this paper uses FGLS regression which can handle cross section heteroscedasticity and serial correlation at the same time, rather than simple OLS regression method.

2. VARIABLES

2.1 Land Leverage（*landlev*）

Prices usually include two main parts: land prices and ground structure prices, namely $HP = L + S$, HP is housing price; L is land price; S is ground structure price. Thus the land price-house price ratio is the land leverage of the city i at time t:

$$landlev_{it} = L_{it} \div HP_{it} \quad (1)$$

So the overall growth rate of house price (g_{HP}) is actually the weighted average of land price growth rate (g_L) and ground structure price growth rate (g_S), and the weight of g_L is exactly the land leverage.

$$g_{HP} = g_L \times landlev + g_S \times (1 - landlev) \quad (2)$$

Land and surface structure have different trends of price changes, and the range of g_L variations is much greater than that of g_S. Under the assumption that factors of production have complete liquidity, the ground structure costs and labor costs in different regions would converge and change smoothly. However, since land cannot be transported, people can only obtain the benefits of land in a fixed location. And the huge regional difference of land supply and demand leads to the large difference of regional land price changes. In the cities with higher land leverage, the volatility of house prices will also be larger. For example: there are two houses, one in Beijing, one in Lanzhou, the land leverage of the former is 60%, and that of the latter is 30%. Assume that in the upward market, both of the land prices would increase by 20%, and in the downward market, both of them would decrease by 20%. And assume that the ground structure price is basically stable, Beijing house price would go up and down

12%, while Lanzhou house price would only fluctuate (up or down) 6%.

2.2 Investment Demand For Real Estate（*investr*）

Houses draw both consumption demand and investment demand as a whole, of which, the investment demand is not derived from personal living need, but to obtain investment gains from buying houses. And the investment income usually includes two forms: buy a house to rent, collecting rent from a tenant; buy a house just to wait for the appreciation and then sell, relying on house price appreciation to obtain benefits.

With the development of urbanization, China's urban floating population has reached 236 million in 2012. The large number of floating population have caused massive demand for urban housing rental and inevitably increased the rent as well as further stimulated the investment demand for rental housing. The rising (falling) of investment demand will be magnified (atrophied) rapidly under the upward (downward) expectation. In the case of inelastic supply, the demand would cause house prices to rise (decline) sharply and largely in a certain period of time. So we expect that investment demand proportion would have a significantly positive impact on house price fluctuations.

Among China's currently available data, the commercial housing sales area or sales amount didn't distinguish between the investment and consumer purchase. But the increase of real estate investment demand means more supply of rental housing, we therefore use the leasing area and sales area ratio of commodity house to measure a city's investment demand for the commercial housing in a certain period.

2.3 Time Effect and Regional Effect

The macroeconomic environment or government intervention policies of different periods have effects on the development of the real estate market. In addition, China's territory is so vast that the regional economic and social development differences are very huge, and these fundamental differences of economic and social development will also be reflected in the development of the real estate market. In view of this, this paper adds dummy variables of each year (D2006 to D2012, D2005 as reference variables) in the regression equations as control variables of time effect, and adds three regional virtual variables of China's three main parts(east, central and west as reference variables) as control variables of regional effect. Having referred to the division method of National Bureau of Statistics released in June 2011, this paper studies the following 35 cities in table 1.

Table1：The Regional Division of 35 Large and Medium Cities

Region	City
East	Beijing, Tianjin, Shenyang, Dalian, Shanghai, Nanjing, Hangzhou, Ningbo, Fuzhou, Xiamen, Jinan, Qingdao, Guangzhou, Shenzhen, Haikou
Central	Shijiazhuang, Taiyuan, Hefei, Nanchang, Zhengzhou, Wuhan, Changsha, Changchun, Harbin
West	Huhhot, Nanning, Chongqing, Chengdu, Guiyang, Kunming, Xi'an, Lanzhou, Xi'ning, Yinchuan, Urumchi

2.4 The Dependent Variables: House Price Volatility（*hpvol*）

We use 2005-2012, a total of 8 years' monthly house price indexes of 35 large and medium cities in China to obtain 280 sample observation values totally. And we use a certain city's standard deviation of monthly actual growth rate of the house price in the 12 months of a year to measure the price volatility

of that city in that year (*hpvolit*). And a bigger standard deviation means greater commercial housing price volatility of a certain city in a certain year.

2.5 The Descriptive Statistics of the Main Variables

The explanatory variables include land leverage, real estate investment demand ratio, and the control variables include annual virtual variable, regional virtual variable (east,central,west). Table 2 shows the descriptive statistics of the explaining and explained variables.

Table2: The Descriptive Statistics of the Main Variables

Variable	Mean	Standard deviation	Minimum	Maximum
hpvol	0.0206	0.0153	0.0025	0.0796
landlev	0.5228	0.4522	0.1649	0.9167
investr	0.0864	0.1283	0.0004	0.7138

Zhou Yu (2014) used 1985-2011 biennium real house prices data of the United States, while this paper uses the monthly index data of China from 2005 to 2012. Though they use the same price volatility index calculation method, but due to the quite different frequency and measured objects, the description statistics (such as the average of house price volatility index) in this paper and Zhou Yu (2014)'s paper vary a lot. For example, in the paper of Zhou Yu (2014), the mean of house prices volatility index is 0.13, the standard deviation is 0.08, the minimum value is 0.02, the maximum value of 0.58, while in this paper, each of the above descriptive statistical values are much smaller than those of Zhou Yu (2014). Zhou Yu (2014) showed that the average of American land leverage was 0.14, and this paper reveals that China's land leverage has an average of 0.5228, that is to say, more than half of China's house price is actually the land prices, and the too high land cost is the main cause of current China's soaring housing price. The average of investment demand ratio is less than 10%, which shows that among China's current real estate investment demand, the proportion of investors who only want to buy, rent out and charge rent is very small. However, this paper cannot give an exact number of how much the ratio of investors who would buy low/sell high to make money among the real estate investment demand is.

3. MODEL

3.1 Model Selection

Firstly, we select the appropriate panel data model according to the collected data. In the first step, we make F test to compare the fixed effect model and the mixed cross section model, the F value is 1.34, the P value is 0.1061, showing it is not significant at 10% level, so the null hypothesis cannot be denied. In the second step, we use BP test to compare mixed cross section model with random effects model, and the Chi2 value is 1.38, the P value is 0.1204, showing it is not significant at 10% level, so the original hypothesis can't be denied, too. In the third step, we use the Hausman test to contrast fixed effect model and random effect model, and the Chi2 value is 0.18, the P value is 0.9157, showing it is not significant at 10% level, so the original hypothesis still can't be denied. The three hypothesis testing results are shown in the following table 3.

Table3：The three hypothesis testing results of panel data model selection

	F-test	BP Lagrangian Multiplier Test	Hausman Test
hypothesis	H0： the mixed cross section model H1：the fixed effect model	H0：the mixed cross section model H1：random effects model	H0：random effects model H1：the fixed effect model
test	F(34，243)=1.34 Prob>F=0.1061	chi2(1)=1.38 Prob>chi2=0.1204	chi2(2)=0.18 Prob>chi2=0.9157
result	Cannot refuse H0， To select the mixed cross section model	Cannot refuse H0， To select the mixed cross section model	Cannot refuse H0， To select random effects model

We therefore choose mixed cross-section model, and construct the following model of commercial housing price fluctuations (use the west region and the year of 2005 as regional reference and base year variables respectively), of which, *i* is a certain city, *t* stands for a certain year.

$$hprvol_{it} = \beta_0 + \beta_1 landdev_{it} + \beta_2 investr_{it} + \beta_3 D2006 + \beta_4 D2007 + \beta_5 D2008 + \beta_6 D2009 + \beta_7 D2010 + \beta_8 D2011 + \beta_9 D2012 + \beta_{10} east + \beta_{11} central + \varepsilon_{it}$$

3.2 Model Testing

3.2.1 Individual Effect Test

Due to the differences between cities, there might be omitted variables that do not vary with time, therefore showing individual effect. This article uses the LSDV regression method to check whether individual dummy variable coefficient of different cities is significant or not, to test the existence of individual effect. The results show that (as shown in table 4), all the individual virtual variables of each city are not significant under 5% significance level, therefore, the assumption of ‘All the individual virtual variables are 0’ cannot be rejected, so the individual effect is not obvious and the mixed regression should be used.

Table4：Individual Effect Test of Model

Variable	Coefficient （Standard Error）	Variable	Coefficient （Standard Error）
2.city	-0.0075 (0.0063)	19.city	-0.0065 (0.0069)
3.city	0.0022 (0.0056)	20.city	-0.0086 (0.0074)
4.city	-0.0115 (0.0073)	21.city	-0.0055 (0.0054)
5.city	-0.0078 (0.0072)	22.city	0.0023 (0.0070)
6.city	-0.0061 (0.0060)	23.city	0.0044 (0.0075)
7.city	-0.0066 (0.0075)	24.city	0.0102 (0.0097)
8.city	-0.0019 (0.0055)	25.city	-0.0028 (0.0054)
9.city	-0.0081 (0.0056)	26.city	0.0122* (0.0067)
10.city	0.0042 (0.0066)	27.city	-0.0075 (0.0052)
11.city	0.0046 (0.0078)	28.city	-0.0100* (0.0056)

12.city	0.0127* (0.0067)	29.city	0.0004 (0.0068)
13.city	0.0096* (0.0058)	30.city	0.0043 (0.0091)
14.city	-0.0022 (0.0053)	31.city	-0.0044 (0.0056)
15.city	-0.0080 (0.0055)	32.city	-0.0033 (0.0056)
16.city	-0.0008 (0.0050)	33.city	-0.0068 (0.0069)
17.city	-0.0049 (0.0057)	34.city	-0.0071 (0.0054)
18.city	-0.0084 (0.0062)	35.city	-0.0064 (0.0056)
observation	280		
Note：Standard errors in parentheses， *** p<0.01, ** p<0.05, * p<0.1.			

3.2.2 Stationarity Test of Time Series

In non-stationary economic time series, even if there is no direct relationship between variables, they may also have a common changing trend, this is spurious regression. If there exists spurious regression problem, the model can't explain any practical relevance even though the R^2 value may be very high. To avoid this problem, stationarity test should be made for the panel data before the regression. Both the co-integration test and the unit root test are common stationarity tests. But they are mainly applied to non-stationary long-term dynamic data (‘big *T* and small *N* type), and the data in this paper is micro panel data (‘big *N* and small *T* type), unit root test and co-integration test can basically not be considered (Bai Zhonglin, 2008; Wen Juan zheng, 2011).

3.2.3 Multicollinearity Test

The result of Variance Inflation Factors(VIF) test shows that the model does not have multicollinearity. A simple judgment rule is that if VIF is less than 10, multicollinearity in the model is thought to be negligible.

Table5：Multicollinearity Test of the Model

Variable	VIF
D2008	1.78
D2009	1.77
D2010	1.76
D2011	1.75
D2012	1.75
D2006	1.75
D2007	1.75
east	1.46
central	1.42
investr	1.19
landlev	1.09
Mean VIF	1.59

3.2.4 Heteroscedasticity Test

To make Breusch-Pagan and White heteroscedasticity tests on the mixed cross section model, the results show that the null hypothesis is rejected, then the model is heteroscedastic and needs to be revised.

Table6： Heteroscedasticity Test of the Model

Breusch-Pagan Heteroskedasticity Test			
chi2(1)	58.7	Prob > chi2	0
White Heteroskedasticity Test			
chi2(46)	62.4247	Prob > chi2	0.0537
White Fitted Heteroskedasticity Test			
chi2(2)	35.0231	Prob > chi2	0

3.2.5 Serial Correlation Test

The null hypothesis of Wooldridge test is that first-order auto-correlation does not exist in the regression equation. And the results reject the null hypothesis; In the Durbin-Watson test, the closer the DW statistic is to 2, the stronger explanation the model has, while the test results show that the DW value deviates from 2 far. So regression equation has serial correlation problem and needs to be revised.

Table7：Serial Correlation Test of the Model

Wooldridge Test：	
F (1, 34)	20.207
Prob > F	0.0001
Durbin Watson Test：	
DW	1.2005

4. EMPIRICAL REGRESSION RESULTS

According to the above model tests, this paper uses FGLS regression method which can handle cross section heteroscedasticity and serial correlation at the same time. The regression results are shown in table 8 below.

Table8：Empirical Results of FGLS Regression

Variable	Coefficient	Standard Error	T Value
landlev	0.0067**	0.0033	2.02
investr	0.0126*	0.0075	1.68
D2006	4.84E-06	0.0017	0.003
D2007	0.0095***	0.0020	4.75
D2008	0.0223***	0.0021	10.62
D2009	0.0128***	0.0021	6.09
D2010	0.0086***	0.0021	4.09
D2011	0.0040*	0.0021	1.90
D2012	-0.0042**	0.0021	-2.00
east	0.0046**	0.0020	2.30
central	0.0021	0.0015	1.40
Observations： 280			
Wald chi2(11) = 253.26, Prob > chi2 = 0.0000			
*** p<0.01, ** p<0.05, * p<0.1			

The P value of Wald test is 0.0000, showing the coefficient of the regression equation on the whole is

significant. The T tests of the single variable coefficients show that leverage (*landlev*) and investment demand ratio (*investr*) have significantly positive correlation to the fluctuation range of China's urban commercial housing price. If the land leverage value drops by 50% from the sample mean 0.5228 (see table2) to 0.2614, the house price fluctuation index will decline from the sample mean 0.0206 (see table2) to 0.0188(=0.0206-0.2614×0.0067), decreasing about 10%. If the land leverage value drops from the sample mean 0.5228 to the average of the United States 0.1400 , house prices volatility index will drop from the sample mean 0.0206 to 0.0180 (=0.0206-(0.5228-0.1400)×0.0067), decreasing about 13%. While China's real estate market has some particularity that different from Euramerican developed country, (such as state-owned land ownership, tenure of 70 years, the share of apartment property right by all the households in the whole building, etc.), the positively significant relationship between land leverage and house price volatility showed in the European and American developed countries is still suitable for China. In addition, if the investment demand ratio declined by 50% from the sample mean 0.0864 to 0.0432, the house price fluctuation index will drop from the sample mean 0.0206 to 0.0200 (=0.0206-0.0432×0.0126), decreasing about 3%.

Table 8 also shows that the price fluctuations in the years 2007-2011 were significantly higher than those of the base year 2005, indicating the time effect of house price fluctuation. The macroeconomic situation and the national real estate policies significantly affect the evolution of the real estate market. Besides, the house price fluctuations also present an obvious regional effect: the house price fluctuation in the eastern region is significantly higher than that in the western and central regions (no significant difference in the central and western regions). The reasons may include: (1) the level of real estate marketization in eastern cities is higher, the information is more symmetrical, and the market can react more quickly in response to external stimuli, which cause larger house prices range; (2) the eastern region is more economically developed, have more floating population and more developed financial markets, is the active region of real estate investment(both in and out); While the western and central regional real estate markets are more closely connected to economic fundamentals and therefore their development depends more on the regional economic development situation. On the whole, the house price fluctuation ranges in the middle and central regions are relatively small to the eastern region.

5. CONCLUSIONS AND SUGGESTION

This paper uses 2005-2012 monthly commodity house price data of 35 large and medium cities in China to build commodity house price volatility model. The paper discusses the factors of commodity house price fluctuations in China and gets the following conclusions: (1) the land leverage has positively significant effects on house price fluctuations; (2) the higher investment demand ratio is, the bigger commercial housing price fluctuations will be; (3) the house price fluctuation has obvious time effect and regional effect.

The results in this paper provide the reference value for the real estate market participants.

For the real estate investors: to consider their own risk tolerance and risk preference, choose real estate investment sub-market which corresponds to their risk preference. For instance, the risk-averse investors or those with low risk bearing ability should choose the real estate markets where prices are less volatile, in order to pursue the long-term housing investment value with a lower risk. The risk-lover investors or those with greater risk tolerance can consider more volatile markets in order to realize the benefit maximization. Investors concern the factors influencing house price fluctuations, such as land leverage, investment demand ratio, etc., as these factors change, price volatility could change correspondingly. For instance, risk-averse investors could have invested in a less volatile sub-market, but once a sudden increase of land leverage or investment demand ratio happens, the

sub-market may well change from low volatile to high volatile. In this case investors should consider whether to get out of this real estate market in time.

For banks and other mortgage lenders: default risk and recovery ratio of collateral value are closely related to the volatility of house prices. The sharp fluctuations in house prices will increase the depreciating risk of the collateral value, and the default risk of the borrowers will increase accordingly. Therefore, house price fluctuations should be taken into account when mortgage lenders price the collateral and they should pay close attention to the land leverage, mortgage, investment demand ratio, regional position and the government regulation policy, etc.

For policy makers, government regulation and control policy has a significant effect on house price fluctuations. Policymakers can comprehensively consider social, economic and political factors and use the relevant policies to suppress the real estate price fluctuations. The available methods include: (1) to adjust land leverage. The government has absolute pricing power on land and they have both duty and ability to restrain land price and thus to reduce the proportion of land price in the whole house prices (for example, by lowering the land-transferring fees), to reduce house price fluctuation, to avoid significant ups and downs, and to maintain the stability of the real estate market. (2) To avoid imposing one policy uniformity in all cases: when making a national level real estate policy, the regional difference between eastern, middle and western regions should be fully considered, because the same regulation policy will produce different degrees of impact on the real estate market and cause different fluctuation range. (3)To restrain real-estate investment demand: policy makers can consider to suppress investment demand through tax and house holding conditions; Besides the real estate market, to further improve and standardize the investment market, and to provide more rich and safe investment options, thus avoiding too much investment fund flooding into the housing market and increasing the house price volatility.

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