Macroeconomic Factors and Housing Market Cycle:

An empirical analysis using national and city level data in China

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Abstract: This paper analyzes the relationship between macroeconomic factors and the housing market cycle in China through theoretical and empirical analysis. The housing market cycle and the regional differences are investigated both on the national level and using data from four typical cities from China. It is found that house prices are determined by the current and lagged macroeconomic variables such as GDP. Significant regional differences in house prices are also identified. In the long run, there is a stable equilibrium relationship between macroeconomic factors and house prices. The elasticity of GDP, income and investment to house prices are greater than one. In the short run, the error correction mechanism can correct the deviation of house prices from the long run equilibrium level through a slow and gradual process. Among the four typical cities, Beijing and Shanghai have greater fluctuations in their house prices than Guangzhou and Chongqing.

Keywords: real estate cycle; macroeconomic factors; Impact-Transmission Mechanism; error correction model; regional differences

1 Introduction

Having a long industrial chain and taking up a large portion of total investments, real estate industry has become the pillar industry of domestic economy in China since the reform of urban housing system in 1998. However, being affected by internal conduction mechanism and external shocks, real estate market is prone to cycle fluctuation. Besides, because market participants are usually myopic and speculative, it can not only cause real estate market to be against the initiative of new technology and institutions but also results in a waste of social resources, which can further trigger financial crisis and influence national economy stability.

During the process of explaining the fluctuation of real estate cycle and its internal formation mechanism, more and more experts are concerned about the influence of macroeconomic variable. Mankiw(1988) regards the demographic factor as the main factor which affect real estate cycle. Poterba (1991) regards the use cost is the principal factor that influence house price fluctuation. Pyhrr and Born(1994), Clapp and Giaccotto(1994), Gordon (1996), Green (1997), Muellbauer and Murphy (1997), Quigley (1999) illustrate that macroeconomic factors and the demographic factor have remarkable influences on real estate cycles. However, they debate on the effect of specific macroeconomic factor which influence real estate cycles, partly because of regional differences of real estate cycles and data qualities.

The remainder of the paper is organized as follows. Section 2 provides a theoretical model, followed by empirical analysis in Section 3. Section 4 concludes.

2 Theoretical analysis

2.1 The macroeconomic factors that influence housing market cycle

The influences of macroeconomic factors on housing market cycle can be divided into three parts: demand, supply and expectation.

First, the demand-side factors including economic growth, income and demographic variables are analyzed. Economic growth is the foundation and guarantee of the sustainable development of housing market. American economist Simon Kuznets believes real estate development has a close relationship with economic growth after analyzing a large amount of data of different countries.

Income and demographics are the other two critical factors which determine the demand for housing. The change of their growth rate brings about demand shock for housing market directly. When the *PCDI* (per capita disposable income) or the growth rate of urban population increase, the demand for housing rises and the vacancy rate declines while rent and house prices continue to rise. But because the short-term supply is inelastic, house prices rise. When the supply is surplus, market situation will turn out to be worse combined with the fluctuation of economic periods.

Second, the supply-side factors including investment, credit quota and cost are analyzed. Investment is often considered as one of the troika pulling China's economy growth in recent years, about a quarter of which is real es-

tate investment[①]. Usually the amount of real estate investment is large, highly risky, and fulling of uncertainties which make the real estate investment tend to be fluctuant. Besides, The myopic developers increase the periodic fluctuation of real estate market.

The investment amount of housing market is large and the construction period is long which determine that credit quota has a major influence on the periodic fluctuation of housing market. The interaction between the expansion of money supply and rising prices causes housing market to be prosperous. On the contrary, the interaction between credit contraction and declining prices bring about depression of housing market.

The land cost which constitutes a large portion of housing investment play an important role in the formation of housing market cycle. It is the traditional opinion that when housing market is impacted by the demand, the house prices will go up and this will stimulate the developers to increase investment as a result. But to a certain degree the rising land prices can share some benefits, which can curb the expansion of housing market. However, there are also studies that consider the profit effect of the house investment brought by land is greater than the cost effect (Liang Yunfang, 2007). The house prices drive the land prices and in turn the land prices prop up the house prices. This phenomenon was verified by the high price in 2007 when Di Wang, namely land with highest auction price, occurred frequently in China.

Finally, expectation also plays an important role both on supply side and demand side in the formation of housing market cycle. Since the information is incomplete, market agents usually have adaptive expectations, which means that they form their expectations based on the past experiences. This kind of expectation tends to make housing market too optimistic when the market is prosperous and too pessimistic when the market is undergoing depression.

2.2 The housing market cycle model

According to Wheaton and Torto(1990) and Quigley (1999), we use the Impact-Transmission Mechanism to explain China's housing market cycle. In this model, the macroeconomic factors are considered as the external shocks, the changes of which are reflected by the change of the optimal housing stock. Then the change of the optimal housing stock is magnified through accelerator. Here the accelerator and lagged construction variables are regarded as internal conduction mechanism which can transmit the external shocks into the changes of the incremental housing supply. The result is the periodic fluctuation of housing market. The model is defined as follows:

$$TD_t = \mu(K^* - K_{t-1}) + \delta K_t \quad (1)$$

Where TD_t is the total incremental supply of housing, K^* is the optimal housing stock, K_{t-1} is the actual housing stock in the last period, μ is the elasticity coefficient, δ is the depreciation rate of housing. Equation (1) implies that the total incremental supply of housing consist of the new incremental supply and the stock depreciation. Besides, the new incremental housing supply can make adjustment to the differential section of housing stock. But Owing to the inelasticity of supply, the adjustment is slow.

$$CD_t = TD_{t-n} \quad (2)$$

Where CD_t is the accomplishment of housing investment. Equation (2) means that due to the time-lag in housing development, new construction need time to be turned into actual supply.

$$K_t^* = P(GDP_t,\ INC_t, POP_t, I_t, D_t, C_t) \quad (3)$$

Where GDP_t is the gross domestic product, INC_t is the per capita disposable income, POP_t is the urban population, I_t is the housing investment, D_t is the balance of credit, C_t is the cost of housing development. Equation (3) indicates that the optimal housing stock is a function of the income, urban population, housing investment and cost of housing development. Substitute equation (3) into (2):

$$CD_t = \mu(K_{t-n}^* - K_{t-n}) + \delta K_{t-n} = \mu K_{t-n}^* + \gamma K_{t-n} \quad (4)$$

Substitute equation (3) into (4):

$$CD_t = \mu P(GDP_{t-n},\ INC_{t-n}, POP_{t-n}, I_{t-n}, D_{t-n}, C_{t-n}) + \gamma K_{t-n} \quad (5)$$

The analysis mentioned above constitutes the supply side of the model. The demand side is deduced as follows:

$$DE_t = P(GDP_t, INC_t, POP_t, CPI_t) \quad (6)$$

Where DE_t is the demand for housing, GDP_t is the gross domestic product, INC_t is the per capita disposable income, POP_t is the urban population, I_t is the housing investment, CPI_t is the consumer price index. Equation (6) indicates the demand for housing is affected by the economic development, per capita disposable income, urban population and the consumer price index.

Take both the supply side and the demand side into account and then:

$$RP_t = P(GDP_{t-n}, INC_{t-n}, POP_t, CPI_t, I_{t-n}, D_{t-n}, C_t, K_t) \quad (7)$$

Where *RP* is the house prices. Because the change of the building cost and housing stock is relatively small and the housing is gradually going into the market, so the current variables are in the model. Equation (7) indicates the house prices is affected by the current and lagged macroeconomic factors such as GDP.

3 Empirical Analysis

3.1 Variables and Data

[①] In 2007 and 2008 China's urban fixed asset investment reached 117464.5 and 148738.3 billion yuan, meanwhile real estate investments reached 25288.8 and 31203.2 billion yuan. So within the urban fixed asset investment, the proportion of real estate investments is 21.5% and 21.0% respectively.

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Following variables are used throughout the model:

P=House prices;

GDP=Gross domestic production;

POP=Urban population at the end of year;

INC=Per capita disposable income;

I= Fixed asset investment;

CPI=Consumer price index;

D=Loans of financial institutions;

C=Average construction cost of completed residential units;

K=Housing stock.

P is the dependent variable, reflecting house price dynamics, and the others are independent variables. The data used in this study are from nation and four typical cities including Beijing, Shanghai, Guangzhou and Chongqing over the period from 1995 to 2008. In order to eliminate negative influence for example long-term growth trend, heteroscedasticity and outliers, we convert those data into their logarithm values and make regression analysis based on logarithmic model. All data are from CEInet's China Statistical Databases, National Bureau of Statistics website and local bureau of statistics websites.

3.2 Econometric Model

Considering that there will probably exists lag effects in the impact of *GDP*, *INC*, *I* and *D* on *P*, We firstly make respectively correlation analysis between *P* and the four variables mentioned above which involve current and lagged variables so as to determine the optimal lagged independent variables. The results are demonstrated in Table 1.

Table 1 The Results of Optimal Lagged Variables

Nation	Beijing	Shanghai	Guangzhou	Chongqing
GDP	*GDP2*	*GDP*	*GDP*	*GDP1*
INC	*INC1*	*INC*	*INC*	*INC2*
I1	*I2*	*I2*	*I1*	*I1*
D1	*D1*	*D2*	*D1*	*D*

Note. GDP, GDP1, GDP2 represents respectively current variable, one-year lagged variable and two-year lagged variable. So are the others.

Based on the analysis above, we construct the following basic econometric model which is applied to Nation, Beijing, Shanghai, Guangzhou and Chongqing[①]:

$$\mathrm{LNP}_t = \partial_0 + \partial_1 LNGDP_t + \partial_2 LNINC_t + \partial_3 LNPOP_t + \partial_4 LNCPI_t + \partial_5 LNI_t + \partial_6 LND_t + \partial_7 LNC_t + \partial_8 LNK_t + \xi_t \quad (8)$$

3.3 Empirical Findings

3.3.1 Unit Root Test

We eliminate the heteroscedasticity and reduce the volatility of data in log linear form (for example using *LNGDP* instead of *GDP*). Augmented Dickey-Fuller unit root test is used to check each variable for stationary (The period which the variable is lagged is determined according to the principle of AIC and CS). The results of the level and first differences of all the economic time series are shown in table 2. We conclude that each of the series is integrated of order 1 at the 5% level.

Table 2 Augmented Dickey-Fuller Unit Root Tests Results

	Levels		First differences	
	t-statistic	Prob.	t-statistic	Prob.
LNGDP	(n,n,2)=1.71	0.97	(c,n,2)=-5.34	<0.01
LNINC	(c,t,2)=0.51	0.99	(n,n,3)=-5.35	<0.01
LNPOP	(c,t,2)=2.92	1.00	(n,n,0)=-5.68	<0.01
LNI	(c,n,2)=0.08	0.99	(n,n,2)=-4.49	0.01
LNCPI	(c,n,1)=-2.53	0.13	(c,n,1)=-6.43	<0.01
LND	(n,n,2)=-2.19	0.22	(n,n,2)=-6.43	<0.01
LNC	(c,n,2)=-0.56	0.84	(c,n,2)=-4.56	0.01
LNP	(c,n,2)=-0.61	0.83	(n,n,2)=-4.32	0.02
LNK	(c,t,2)=-1.42	0.80	(c,n,1)=-4.93	0.01

Note. c represents the constant in test equation, t denotes the trend in test equation, the number 0 to 4 represents the lag length based on SIC, n denotes no constant or trend in test equation, all variables are in the logarithm form.

3.3.3 Error Correction Model

In order to estimate the equilibrium level of house prices in the long-run and short-term fluctuation, we construct error correction model and adopt the Engle and Granger two-step procedure. In the first step, the equilibrium level of house prices in the long-run is estimated with the OLS method. Augmented Dickey-Fuller unit root test is used to check each variable for stationary. If all variables are of the same order of integration, the linear regression equations (8) can be estimated with the OLS method. On the condition that the residual derived from this regression is stationary in the level, the estimation results are valid and there exist a long-run equilibrium relationship between house prices and other explanatory factors. With the estimated model the equilibrium level of long-run house prices can be derived.

Table 3 Results of ADF Tests of Residual Series

	Augmented Dickey-Fuller test statistic		Test critical values	
	t-Statistic	Prob.	t-Statistic	Prob.
Nation	（c,t,2）=-3.88	0.02	-3.18	0.05
Beijing	（c,n,1）=-3.45	0.03	-3.18	0.05
Shanghai	（c,t,3）=-3.45	0.03	-3.18	0.05
Guangzhou	（n,t,2）=-5.62	<0.01	-3.12	0.05
Chongqing	（c,t,2）=-4.72	<0.01	-3.12	0.05

According to Table 3, we can reject null hypothesis at 5% significant level which means that all the explanatory variables are cointegrated. Then the estimation results are valid and there exist a long-run equilibrium relationship between house prices and the explanatory factors.

In the second step, the one period lagged residuals in equations (8) are taken as the error correction terms in

① The specific forms of model representing the situation of nation and four cities adopting different lagged variables.

the short-run dynamics model respectively. Equation (9) is estimated with the OLS method[①].

$$DLNP_t = \beta_0 + \beta_1 DLNGDP_t + \beta_2 DLNINC_t + \beta_3 DLNCPI_t + \beta_4 DLNI_t + \beta_5 DLND_t + \beta_6 DLNC_t + \beta_7 DLNK_t + \beta_8 ecm_t + \xi_t \quad (9)$$

Table 4 Results of Correction Model Regression

	Nation	Beijing	Shanghai	Guangzhou	Chongqing
β_0	-0.267	-6.798	5.933**	-6.106	-4.922
	（3.11）	（10.69）	（1.33）	（9.11）	（6.99）
β_1	2.633	0.193	0.890	0.287	0.394
	（1.63）	（1.89）	（0.54）	（0.61）	（0.33）
β_2	1.326	3.632	0.682**	0.240	1.639
	（2.37）	（1.85）	（0.22）	（0.45）	（1.03）
β_3	-0.008	1.591	-1.301**	-0.109	1.799
	（0.64）	（2.31）	（0.29）	（0.85）	（1.20）
β_4	2.151**	0.018	-0.123	-0.182	-0.053
	（0.78）	（0.20）	（0.09）	（0.18）	（0.09）
β_5	-0.550	-0.811	-0.103	-1.478	0.777
	（0.99）	（0.56）	（0.27）	（2.32）	（1.67）
β_6	0.009	0.170	0.357**	0.752	0.016
	（0.38）	（0.47）	（0.08）	（0.51）	（0.24）
β_7	-0.139	-0.663	-0.288	-0.389	-0.445
	（0.62）	（0.51）	（0.31）	（0.33）	（0.37）
β_8	-0.382	-1.646**	-1.085**	-0.308	-0.530
	（1.22）	（0.49）	（0.35）	（0.55）	（0.90）
Adjusted R^2	0.66427	0.58781	0.88524	0.43454	0.32252
F-statistic	3.96791	2.90141	11.2854	0.82212	0.95313
D-W	2.18459	2.49055	2.50122	2.29080	2.67974

Note. Standard error of the estimated coefficients are given in the parentheses, ,** and*** denotes 10%,5% and 1% significant level respectively.*

Based on Table 4, analysis of national data shows that: *GDP*, per capita disposable income and fixed asset investment have greater impact on house prices than the other explanatory variables whose elasticity are greater than 1 while average construction cost of completed residential units and housing stock have lower impact on house prices. Generally from nationwide aspect, there exists relatively stable long-term equilibrium relationship between macroeconomic variables and house prices. In the long run, the increase in house prices is largely because of increases in *GDP*, per capita disposable income and fixed asset investment. In the short term, non-equilibrium error in the previous period makes current house price volatility correction of which the extent is lesser. So when an external shock makes short-term fluctuation deviate from long-term equilibrium level, it takes long time for error correction mechanism to correct it, hence house prices are prone to cyclical fluctuation.

Analysis of four typical cities shows that: The impact of macroeconomic factors on house price cyclical fluctuation varies according to housing market in different regions. In Beijing and Chongqing, per capita disposable income has significant effect on house prices whose elasticity are greater than 1 while the effects are lower in Shanghai and Guangzhou. Referring to *CPI* and loans of financial institutions, even the coefficient sign is opposite in different regions. This situation may be due to adopting different periods lagged. Meanwhile, construction cost of residential units, housing stock and *GDP* have lower influences on house prices in each region. Finally in the case of short-term fluctuation, the extent of current price deviation correction made by non-equilibrium error in the previous period also varies in different regions. The extent of correction is larger and house prices have stronger sensitivity and volatility in Beijing and Shanghai than that of Guangzhou and Chongqing.

4 Conclusion

This paper analyzes the relationship between macroeconomic factors and the housing market cycle in China through theoretical and empirical analysis. The housing market cycle and the regional differences are investigated both on the national level and using data from four typical cities from China. It is found that house prices are determined by the current and lagged macroeconomic variables such as GDP. Significant regional differences in house prices are also identified. In the long run, there is a stable equilibrium relationship between macroeconomic factors and house prices. The elasticity of GDP, income and investment to house prices are greater than one. In the short run, the error correction mechanism can correct the deviation of house prices from the long run equilibrium level through a slow and gradual process. Among the four typical cities, Beijing and Shanghai have greater fluctuations in their house prices than Guangzhou and Chongqing.

References

[1] Case, K. E., & Mayer, C. J. (1995). The housing cycle in Eastern Massachusetts: Variations among cities and towns. New England Economic Review, pp. 24-40 (March/April).

[2] Edelstein R. H.& Desmond Tsang. Dynamic Residential Housing Cycles Analysis. Real Estate Finan Econ (2007) 35:295-313.

[3] Gordon, J., Mosbaugh, P., & Canter, T. (1996). Integrating regional economic indicators with the real estate cycle. Journal of Real Estate Research, 12(3), 469-501.

[4] Grenadier, S. R. (1995). Local and national determinants of office vacancies. Journal of Urban Economics, 37,57-71.

[5] Liang Yun Fang: China's economic growth cycle fluctuations of real estate during the transition period - in the measurement of characteristics, causes and structural changes [D], Dongbei University of Finance PhD thesis, May 2007.

[6] Liu Hongyu, Shen Yue: housing prices and economic fundamentals: 1995-2002 An Empirical Study of China's 14 cities [J], Economic Research, No. 6, 2004.

① Base on Granger causality test, we have excluded the variable *POP* in models, the same below.

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[7] Michael Ball etc: The Economics of Commercial Property Markets, Part 2 Macroeconomics and the Property Market. 134-213.
[8] Muellbauer, J. & Murphy,A. (1997). Booms and busts in the UK housing market. The Economic Journal, 107, 1701-1727 (November).
[9] Peng W S,Tam D C,Yiu M S.The Property Market and the Macroeconomy of the Mainland:A Cross Region Study[J]. Pacific Economic Review,2008,13(2): 240-258.
[10] Phyrr, S. A., & Born, W. L. (1994). Real estate valuation: The effect of market and property cycles. Journal of Real Estate Research, 9(4), 455-486 (Fall).
[11] Quigley,J.M.(1999).Real estate prices and economic cycles. International Real Estate Review, 2(1), 1-20.
[12] Seko, M. (2003). Housing prices and economic cycles: Evidence from Japanese prefectures. Macro-Housing Workshop at Chinese University of Hong Kong.
[13] Tan Gang:The analysis of the real estate cycle transmission model and its main factors [J], "Construction Economics," No. 7, 2002.
[14] Wheaton, W. C. (1999). Real estate cycles: Some fundamentals. Real Estate Economics, 27(2), 209-230.