VGTU LEIDYKLA TECHNIKA

STUDY OF GUANGZHOU HOUSE PRICE BUBBLE BASED ON STATE-SPACE MODEL

Eddie Chi Man HUI [1] ✉ and Qi GU [2]

[1] *Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong*
E-mail: bscmhui@inet.polyu.edu.hk; Tel.: 852-27665881; fax: 852-27645131
[2] *Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong*
E-mail: guqi52@163.com

Received 6 August 2009; accepted 23 September 2009

ABSTRACT. Previous literature has explored Guangzhou's real estate market bubble problem, by using the perspective of rent receipts to measure the fundamental housing value. Since there is high proportion of owner-occupied property in Guangzhou; and that the household income is considered a key factor affecting housing price level, this article is from the perspective of household income, by the present asset market model, it sets up housing price model that analysis of the bubble phenomenon, and uses the state-space model that can be estimated characteristics by unobservable variables. The article estimates the price bubble and analyzes the size of the bubble at different times. The housing price in Guangzhou from January 2004 to December 2008 is studied. The results concluded that the housing market bubble peaked in October 2007 at around 43% of the market housing price.

KEYWORDS: Housing price; Income; Bubble; State-Space Model

1. INTRODUCTION

In recent years, in Guangzhou, due to an increase in housing demand and economic growth, coupled with increased speculative activities resulting from good signals for future economic activities such as the forthcoming 2010 Guangzhou Asian Games etc., the housing price soared by 131.5% between 2004 and 2007 (from about RMB 5,000 per square meter in 2004 to RMB 11,574 per square meter in October 2007)[1]. Since 2008 the housing price in Guangzhou has come down, though the price level is still considered high, because of the Central Government's macro-control policies, as well as global recession.

In theory, the market equilibrium prices are determined by supply and demand. In Guangzhou, household income, which represents affordability, is an important indicator of housing market demand: during the aforementioned housing price boom, the annual growth rate of Guangzhou family disposable income was approximately 11.5%. Clearly, family disposable income contributes to part of the housing price growth, and there could be some other factors which constitute such growth.

[1] Guangzhou Municipal Bureau of Land Resources and Housing Management

International Journal of Strategic Property Management
ISSN 1648-715X print / ISSN 1648-9179 online
http://www.ijspm.vgtu.lt
DOI: 10.3846/1648-715X.2009.13.287-298

According to Xu et al. (2000), the demand for assets can be divided into real demand and speculative demand; in particular the later one is a direct cause of real estate bubbles. Wang and Ming (2007) compare the methods of real estate bubble measurement in China with that of the overseas. Many real estate bubble researches have been carried out in China using different approaches, for instance the overall target measure, vector autoregressive (VAR) test, etc. However, since it is not until lately that real estate market in China begins to develop, not much data is available for research, which hinders the study quite a lot.

Income is a prerequisite for durable purchases. Chen (1990), Hsueh (1990), Wu (1994), conclude that income growth is positively related to housing price; Giussani and Hadjimatheou (1991), Milne (1991), Chen and Patel (1998) also find that a long-run equilibrium situation exists between housing price and income, i.e. stabilized figures could have be found in "price-to-income ratio". This is backed by the findings of Black et al. (2006), which study the British real estate bubble by calculating such ratio. Chang et al. (2008) also set up housing price-income and housing price-rent state-space model to analyze the Taipei housing price bubble. Therefore, the author justifies that the study of housing price bubble phenomenon should begin with estimating the housing price – income ratio.

Some researches attempt to quantify price bubble by means of regression analysis which addresses the difference between the actual and fundamental housing price, however, their assumptions to various market-based factors are somehow different; such approach is less preferable because it may result in error in regression residual models, and eventually cause discrepancy in housing price bubble calculations. In the field of studying price bubble, it is obvious that the deviation of market price from fundamental value, and the trend of the price bubble are still yet to be measured with more sophisticated calculations.

This article attempts to apply the state space model as the theoretical foundation, and use Kalman filter as a recursive way of computing method, together with a housing price – income model constructed based on the housing price in Guangzhou, to track bubble phenomenon.

This paper consists of five sections: following this introductory section is the literature review. Section 3 explains the empirical model and strategy. The remaining two sections analyze the data set and make conclusion respectively.

2. LITERATURE REVIEW

The real-estate market has the longest and the most reliable history of boom and bust. The study on price bubbles slowly develops as the real estate market evolves. Early researches on price bubble mainly focus on identification of possible indicators and research methods innovation. Some advancement in recent studies is discussed as below.

2.1. Market fundamental, housing price and rent

Since the last decade researches has extended to study bubble phenomenon by tracking the movements of market fundamentals, housing price and rent. For instance, Case and Shiller (2003), Bourassa et al. (2001), Hui and Yue (2006) select supply-side and demand-side factors as the fundamental price factors, then test the impact on housing price using different composition of these factors. The error term of the returned structure will be a price bubble.

Bjorklund and Soderberg (1999) examine the 1985–1994 cycles in the Swedish property market and conclude if that the ratio of property value to rent increased too much, a bubble may have existed. In the contrary, Tseng et al. (2005) express that Taiwan's long-run equilibrium adjustment function of the rent is

insignificant, i.e. housing price and rent have no significant causal relationship.

Lee (1997) conducted a test of bubble in the land price of Korea between 1964 and 1994. Using a structural model with Gross National Product, interest rate and money supply as fundamentals, he rejects the hypothesis that only the market fundamental drive the land price in Korea, suggesting that other indicators should also be taken into consideration while studying bubble phenomenon.

2.2. Income and housing price relationship

Further studies on real estate bubbles suggest incorporating income into the bubble analysis because a casual relationship is found between housing price and income. Knowing that housing price is an indicator of bubbles, a change in income growth could be influential to formation of real estate bubbles.

According to Giussani and Hadjimatheou (1991), Milne (1991), Chen and Patel (1998), income and housing price have a positive relationship. They use co-integration test to show the relevance of the basis of significant, and find that housing price and income exist long-run equilibrium situation. Kim and Lee (2000) also stand for the existence of an equilibrium relationship between income and housing price. They supplement that, in the short run, nominal and real land prices might not co-integrate with market fundamentals because speculative forces could drive prices away from market fundamentals; however, in the long run, such co-integration relationship exists because fundamental forces will eventual reassert themselves. This is consistent with Blanchard and Watson (1982)'s notion that speculative bubbles are periodically collapsing.

Fernández-Kranz and Hon (2006) comment that bubble is formed when there is a rise in housing price caused by unusual fluctuations in demand. In usual, people engage in durable purchases either for investment or consumption, thus their paper investigates the relationship between price growth and bubble phenomenon in the perspectives of both the investors and homebuyers. They conclude that, in either case, income is a key factor determining whether investors or homebuyers can engage in property purchase or not. Fernández-Kranz and Hon then compare the predicted house value with the current market price, and then estimate the Spanish bubble price proportion. Their findings show that income is the most influential factor on housing price; and the bubble size might change with income growth.

Similarly, Black et al. (2006) also use disposable income as the key factor to construct a time-variable present value model for studying housing price bubbles. VAR models are adopted to test the present value of housing prices. They then estimate the fundamental housing value, calculate its difference with the market price and find out the proportion in British housing market bubble price.

2.3. Other approaches

Apart from looking at the housing price, market fundamentals and income growth, recent researches have explored many other approaches in analyzing real estate bubble phenomenon, they include: the asset pricing model (Lin, 1996), linear regression model (Zhang and Yang, 1999), present value method (Smith and Smith, 2006), property stocks analysis (Scott, 1990; Brooks et al., 2001), Markov-switching ADF approach (Xiao, 2005) etc.

It is worthwhile noting that, the results of bubble study depends heavily on the type of tests used, as well as the choice of data set: Lim (2003) conducted two bubble tests based on the present value relation on the housing price of Korea, one is a modified volatility test (MRS test) suggested by Mankiw et al. (1985), another is a combination of the Unit-Root Test suggested by Diba and Grossman (1988), and the co-integration test introduced by Campbell

and Shiller (1987). The MRS test shows that the null hypothesis of market efficiency is rejected, indicating the existence of irrational bubble. On the contrary, the Unit-Root Test and co-integration test suggest that bubbles do not exist.

2.4. Authors' choice: State Space Model

In Guangzhou, durable purchases require buyers to enter into typical mortgage agreements such that they are required to repay loan principle on a regular basis. Since it is established from literature that there exists relationship between income and housing price, it is justifiable to take both factors into consideration while studying bubble phenomenon. According to the "house price-income ratio" equilibrium relationship, a change in the ratio could be a symptom of housing price bubble. Many research works regarding the real estate bubble in China have been carried out, but none investigates the bubble problem by analyzing the relationship between house price and income. Therefore, this article aims at studying Shenzhen house price bubble by taking both factors into consideration.

Bubble price is an unobservable variable; the most common tests to prove its existence include the Unit Root Test (to study whether the housing price is at steady state), and the co-integration test (for the housing price and market-based factors). However, these tests still cannot measure the price bubble in quantifiable terms.

One possible solution is to adopt the state space model. There are plenty researches which use the state space model to study bubble phenomenon: Bertus and Stanhouse (2001) use the model to investigate whether there is a random bubble gold market; Lau et al. (2005) and Alessandri (2006) apply it to study stock price bubble situation; Xiao and Tan (2007) combine rent with housing price, and then use the state space model together with the Kalman Filter to examine bubble phenomenon. Similar approach is also applied by Chang et al. (2008) to study the real estate phenomenon in Taipei.

No literature has adopted the state space model yet to study the real estate bubble phenomenon in China. As a result, this article attempts to apply the model as the theoretical foundation, and use Kalman filter as a recursive way of computing method, together with a housing price – income model constructed based on the housing price in Guangzhou, to track bubble phenomenon.

3. METHODOLOGY

3.1. House price vs. Income model

For those who purchase property for self-occupation, they tend to look for property with a reasonably affordable price. Capozza et al. (2004), Sutton (2002), Case and Shiller (2003) and Farlow (2004) point out that the real income and interest rates are important determinants of real house prices. Hence Black et al. (2006) discount the expected value of future real disposable income; they use VAR models to test the present value of the housing price, and convert it to a state-space model for housing price bubble estimation. The model is as shown below:

$$P_t = E_t \sum_{i=1}^{\infty} \left(\frac{1}{\prod_{j=1}^{i} (1 + \rho_{t+j})} \right) Q_{t+i} \tag{1}$$

where: P_t is the real price at the end of period t; Q_{t+1} is real disposable income measured during $t+1$, and ρ is the real discount rate. Eqn(1) is a particular solution to $P_t = (P_{t+1} + Q_{t+1}) / (1 + \rho_{t+1})$, and it follows that:

$$1 + \rho_{t+1} = (p_{t+1} + Q_{t+1}) / P_t \tag{2}$$

Taking *lns* and using lower case letters to represent the *lns* of their upper-case counterparts, we have:

$$r_{t+1} = \ln(1+\rho_{t+1}) = \ln(1+\exp(q_{t+1}-p_{t+1})) + p_{t+1} - p_t \quad (3)$$

where: r is defined as $ln\ (1 + \rho)$ and the term $(q - p)$ can be viewed as the economy-wide income-price ratio. Applying the first-order Taylor expansion and Eqn(3) can be written as:

$$r_{t+1} = -(p_t - q_t) + \mu(p_{t+1} - q_{t+1}) + \Delta q_{t+1} + \kappa \quad (4)$$

where: k and μ are expressed as follows:

$$\kappa = -\ln\mu - (1-\mu)\overline{(q-p)}$$

$$\mu = 1/(1+\exp\overline{(q-p)})$$

where: $\overline{(q-p)}$ is the sample mean of $(q - p)$. Clearly, $0 < \mu < 1$ and in practice is close to 1. Denote the (log) price-income ratio, $p_t - q_t$, by pq_t and rearrange Eqn(4) as:

$$pq_t = \kappa + \mu pq_{t+1} + \Delta q_{t+1} - r_{t+1} \quad (5)$$

After repeated substitution for pq_{t+1}, pq_{t+2}, on the right-hand side of Eqn(5), we have:

$$pq_t = \frac{\kappa(1-\mu^i)}{1-\mu} + \sum_{j=0}^{i-1}\mu^{j+1}E_t\Delta q_{t+j+1} - \sum_{j=0}^{\infty}\mu^{j+1}E_t r_{t+j+1} + \mu^i pq_{t+i} \quad (6)$$

Let $i \to \infty$ and assume that the limit of the last term is 0, we shall obtain an alternative form of Eqn(6) as follow:

$$pq_t = \frac{\kappa}{1-\mu} + \sum_{j=0}^{\infty}\mu^{j+1}E_t\Delta q_{t+j+1} - \sum_{j=0}^{\infty}\mu^{j+1}E_t r_{t+j+1} \quad (7)$$

where: $E_t\ r_{t+j+1}$ is the investors' required return.

In order to use Eqn(7) to generate a series for pq_t^* and p^*, Black et al. (2006) put the price-income ratio, the expectation of income growth, and the housing return variance into a three-variable VAR model, so as to test the present value model. Lastly, (the log of) fundamental house prices can be generated as:

$$p_t^* = pq_t^* + q_t \quad (8)$$

Since the fundamental value model of house price cannot be ruled out the existence of price bubbles, and that the size of house price bubble is unable to be observed in advance, Chang et al. (2008) assume that price bubble is a stochastic froth, they use the house price and the state space model which carry on the real diagnosis to match accordingly. This article shall adopt a similar empirical model as shown below:

$$p_t = c_1 pq_t^* + c_2 q_t + b_t + \upsilon_t \quad (9)$$

$$b_t = \varphi^* b_{t-1} + \varpi_t \quad (10)$$

And:

$$E\left[\upsilon_t \omega_s^{'}\right] = 0$$

$$E\left[\varpi_t\right] = 0$$

$$Var\left[\omega_t\right] = \sigma_w^2$$

3.2. State Space Model

One advantage of adopting State Space Model (SSM) is the use of circuitous method for calculating with the Kalman Filter, i.e. parameters of model composed of state variables are obtained via observing model composed of observable variables using Maximum Likelihood Estimation. Therefore, any unobservable variable existing in model can mostly obtained by SSM in econometric literatures. It consists of two equations, one is a measurement equation which expresses the relations between observable variables and unobservable variables; while the other is a transition equation which mainly describes the dynamic state variables:

Equation 1 (measurement equation):

$y_t = A^{'}x_t + H^{'}\xi_t + w_t \quad w_t \sim$ i.i.d.N (0, R);

Equation 2 (transition equation):

$\xi_{t+1} = F\xi_t + \upsilon_{t+1} \quad \upsilon_t \sim$ i.i.d.N (0, Q).

In both equations, y_t refers to an observable $n\times1$ vector variable at the period of t; ξ_t refers to an unobservable $r\times1$ vector variable at the period of t; $H^{'}$ is a $n\times r$ correlation matrix means mutual relations between y_t and ξ_t; x_t is an $k\times1$ exogenous vector or observable vector decided; $A^{'}$ and F are respectively $n\times k$, $r\times r$ matrix, which are combined correlation matrix including measurement variance R and state variance Q, they are not regarded as stochastic matrix without special hypothesis; and $(n\times1)$ w_t, $(r\times1)$ υ_t are both independent white noise.

Accordingly, bubbles could be regarded as an unobservable state variable, and could be resolved by SSM.

3.3. Establishment of estate bubble measuring model

Theory reducing income to fundamental housing price is applied to SSM (all variables should be changed into logarithm value). The model is applied as follows (where p_t is housing price, pq_t^* is ratio of housing price to income, q_t is income, B_t is bubble, and ε_t, η_t are error terms):

Measure equation:

$$y_t = A^{'}x_t + H^{'}\xi_t + w_t \ldots p_t = c_1 pq_t^* + c_2 q_t + b_t + \upsilon_t$$

State equation:

$$\xi_{t+1} = F\xi_t + \upsilon_{t+1} \ldots b_t = \varphi^* b_{t-1} + \varpi_t$$

In equations:

$$y_t = P_t,\ A^{'} = \left[c_1, c_2\right],\ x = \begin{bmatrix} pq_t^* \\ q_t \end{bmatrix},\ H^{'} = 1,\ w_t = \upsilon_t,$$

$$\xi_{t+1} = b_t,\ F = \varphi^*,\ \xi_t = b_{t-1},\ \upsilon_{t+1} = \varpi_t,\ R = \sigma_\upsilon^2,$$

$$Q = \sigma_\varpi^2$$

4. MEASUREMENT OF REAL ESTATE BUBBLE IN GUANGZHOU

4.1. The data

The variables adopted are original time series variables; the period under study consists of 60-month intervals from January 2004 to December 2008. Housing price statistics are obtained from the Guangzhou Municipal Bureau of Land Resources and Housing Management (see Figure 1). Data of income per household is obtained by doubling the average wage of workers in the Statistical Yearbook of Guangzhou, 2008 (see Figure 2). Housing price to income ratio are obtained from Figure 1 and Figure 2 (see Figure 3). Statistical data of variables are summarized in Table 1.

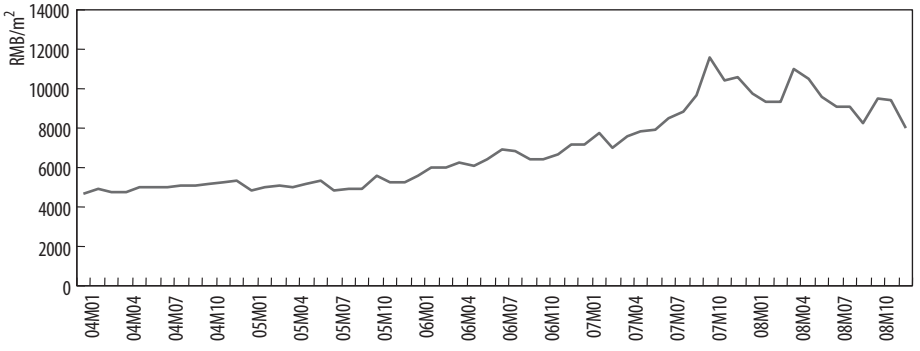

Figure 1. Time series plots of housing price
(*Source*: Guangzhou Municipal Bureau of Land Resources and Housing Management; Statistical Yearbook of Guangzhou, 2008)

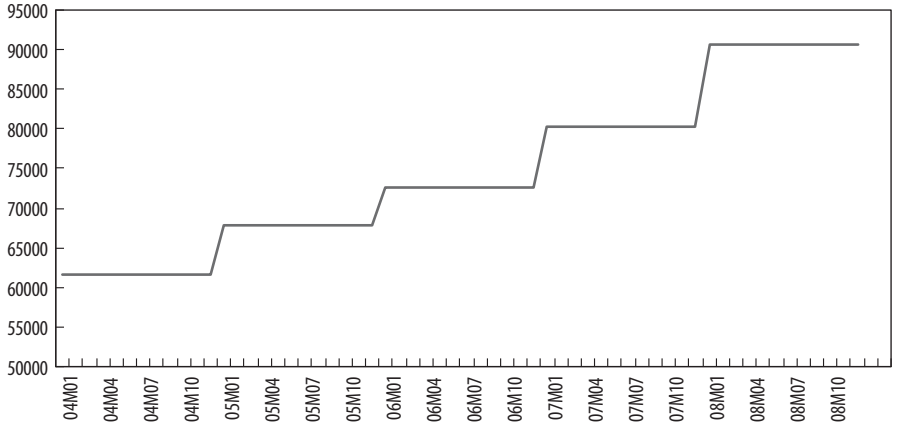

Figure 2. Time series plots of income
(*Source*: Statistical Yearbook of Guangzhou, 2008)

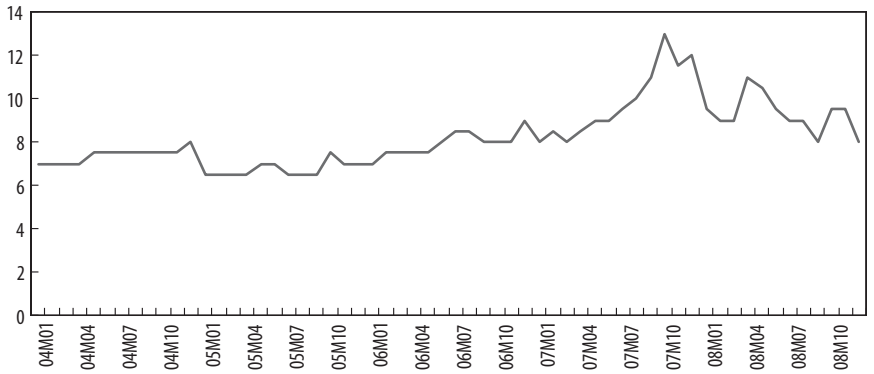

Figure 3. Time series plots of housing price to income ratio
(*Source*: Guangzhou Municipal Bureau of Land Resources and Housing Management; Statistical Yearbook of Guangzhou, 2008)

Table 1. Preliminary statistic

	Housing price	Income	Price-income ratio
Mean	6928	74629	8.22
Standard deviation	1999	5104	2.89
Skew	0.65	0.36	1.18
Kurt	0.87	1.10	1.00

4.2. Analysis of real estate bubble

A positive relationship is found between housing price and income from the result of the model introducing fundamental value according to income to SSM, i.e. variation in household income will obviously affect the growth of housing price. Moreover, in this model is significantly different from 0 at the 5% statistical significance level, also indicates the extent of bubble price fluctuations is distinct and there exists some real estate bubble (see Table 2).

Table 2. Model results

House fundamental value by reducing income	$p_t = c_2 pq_t^* + c_3 q_t + b_t + \upsilon_t \quad b_t = \varphi^* b_{t-1} + \varpi_t$			
	c_2	c_3	φ^*	ϖ_t
Maximum likelihood estimation	–1.6**	1.34**	0.87**	0.0093
Standard deviation	0.14	0.05	0.03	0.12

The housing price bubble phenomenon exists in Guangzhou, known from the essential price calculated by the real estate price and income. Figure 4 shows the proportion of bubble price accounting for the real estate price; Figure 5 shows the trend of bubble price deduced from income; Figure 6 shows the trend of bubble price and real estate price. In 2004-2005, the real estate price was relatively stable and the bubble was also rational in Guangzhou. From 2006, the housing price rose gradually and the bubble price gradually increased because of rapid economic growth, increased speculative activities and the successful bid to

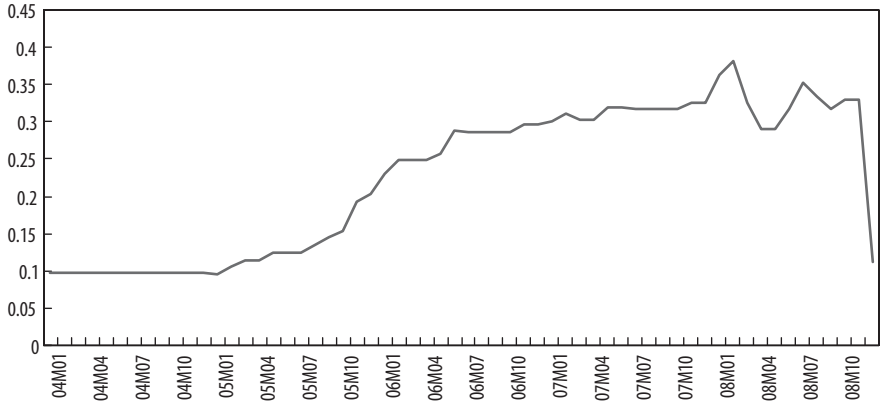

Figure 4. Proportion of bubble price accounting for the housing price

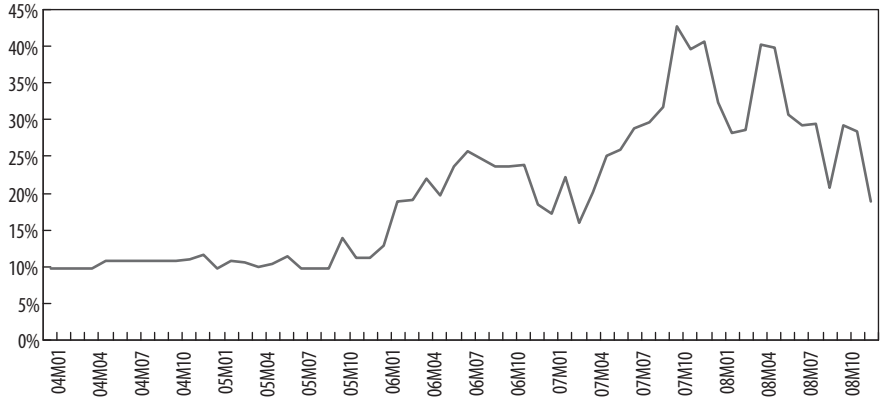

Figure 5. Trend of bubble price deduced from income

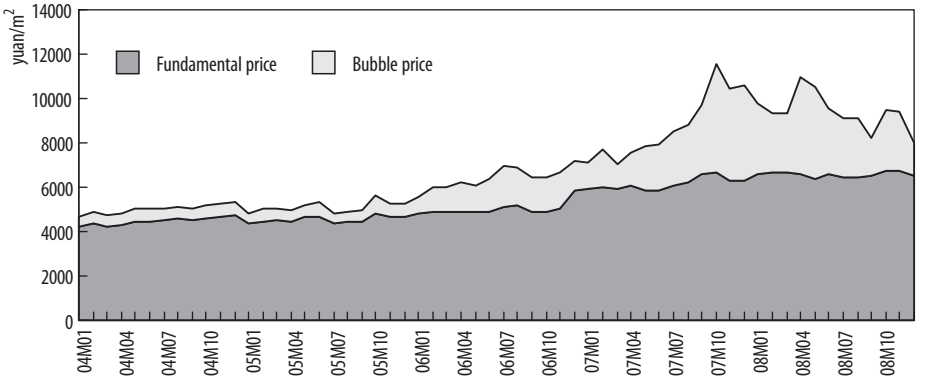

Figure 6. Trend of bubble price and house price

host the 2010 Guangzhou Asian Games. Empirical results show that, since April 2006, the bubble price has been exceeding the market price by some 20%. The bubble price peaked in October 2007, accounting for about 43% of market value. As the property transaction volume continued to decline as a result of global economic recession, the housing price gradually drops, nevertheless still maintains at high level when compared to that of the early years. It is not until lately that the transaction volume had slowly increased again.

5. CONCLUSIONS

The study on real estate bubble phenomenon is closely related to asset price changes. Test results on bubble could vary a lot depending on the research interests of and different assumptions made by the researchers, as well as the data set used. In the past, people relied on rental movements to measure the deviation of housing prices from their fundamental values. However, owing to lease fixation in the Guangzhou housing market, rental values have become less sensitive to market changes; in comparison, household income, being a primordial consideration in home purchasing, becomes a more critical factor affecting the housing price.

This article takes household income and housing price into consideration while studying Guangzhou bubble phenomenon. The housing price level in Guangzhou remains relatively high level nowadays and is experiencing persistent fluctuations. The results show that the housing market bubble was very serious in October 2007, which surged to a peak value of around 43% of the market value. Although the trading volumes have been rising recently, the housing price movement still shows a downward trend. It is advisable that the Government should closely monitor the lending policies of the banking industry, as a preventive measure against excessive monetary expansion. Otherwise, there could be abnormal growth of housing prices; when the price deviates excessively from essential value again, another severe bubble economy might be resulted.

It is indicated by the study that there is considerably much disparity between the growth rate of income and increasing level of housing price, implying that there may exist some underlying forms of income. It is suggested that further studies could be carried out to identify these hidden factors. On the other hand, according to the social development of Guangzhou, it seems only the low income buyers may suffer from the rapid increase in

housing price, but not the high income groups instead since they possess higher affordability. Therefore, it is necessary to study further about real estate bubble. The future tasks should divide the household income and make a comparative analysis of them. By doing that, more accurate conclusion as to whether bubble exists can be obtained. Moreover, more studies about different areas can also be a direction to explore real estate bubble.

ACKNOWLEDGEMENT

This study was funded by the Hong Kong Polytechnic University (ZZ1Z and 1-ZV1X).

REFERENCES

Alessandri, P. (2006) Bubbles and fads in the stock market: another look at the experience of the US, *International Journal of Finance & Economics*, 11(3), pp. 195–203. doi:10.1002/ijfe.292

Bertus, M. and Stanhouse, B. (2001) Rational speculative bubbles in the gold futures market: An application of dynamic factor analysis, *Journal of Futures Markets*, 21(1), pp. 79–108. doi:10.1002/1096-9934(200101)21:1<79::AID-FUT4>3.0.CO;2-D

Black, A., Fraser, P. and Hoesli, M. (2006) House prices, fundamentals and bubbles, *Journal of Business Finance & Accounting*, 33(9/10), pp. 1535–1555. doi:10.1111/j.1468-5957.2006.00638.x

Blanchard, O.J. and Watson, M.W. (1982) Bubbles, rational expectations and financial markets, *NBER Working Papers*, no. 9045.

Bjorklund, K. and Soderberg, B. (1999) Property cycles, speculative bubbles and the Gross Income Multiplier, *Journal of Real Estate Research*, 18(1), pp. 151–174.

Bourassa, S.C., Hendershott, P.H. and Murphy, J. (2001) Further evidence on the existence of housing market bubbles, *Journal of Property Research*, 18(1), pp. 1–19. doi:10.1080/0959991001004110

Brooks, C., Katsaris, A., McGough, T. and Tsolacos, S. (2001) Testing for bubbles in indirect property price cycles, *Journal of Property Research*, 18(4), pp. 341–356. doi:10.1080/09599910110079640

Capozza, D.R., Hendershott, P.H. and Mack, C. (2004) An anatomy of price dynamics in illiquid markets: analysis and evidence from local housing markets, *Real Estate Economics*, 32(1), pp. 1–32. doi:10.1111/j.1080-8620.2004.00082.x

Campbell, J.Y. and Shiller, R.J. (1987) Cointegration and Tests of Present Value Models, *Journal of Political Economy*, 95(5), pp. 1062–1088. doi:10.1086/261502

Case, K.E. and Shiller, R.J. (2003) Is there a bubble in the housing market? *Brookings Papers on Economic Activity*, 2, pp. 299–362. doi:10.1353/eca.2004.0004

Chang, C.O., Chen, M.C. and Deng, Y. (2008) How much price bubbles are there in Taipei's real estate? *Papers of the 1st Global Chinese Real Estate Congress*, July 2008, Shanghai, China. (In Chinese)

Chang, C.O. and Liu, S.L. (1993) A discussion of real estate quality, price levels and consumer price indices, *Journal of Taiwan Land Economics*, 67, pp. 369–400. (In Chinese)

Chang, C.O. and Yang, C.H. (2000) How much housing price bubbles are there in Taipei? *The 9th Annual Conference of the Real Estate Society organized by the Institute of Physical Planning and Information*, pp. 15–29. (In Chinese)

Chen, M.C. (1990) A study of real estate price and its fluctuation, *Bank of Taiwan Quarterly Journal*, 41, pp. 220–244.

Chen, M.C. and Patel, K. (1998) House price dynamics and Granger causality: An analysis of Taipei new dwelling market, *International Real Estate Review*, 1(1), pp. 101–126.

Diba, B.T. and Grossman, H.I. (1988) Explosive Rational Bubbles in Stock Prices? *American Economic Review*, 78(3), pp. 520–530.

Farlow, A. (2004) UK house prices: A critical assessment, Part one of a report prepared for the Credit Suisse First Boston Housing Market Conference in May 2003, London: Credit Suisse First Boston (CSFB), January.

Fernández-Kranz, D. and Hon, M.T. (2006) A cross-section analysis of the income elasticity of housing demand in Spain: Is there a real estate bubble? *Journal of Real Estate Finance and Economics*, 32(4), pp. 449–470. doi:10.1007/s11146-006-6962-9

Giussani, B. and Hadjimatheou, G. (1991) Modeling regional house prices in the United Kingdom, *Papers in Regional Science*, 70(2), pp. 201–219. doi:10.1007/BF01434329

Han, D.M., Liu, L.J. and Cao, K. (2008) Empirical analysis on real estate price bubble based on state-space model, *Journal of Finance and Economics*, 1, pp. 126–135. (In Chinese)

Hsueh, L.M. (1990) Determinants of housing prices in Taipei City, *The Conference of Current Financial Situations and Price Issues*, June 1990, Organized by Institute of Economics, Academia Sicina. (In Chinese)

Hui, E.C.M. and Yue, S. (2006) Housing price bubbles in Hong Kong, Beijing and Shanghai: A comparative study, *Journal of Real Estate Finance and Economics*, 33(4), pp. 299–327. doi:10.1007/s11146-006-0335-2

Kim, K.-H. and Lee, H.S. (2000) Real estate price bubble and price forecasts in Korea. *Presented at Asia Real Estate Society Fifth Annual Conference*, Beijing, August 2000.

Lau, E.E.L., Tan, G.K.R. and Rahman, S. (2005) Assessing pre-crisis fundamentals in selected Asian stock markets, *The Singapore Economic Review*, 50(2), pp. 175–196. doi:10.1142/S0217590805001962

Lee, J.S. (1997) An Ordo-liberal perspective on land problems in Korea, *Urban Studies*, 34(7), pp. 1071–1084. doi:10.1080/0042098975736

Lim, H.Y. (2003) Asset price movements and monetary policy in South Korea, *Monetary Policy in a Changing Environment, BIS Papers*, no 19.

Lin, C.C. (1996) Establishing a regional house price model for Taiwan, *Journal of Taiwan Land Economics*, 1(1), pp. 29–49. (In Chinese)

Mankiw, N.G., Romer, D. and Shapiro, M.D. (1985) An unbiased reexamination of stock market volatility, *Journal of Finance*, 40(3), pp. 677–687. doi:10.2307/2327790

Milne, A. (1991) Incomes, demography and UK house prices, Centre for Economic Forecasting Discussion Paper, No 3090, London Business School.

Scott, L.O. (1990) Do prices reflect market fundamentals in real estate markets? *Journal of Real Estate Finance and Economics*, 3(1), pp. 5–23. doi:10.1007/BF00153703

Sutton, G.D. (2002) Explaining changes in house prices, *BIS Quarterly Review*, September, pp. 46–55.

Smith, M.H. and Smith, G. (2006) Bubble, bubble, where's the housing bubble? *Brookings Papers on Economic Activity*, 1 (Spring), pp. 1–50. doi:10.1353/eca.2006.0019

Statistical Yearbook of Guangzhou (2008) Bureau of Statistics of China.

Tseng, C.Y., Chang, C.O. and Hua, C.C. (2005) The dynamic relationship of rents and prices among Taipei housing spatial submarkets, *Journal of Housing Study*, 14(2), pp. 27–49. (In Chinese)

Wang, Z.C. and Ming, J. (2007) An empirical research on the measurements of the real estate bubbles: A case study of Guangzhou, *Economic Geography*, 9, pp. 819–822. (In Chinese)

Wu, S.T. (1994) Income, money and housing price: An observation of Taipei area for the past two decades, *Journal of Housing Study*, 2, pp. 49–66. (In Chinese)

Xiao, Q. (2005) *Property market bubbles: some evidence from Seoul and Hong Kong*, PhD thesis, Chapter IV, Technological University of Singapore.

Xiao, Q. and Tan, G.K.R. (2007) Signal extraction with Kalman filter: A study of the Hong Kong property price bubbles, *Urban Studies*, 44(4), pp. 865–888. doi:10.1080/00420980601185650

Xu, D.Q., Yu, Z.X. and Wang, J.I. (2000) Bubble economy and the financial crisis, Beijing: China Renmin University Press.

SANTRAUKA

GUANGŽU BŪSTO KAINŲ BURBULO TYRIMAS PAGAL BŪSENŲ IR ERDVĖS MODELĮ

Eddie Chi Man HUI, Qi GU

Jau skelbtuose darbuose Guangžu nekilnojamojo turto rinkos burbulo problema nagrinėta pasitelkus gaunamos nuomos perspektyvą, siekiant nustatyti fundamentaliąją būsto vertę. Kadangi nemaža dalis nuosavybės Guangžu mieste užimta savininkų, o namų ūkių pajamos laikomos esminiu būsto kainų lygį lemiančiu veiksniu, šiame straipsnyje pasirinkta namų ūkio pajamų perspektyva pagal esamą turto rinkos modelį; sudarytas būsto kainų modelis, kuriuo remiantis nagrinėjamas burbulo reiškinys, ir pasitelktas būsenų ir erdvės modelis, kuris charakteristikas leidžia įvertinti pagal netiesioginius kintamuosius veiksnius. Straipsnyje vertinamas kainų burbulas ir analizuojamas burbulo dydis įvairiu metu. Nagrinėjamos Guangžu būsto kainos nuo 2004 m. sausio iki 2008 m. gruodžio. Rezultatai rodo, kad būsto rinkos burbulas piką pasiekė 2007 m. spalį, apytikriai prie 43 % būstų rinkos kainos.