

## Analysis on Influencing Factors on the Fluctuation of Commercial Housing Prices Based on ECM Model: Taking Changsha as an Example

CHEN Liping<sup>[a],\*</sup>

<sup>[a]</sup>Associate Professor, Basic Department, Hunan University of Finance and Economics, Changsha, China.

\*Corresponding Author.

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### Abstract

Based on the data from Changsha real estate market, this study builds a long-term equilibrium model and a short-term error correction model on the fluctuation of Changsha commercial housing prices. It shows that, GDP, urbanization rate, per capita saving and completed area of housing are the main factors on the fluctuation of Changsha commercial housing prices in the long term, while the influence from the factors of total housing investment, sold area of housing and per capita living area are limited. In short term, the fluctuation of Changsha housing prices has no ability of self-revising, and a real estate bubble is building in the whole market.

**Key words:** Housing Prices; Urbanization; Co-integration Test; Error Correction Model

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### INTRODUCTION

Real estate market has a strong correlation with the national economy, and a change in real estate prices may induce the risk in financial system. A study on the law of real estate market development is the fundamental basis

for government to make relevant policies. Since 2004, China's commercial housing prices have been rising sharply, bringing several unrest factors to people's living and the society. The Annual Report on the Development of China's Real Estate, 2010, which is published by Chinese Academy of Social Sciences, said that, China's real estate market is still in disorder, where government's control measures failing to resolve major problems and the rising housing prices brought by speculative investment pushing rigid-demand out, housing prices outpacing people's income causing economic problems. Real estate control measures are far to be mature, with some even leading to opposite results. Government takes a series of macro-control measures to restrain the bubble in the real estate market, which is effective in some regions, while in other regions, they are much less than expected. Therefore, it is of great significance to have an overall understanding of the factors on the fluctuation of commercial housing prices for the innovation of macro-control measures (Chen & Yang, 2007; Li, Chen, & Yang, 2009; Li & Chen, 2009; Meen, 2002; Malpezzi, 1999).

Many domestic and foreign scholars have analyzed the factors of housing price by establishing econometric models, and have obtained certain achievements. According to the principle of balance between supply and demand, Nellis and Longbottom (1981) tried to explain the determinants of housing price through the analysis of the data in the UK. They got a simplified formula of the average price of a commercial housing by using the method of econometric analysis, and concluded that: income was the most important factors influencing the housing price, followed by the mortgage interest rates and the stock of mortgage assets in the community (Longbottom, 1981). Case and Shiller (1989) also discussed the influence factors of housing price from supply and demand. Using the data from 1965 to 1990 in Hong Kong, Peng and Wheaton (1994) studied the spillover effect of land supply constraints. The empirical

results showed that the change of land supply had a great influence on land price, housing price and housing supply. Raymond (1998) researched empirically the relationship between housing price and land price in Hong Kong by using Granger causality analysis. The results showed that there was no causal relationship between housing price and land price. Glaeser, Gyourk and Hilber (2002) thought that the land price had a positive relationship with the regional economic development and human capital, but there is no direct relationship between housing price and land price by the method of regression analysis. Using a 12-year time series of the average housing price and the per capita annual income of urban residents, from China Statistic Year Book, Wu and Long (2005) implemented unit roots and co-integration tests as well as ADL and ECM models to find that the house prices and the income were cointegrated and have a longtime equilibrium. Meanwhile the income variation influences the prices with a 2-year lag and was insignificant in a short term. Using the theory of Markov chains, Xu and Hao (2010), tentatively present the short-term prediction of monthly average price and sales of Zhengzhou. Cui (2010) established a linear regression model, and then got a result by using Granger causality test, which showed that, the government policy of real estate, residential investment and development costs were the main factors influencing the housing price. In attempting to explain why house prices and urban land prices varied so dramatically between Chinese metropolitan areas, Zhang and Liu (2010) presented a simultaneous equations model of a metropolitan house market and urban land market to identify the two interrelated markets. At 105 observations from 35 Chinese metropolitans, the equations for housing prices and urban land prices were estimated by using OLS and 2SLS methods. The empirical results provided strong support that these two markets interacted and the housing prices and urban land prices were simultaneous determined by markets system. The results also suggested that population, wealth level, construction costs, house expected return and marketization degree of land system were important determinants causing housing prices and land prices to vary between metropolitan areas. But, average wage and urban amenity were not significant

determinants (Zhang & Liu, 2010).

The above studies analyzed the factors affecting the commodity residential house prices from the aspects of multiple factors , using the method of Granger causality test, linear regression model, factor analysis and partial least-squares regression, etc., but the main was to use static analysis method, not well reflecting the dynamic equilibrium process of commodity housing price fluctuations. This paper is planning to adopt the ECM model to have an overall analysis on the influencing factors on the fluctuation of commercial housing prices. Meanwhile, as one of the hot topics in current China's economy, how urbanization influence housing prices, which have not been explained before, will be included in this model as an explanatory variable, which is scarce to see in previous studies.

## 1. THE SELECTION OF VARIABLES AND SYMBOLS OF VARIABLES

There are various factors on the fluctuation of commercial housing prices, including macro economic as well as micro demand and supply. This study is mainly focused on the influence from economic development and the supply and demand of commercial housing on the fluctuation of prices. Main variables that involved and the explanation are as followed (see Table 1).

## 2. THE EXPLANATION ON DATA

Data in this study are mainly from the Changsha's Statistical Yearbook (1998-2012) and the Hunan's Statistical Yearbook (1998-2012). In order to reduce the impact of inflation, this study takes 1998 as the base year, dividing the nominal average housing prices, nominal total housing investment, nominal per capita saving and nominal GDP by the CPI of each year (100 in 1998) to achieve the actual average housing prices, actual total housing investment, actual per capita saving and actual GDP. Urbanization rate is the result of using population to divide the non-agricultural population. The software that is used in this study is EViews6.0.

**Table 1**  
**The Explanation on Main Variables**

Influencing factors	Main variables	The influence on housing prices	Symbols of variables
Economic Development	GDP	Positive	G
	Urbanization Rate	Uncertain	U
Demand	Total Investment	Positive	I
	Current Completed Area	Negative	C
Supply	Current Sold Area	Positive	S
	Per Capita Saving	Positive	D
	Per Capita Living Area	Negative	L

### 3. THE UNIT ROOT TEST OF VARIABLES

In practice, most of the economic and financial data are a non-stationary series. For a non-stationary time series, it is characteristic of certain numbers as time changes, that is to say, random regularity of it at all time points is different. It is hard to grasp the overall random time sequence through the sequence of known information. A feasible way is to put a non-stationary time series into a stationary series by a transformation, then build the model to describe the change laws of economic time series. A class of sequence in non-stationary sequence can be through the difference operation, with a stationary sequence, called difference stationary process. The standard method to check sequence smoothness is a unit root test. There are various methods of unit root test, including ADF test and PP test, NP test, etc.. In order to avoid “spurious regression”, a unit root test is needed before regression estimation of each variable to see its stability. The details are in Table 2.

**Table 2**  
**The Result of the Unit Root Test of Each Variable**

Variables	t-statistic	Prob	Variables	t-statistic	Prob
$\ln P_t$	-1.241	0.8511	$\ln U_t$	-1.1004	0.8790
$\Delta \ln P_t$	-7.190	0.0006	$\Delta \ln U_t$	-7.7867	0.0004
$\ln G_t$	-3.9581	0.0384	$\ln C_t$	-3.2841	0.1208
$\Delta \ln G_t$	-3.8045	0.0169	$\Delta \ln C_t$	-3.8010	0.0011
$\ln I_t$	-2.6875	0.2589	$\ln S_t$	-0.5812	0.9578
$\Delta \ln I_t$	-4.143	0.0311	$\Delta \ln S_t$	-4.2155	0.0076
$\ln D_t$	0.4720	0.9972	$\ln L_t$	2.3507	1.0000
$\Delta \ln D_t$	-5.252	0.0059	$\Delta \ln L_t$	-4.2929	0.0307

According to Table 2, the above variables are integrated of order one.

$$\ln(P_t) = \alpha_0 + \alpha_1 \ln(G_t) + \alpha_2 \ln(U_t) + \alpha_3 \ln(I_t) + \alpha_4 \ln(C_t) + \alpha_5 \ln(D_t) + \alpha_6 \ln(S_t) + \alpha_7 \ln(L_t) + u_t, \quad t = 1, 2, \dots, T \quad (1)$$

As the samples are limited in amount, not all explanatory variables can be put into the regression model (1) at the estimation of the regression equation (1). So, this study uses stepwise regression method to find out the best model. At the same time, in order to figure

### 4. THE TEST OF THE CO-INTEGRATION RELATION BETWEEN COMMERCIAL HOUSING PRICES AND EACH MAIN VARIABLE

Through the first order difference, variables with unit root became a stationary array, but the meanings of the variables are different from the previous array. If the regression is still need to be done on the previous array, it has to see whether there is a “long-term equilibrium relation” between the variables, which is the co-integration test. Engle and Granger (1987) proposed co-integration theory and method, provided another way for non-stationary sequence modeling. Although some economic variables itself are stationary series, however, they are likely to be the linear combination of stationary series. Concept of co-integration is a powerful concept. Because the co-integration allows us to depict the balance between two or more sequences or stable relationship. If the dependent variable can be explained by a linear combination of the independent variables, there is a stable equilibrium relationship between them, and the part cannot be explained by the independent variables constitutes a residual error sequence, then the residual sequence should be smooth. Therefore, inspection a set of variables (dependent variables and explanatory variables) whether there is a co-integration relationship between equivalent to test whether the regression equation of residual error sequence is a stationary series. If the residual sequence is steady, the regression equation set is reasonable, otherwise it is “false return”. The co-integration test can be classified into two types according to test objects: the test based on regression coefficient, like Johansen co-integration test, and the test based on regression residual, like AEG co-integration test. The latter one is adopted in this study to have a unit root test on the residual of regression equation.

First, to establish a double logarithmic linear regression equation between commercial housing prices  $P_t$  and variables of  $G_t, U_t, I_t, C_t, S_t, D_t$  and  $L_t$ .

out the influence of urbanization rate on housing prices fluctuation, this study takes the urbanization rate as a mandatory explanatory variable to put into the model. The regression result is as followed:

$$\ln(P_t) = -2.200 + 0.398 \ln(G_t) - 2.645 \ln(U_t) - 0.335 \ln(C_t) + 0.547 \ln(D_t) + \hat{u}_t$$

$$t = (-2.008) \quad (3.495) \quad (-4.464) \quad (-3.974) \quad (5.700) \quad (2)$$

$$R^2 = 0.990 \quad DW = 2.242$$

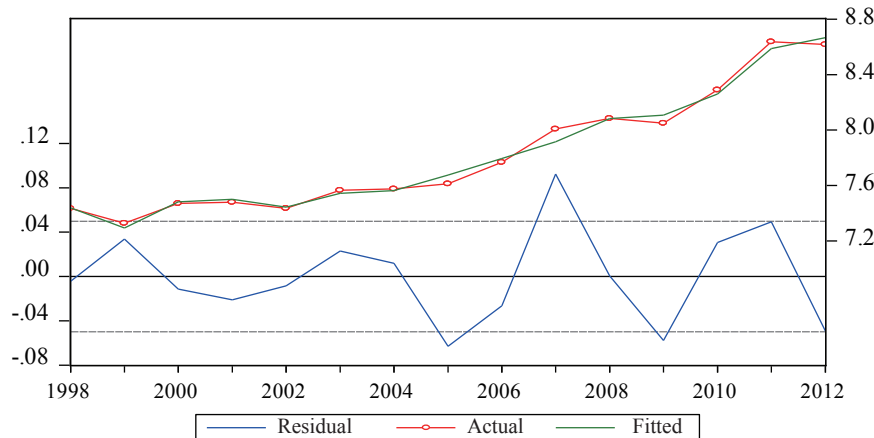
In the above equation,  $R^2=0.99$  means  $\ln(G_t), \ln(D_t), \ln(U_t), \ln(C_t)$  can give a good explanation on the fluctuation of housing prices. The symbol of estimated coefficient is in line with expectation-Durbin-Watson statistic is close to 2, at 2.242, meaning the model has no serial correlation and the regression effect is good.

Then, an AEG stability test is to do the residual  $\hat{u}_t$  in equation (2), excluding constant and time trend terms and using SCI principle to confirm lag orders. The results are in Table 3.

**Table 3**  
AEG Stability Test

	T-statistic	Prob
AEG-statistic	-10.008	0.000
Significance Level	1%	-4.80
5%	-4.15	
10%	-3.85	

The results show that, the residual array  $\hat{u}_t$  is stationary array, that is  $\hat{u}_t I(0)$ .



**Figure 1**  
The Comparison and Residual Between P's Fitted and Actual Values

The above result shows that, there is a co-integration relation between  $\ln(P_t)$  and  $\ln(G_t), \ln(D_t), \ln(U_t), \ln(C_t)$ , meaning that there is a long-term equilibrium relation between commercial housing prices and GDP, per capita savings, urbanization rate and current completed area.

## 5. THE ECM MODEL OF THE FLUCTUATION OF COMMERCIAL HOUSING PRICES

The regression model (2) only shows the long-term

$$\Delta \ln(P_t) = 1.193ecm_{t-1} + 0.331\Delta \ln(G_t) - 2.264\Delta \ln(U_t) + 0.528\Delta \ln(D_t) - 0.3124\Delta \ln(C_t) + \varepsilon_t$$

$$t = (3.929) \quad (2.8475) \quad (-2.299) \quad (4.9790) \quad (-5.2571) \quad (4)$$

$$R^2 = 0.91 \quad DW = 1.849$$

## 6. THE EXPLANATION ON MODEL

The co-integration regression model (2) gives a long-term equilibrium model of the fluctuation of commercial housing prices. In long term, GDP, urbanization rate, per capita saving and completed area are the main factors that influence the Changsha commercial housing prices, while the influence from total housing investment, sold area and per capita living area is limited. GDP and per capita savings have a positive effect on the growth of

equilibrium influence on commercial housing prices from external factors. While in fact, the previous housing prices also have an influence on the later prices. Then, the lag factor  $P_{t-1}$  of the housing prices themselves will be taken into consideration too. Making the residual array  $\hat{u}_t$  as an error correction term to achieve  $ecm_t = \hat{u}_t$ , and then the error correction model (3) is established.

$$\Delta \ln(P_t) = \beta_0 + aecm_{t-1} + \beta_1 \Delta \ln(G_t) + \beta_2 \Delta \ln(U_t) + \beta_3 \Delta \ln(D_t) + \beta_4 \Delta \ln(C_t) + \varepsilon_t \quad (3)$$

The regression result is as followed:

housing prices. A 1% increase in GDP causes an increase of around 0.4% in housing prices, while a 1% increase in per capita saving causes an increase of around 0.5% in housing prices. However, completed area and urbanization rate have a negative effect on the growth of housing prices. A 1% increase of the completed area causes a fall of around 0.3% in housing prices, while the impact from sold area is not clear, that means, in Changsha's real estate market, suppliers are in advantageous position but buyers have no advantage. Meanwhile, the impact from

urbanization rate has two sides. On one hand, urbanization expands the area of city, increasing the supply of land as well as housing, which brings down housing prices, and this is called the “supply effect” from urbanization rate to housing prices. On the other hand, urbanization means the growth of urban population, which lifts the demand for housing and pushes up housing prices. This is called the “demand effect” from urbanization rate to housing prices. The effect from urbanization rate is the combination of these two effects. From model (2), a 1% increase in urbanization rate causes a drop of around 2.6%, meaning that, in Changsha real estate market, the “supply effect” of urbanization rate is more than its “demand effect”. In the end, the effect from per capita living area on the fluctuation of housing prices is not big, meaning that, in Changsha real estate market, speculation is more serious, most houses are in the hand of a small minority and most people are averaged.

The Error correction model (4) gives a short-term model of the fluctuation of commercial housing prices. In short term, the fluctuation of commercial housing prices is decided by relatively stable long-term trend and short-term fluctuation—the degree of deviation of system from stable situation in the short term has a direct effect on the degree of fluctuation. The difference term in the model reflects the effect of short term, and error correction term  $ecm_t$  reflects the degree of housing prices from long-term equilibrium, and the coefficient of  $ecm_t$  reflects the adjustment strength when housing prices deviating from long-term equilibrium. According to the coefficient estimation 1.139, when short-term fluctuation deviating from long-term equilibrium, the market lack the ability to draw the housing prices to long-term equilibrium situation, but also intensify this deviation. This indicates that, there is a bubble building in Changsha real estate market amid the hot speculation, high expectation from consumers and investors as well as the non-rational expansion of bank’s loan. Once the bubble broke, it may cause imbalance in economic and social structure, financial crisis or even political and social crisis.

## CONCLUSION

The research shows that, in the short term, Changsha’s commercial housing prices have no ability to self-revising, and a bubble of the whole real estate market is building. In order to achieve a continuous, stable and healthy economic development, firstly, the government should take moderate control on the real estate market to restrain the expansion of the bubble and prevent it from breaking. Secondly, try to reduce the independence of social development on the real estate market to make

the commercial houses go back to its original role—living, and to decrease speculation. Thirdly, in the process of urbanization, more focus should be put on the “urbanization of humans” to improve people’s income so as to increase the demand for houses and to control the supply side, assuring a stable and healthy development of real estate market. Additionally, as this study doesn’t take land prices, developing cost and the impact from government’s policy into consideration, the influence from those factors on housing prices needs further research.

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