Bubbles in Shanghai Real Estate Market

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Abstract

In this paper we emphasize that bubble is a very risky phenomenon in financial market. So development of measurement of bubbles is extremely meaningful. Many models have been established in stock market and they work quite well in due field. We try to transform two distinct stage models which are applied in stock market to a completely new stage model which is designed for bubble measurement in real estate market. This model is developed based on one assumption. A house only has two functions: residence and trade. It aims to evaluate the fundamental price of a house and compare it with its real price. A bubble is identified according to the distance between two prices. We separate Shanghai real estate market into three segments and test them individually. During the research, Hott and Monnin model is also used to test bubbles in same period and place. Both models have proved that a bubble has already existed in residential house market of Shanghai.

Key words: bubbles, stage model, Hott and Monnin model, fundamental price

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Ⅰ Introduction

Bubbles, a mysterious phenomenon in financial market, attract some attention[1] with limited understanding from academic research fields. It is also a puzzle because there are always some people saying bubbles and others arguing no bubble. Up to the present, the truth of it still remains unexplainable. Peter Garber (2000) gave comments on bubbles, in his 'Famous First Bubbles', a fuzzy word filled with import but lacking any solid operational definition. Some researchers even argue that a bubble cannot be determined until it has burst. In other words, people only know there was a bubble ex post. Greenspan is one of the advocates for this doctrine. It is widely recognized that his policy of keeping the Federal Reserve rate at a low level was an indirect trigger of financial crisis happened in 2007 and 2008 which had been the greatest economic recession since the Great Depression in 1930s. Many articles have been composed to explain the causes and effects between the bubble's break in US real estate market and world economic recession. (Gorton, G.B. 2009) Their common idea is that with the low reserve interest rate, many investments flowed out of banking system and turn to other financial sectors. For example, they flowed into housing market. It gave rise to the prices of real estate through speculation. On the other hand, based on fake prosperity of real estate market, financial institutions lent money to people who were originally with limited capabilities of repayment. When an occasional crash happened and real estate prices sharply declined, the financial products which were built upon the rising house prices and repayable mortgage became poisons quickly.

This example tells people that bubble is a potential disaster in financial market. Once it appears and breaks, the whole economy always suffers a lot. However, there is no expert who is able to predict when a financial bubble is going to burst. Maureen O'Hara (2008) quoted Oskar Morgenstern's dictum[2] to show his understanding about bubble. This dictum, nevertheless, still cannot provide a clear answer about growth and breaks of bubbles.

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1 Garber (2000) cautions that 'bubble is merely a name we attach to a financial phenomenon that we have not invested sufficiently in understanding.'

2 A thing is only worth what someone else will pay for it, this will be true whether in a bubble or not.

Prediction of burst of bubbles may be difficult, but people can measure whether there is a bubble in a financial market. In fact, bubbles may appear everywhere across the whole financial world. The stock market receives most attention. Therefore, varieties of theoretical methods were developed to identify if there is a bubble at certain moment. The most popular model is called fundamental valuation model. The core idea of the model is to calculate the present value of an asset by discounting its future cash flows. Although there are still a lot of debates on the formula of fundamental valuation with its elements, it didn't trouble researchers much to transform this model which was initially measuring stock price to measure the fundamental prices of houses in real estate market.

In fact, there are various methods available to test whether there is a bubble in real estate market. For example, Bertrand M. Roehner (1997) developed a spatial analysis to measure housing bubble by testing distinct districts in Paris in terms of house trading and supply. Hendershott & Patric H. (2000) and Richard Herring et al (2002) employed vacancy rate[3] to identify bubbles. The aim of this paper is to quote two different fundamental valuation models with some adjustments to measure the bubbles of real estate market in Shanghai based on a period from 1999 to 2009. Both models apply the rent as the future cash flow but differentiate on calculation method and some other elements.

The contribution of this paper is the first to separate whole real estate market into three segments: namely, the common residential houses, office buildings and houses for commercial use. Each segment has its own rental price level and each rental price in different segments will be used to calculate the fundamental price individually. Distinct fundamental prices should be compared with specific real price in each of the three sub-markets. This analysis never appeared in any past research papers. The bubble identification is according to the Jeremy J. Siegel's (2003) two standard deviation definition. Furthermore, this paper is also the first to directly transfer the combination of one stage and three stage fundamental valuation models

3 Vacancy rate is the percentage of all rental properties (also in hotels), homes for sale that have not been unoccupied or rented out at a certain time. High vacancy rate normally implies existence of bubbles and low rate means demand of houses is quite large.

developed in stock markets to real estate markets with taking the variance bound fallacy into account.[4]

The rest of the paper is organized as follows: in the second section, three different models will be explained and transformed to fit the situation in real estate market. In the third section, data and methodology will be expressed to estimate two models for Shanghai real estate market. Besides, a least square regression will be done to analyze the relationship between house prices and some common factors such as population growth, capita disposable income and CPI. Varieties of fundamental values will also be calculated. In the fourth section, Jeremy's method will be used to identify the existence of bubbles. And the conclusion will be drawn in the fifth section. In the last section, an interesting phenomenon will be pointed out for further research.

Ⅱ Description of Models

Least Square Regression Analysis

Before we start to apply different models to test whether there is a bubble in target real estate market, we have to choose the markets which are worth receiving attentions. It looks like specifying suspects in a case from numerous innocents and finally determining who the criminal is.

In order to find a most suspected real estate market which may contain bubbles, we have to make a key assumption at first. A house only has two functions. The first is for residence and the second is for trade. Residence is the basic function that a house delivers. Trade is an alternative and it will cause speculation.

If housing market doesn't deviate too far from its basic function, then its price's movement should be closely related to three key factors: the growth of population, personal disposable income and CPI.[5] In other words, if these three factors have no adequate explanation power during the least square regression analysis, then, most probably, the due market has already had a bubble. This method will be based on time

4 Shiller (1981) developed a so called variance bound test to evaluate fundamental valuation model. He argued stock prices always show excess volatility compare to their fundamentals. So, it cannot be represented by fundamental valuation model.

5 More details will be discussed in the following sections. These three things are the key elements we will use in our least square regression analysis to find a suspected real estate market.

series data. And the explanation power will be represented by R square.

One Stage Model

Over past century, people witnessed sharp fluctuations in the stock markets. For example, US stock market kept sharp rising and reached its peak just before 1930 and after that, it experienced a nightmare in a very short period. The similar situation also appeared in the nearest credit crunch 2008 which was triggered by subprime crisis. As can be observed from the Figure 1 below, the stock price was floating so much that significant increase and decrease can be observed almost everywhere along the historical line.

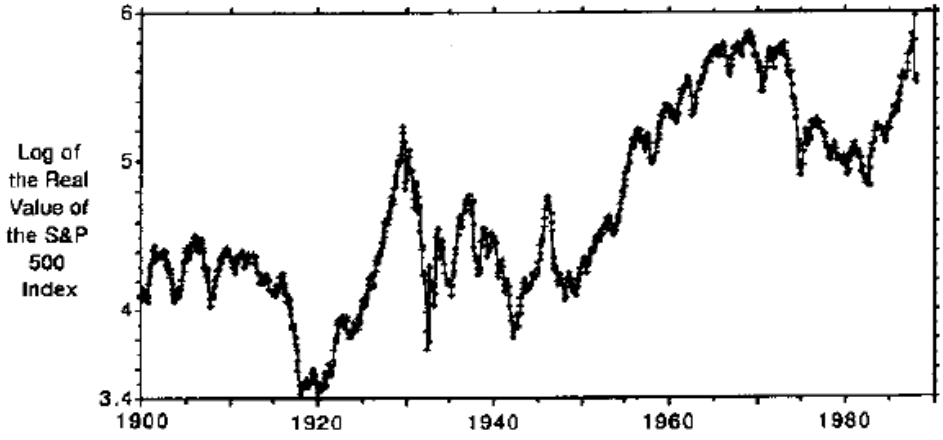

FIGURE 1

REAL UNITED STATES STOCK INDEX PRICES, 1900–1988

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This sort of fluctuation exists not only in stock market but also in real estate market.[7] The question is why there are so many positive and negative movements on prices and why sometimes the movements are significant? In order to explain the interesting phenomenon, economists introduce an idea of bubbles. However, identifying a bubble is not that straight forward. It must be compared with a fundamental value. Researchers initially developed *one stage fundamental valuation model* for stock price measurement. Here we use the model of Nikolaos Panigirtzoglou and Robert Scammell (2001) as an example. It can be expressed as follows:

6 This picture is quoted from Rober B. Barsky, J. Bradford De Long (1990)

7 The Figure 2 (house price of Hong Kong) and Figure 3 (house price of US) can be observed in appendix.

$$P_t = \frac{D_{t+1}}{1+R_{t+1}} + \frac{D_{t+2}}{1+R_{t+2}} + \cdots$$

Pt here stands for present value at time t and Dt+1 or Dt+2 means the expected dividend payments. Rt+1 or Rt+2 is the discount rate at different time spots. The authors assume that dividends are expected to grow at a constant rate g, and then the formula becomes:

$$P_t = \frac{D_t \cdot (1+g)}{(ERP+r)-g}$$ [8]

Although the ERP and g cannot be observed directly from real world, they are assumed to be constant in many academic articles (Nikolaos Panigirtzoglou et al 2002, Rober B. Barsky, J. Bradford De Long 1990, Hott and Monnim 2008, Roy Kouwenberg and Remco C.J. Zwinkels 2010).

The core idea of one stage model exactly fits real estate markets since there are many similarities between these two markets. Dt, the element in the formula mentioned above, can be defined by different ways in real estate market. Himmerlberg, Mayer and Sinai (2005) suggest D can be represented by user cost of housing. They deny the correctness of *price to rent ratio* & *price to income ratio* and argue that user cost of housing is an opportunity cost of alternative investment by considering the distinctions on risks, tax benefits, maintenance expenses and capital gains. This is a comprehensive method with varieties of elements involved. On the other hand, D also can be simply replaced by rental price. The reason is that an agent who buys a house in real estate market basically has two purposes—living and trading. This means the function of housing is either for residence or for speculation. Kaldor (1939) and Markusen and Scheffman (1977) defined speculation in real estate market as follows: the purchase of housing is mainly for collecting capital gain rather than enjoying the benefits from using it. This definition is exactly the same as Eatwell et al (1987) conclusion about bubble and speculation in their article. They suggest bubbles

8 The ERP stands for equity risk premium which is the rate a bit higher than risk free rate in order to compensate investors who are willing to bear uncertainty of further cash flows. Although the ERP and g cannot be observed directly from real world, they are assumed to be a constant.

are caused by speculation.[9] As mentioned above, residence is the fundamental function of housing since living is the basic need of people. If one cannot afford a house, then he will rent a house anyway. Therefore, the series of present values of rent in the life span of a house can reflect its fundamental value in terms of the basic function. The transformed one stage fundamental valuation model for house price can be roughly written as follows:

$$F= \sum [(Rt+1)/(1+i)^n]$$

Where the Rt+1 stands for the expected rental payments at different time spots in the future and i represents the opportunities cost (mortgage rate) of renting houses. As can be observed, there are two elements in this model. Both of them may lead to fierce debates because R and i moves randomly in real world and no one is able to foresee the rents in the future and then, determine the precise fundamental price of a house. So, it is a serious problem on the measurement of the future rental payments. Most researchers[10] presume that rent grows at a constant rate g permanently and they calculate the g by taking average of the historical growth rates.

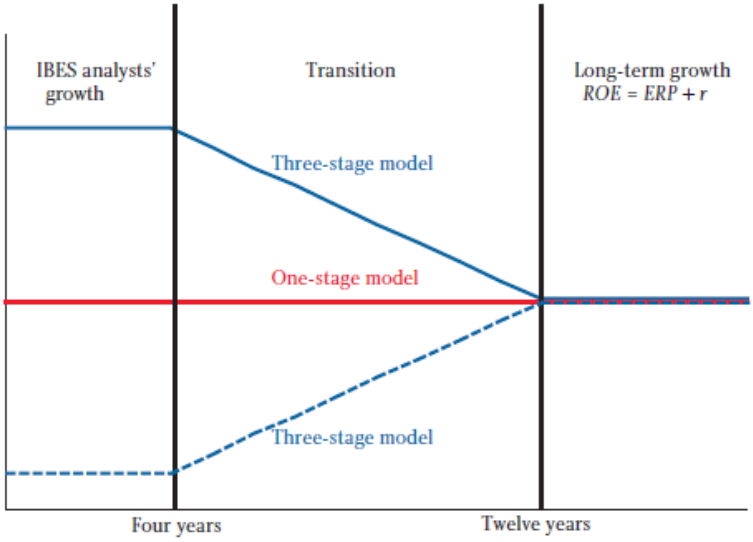
Three Stage Model

It is indeed a way to compute the expected rents. However, in order to be as close as to the reality, researchers initially developed a so called three stage model[11] to test stock price. It allows a floating growth rate in short run and a constant rate in long run.

The first stage concerns the growth rate of beginning 4 years in which the growth rate can be fluctuate. And the second stage concerns the transition period of the following 8 years. In this period, no matter how growth rate fluctuates, it will finally move to a long run constant rate. This rate is calculated by the long run equilibrium restriction: return on equity = cost of equity. The third stage assumes the

9 Eatwell's definition: a bubble may be defined loosely as a sharp rise in the price of an asset or a range of assets in a continuous process, with the generating expectations of further rises and attracting new buyers. Generally speculators are interested in profits from trading in the asset rather than its use or earnings capacity.
10 As I mentioned above, many articles and experts used the constant g and their names have been quoted.
11 Three-stage model is an improvement of one stage model.

growth rate is constant in the long run and it mainly measures the period after 12th year. The main idea and comparison of one stage and three stage model can be illustrated in the **Figure 4:**



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The red line represents the one stage model and it assumes the dividends increase at a constant rate. Two blue lines both represent the three stage model according to two conditions. Solid line means the four years' growth rate stays above long run growth rate and Dotted line means the growth rate in the same period stays below constant rate. It implies the floating rate in short run. The period between 4th year and 12th year is called transition which shows that no matter what the growth rates are in the previous years, they will move towards the constant rate in equilibrium eventually. The accuracy of the three stage model is proved in the Figure 5 in appendix.

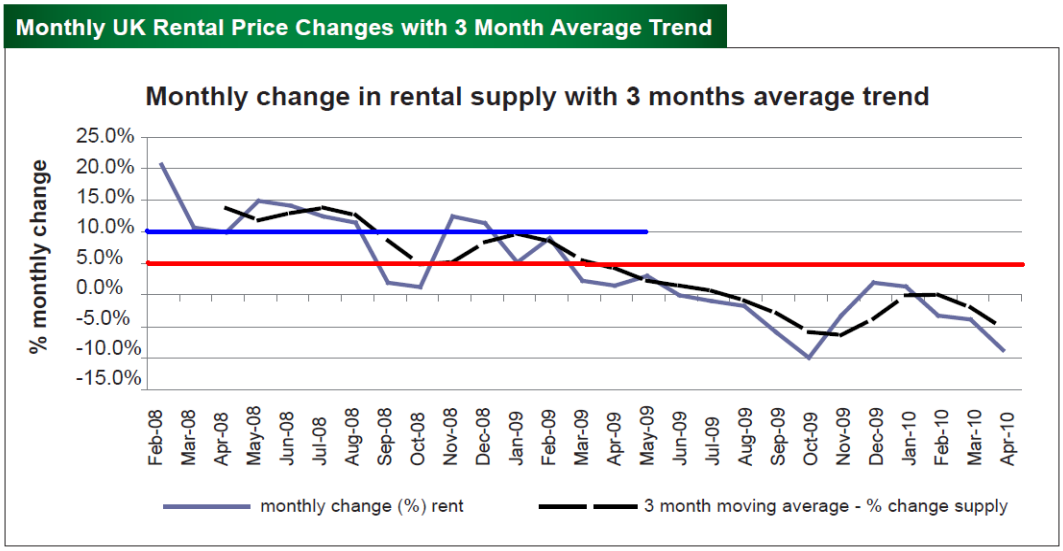
The growth rate of dividend in the first four years is calculated by assuming the unchanged dividend to earnings ratio over time according to Nikolaos Panigirtzoglou et al (2002). This assumption may be logical in the stock market. However, it is difficult to find 'earnings' in real estate market. Besides, the rent to income ratio and rent to CPI ratio are inconstant at least in Shanghai real estate market.

12 This figure is quoted from Nikolaos Panigirtzoglou and Robert Scammell (2002), Analysts' earnings forecasts and equity valuations, the Bank's monetary instruments and Market division.

Combined Model for real estate market

Although the three-stage model cannot be directly transformed to a house price testing model, it enlightens us that the assumption of floating growth rate of rent may be more realistic than the assumption of constant growth rate. The latter assumption is quite popular not only in research of stock markets but also in real estate markets. Jeremy J. Siegel (2003) applies constant growth rate of dividend payments[13] to estimate the fundamental value of stocks and some researchers also rolls average of the historical data of certain period in the past to determine the fixed growth rate of rent. Their theory can be generally illustrated by UK rental price index as an example. The Figure 6[14] shows how researchers quote past data to predict the future cash inflows[15].

Figure 6: UK Monthly Rent Growth Rate (2008 – 2010)



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The grey line in the figure represents the monthly growth rate of rent from February 2008 to April 2010. And both the blue line and red line stand for the constant growth rates but they are calculated based on different time span. 10% is the average growth rate based on period from February 2008 to May 2009 and 5% is

13 Siegel (2003) basically assumes the growth rate of real return is constant and it can be calculated by taking average of historical data in the past 30 years. Since the dividend to earnings ratio is presumed to be constant, the growth rate of dividend should be fixed as well.

14 Figure 6 is quoted from Rental Index (April 2010), the FindaProperty.com

15 Cash inflows generally stand for both dividends and house rents.

16 The period of quotation is not as long as most researchers did because of the limitation of data. Most researchers usually apply historical data of 30 years as least. However, the core idea of constant growth rate can be completely reflected by Figure 6.

another average growth rate through the whole testing period.

Assume that an author wrote his research paper in May 2009 and applied blue line as the constant growth rate of rent. Then, the prediction of rental price should always increase at 10% according to the theory. However, as can be seen from Figure 6, the actual growth rate after May 2009 never achieved 10% again. It seems to be continuously diminishing and fluctuating around zero. One the other hand, if the author composed his article in April 2010, then the red line should be employed as constant growth rate which was equal to 5%. Since the testing period was widened and more historical data was involved, the constant rate 'g' was subject to change.

It definitely cannot be denied that no matter how the growth rate changes or floats, it will finally achieve a constant rate just like many experts suggest. Based on this reasoning, the expected cash inflows should reflect the actual amount in the future period. However, this is not true. The inaccuracy has been proved by Nikolaos Panigirtzoglou et al (2002) through comparison of the estimation results between one stage model and three-stage model. One issue ought to be stressed here: does a rational agent predict the future rents by only considering past constant rate? For instance, if an agent calculated the expected rent in the future when he was in May 2009, then it was logical to quote 10% as constant rate. However, what if he stood on August 2009 and looked forward? It might be a question that whether the agent would apply 10% again without taking any event happened in June 2009 and July 2009 into account.

D.J.C. Smant (2009) also holds similar opinion. He provides some clues through his arguments on the fallacy of variance bound. He mainly explains why Shiller's (1981; 2000) and Akdeniz's et al (2007) theories are wrong. Shiller suggests that the actual stock price performs less volatility to the fundamental price derived from expected cash inflows. In fact, this conclusion is quite opposite to the observation in real world.[17] Smant indicates that today's expectation may differ from tomorrow's expectation due to new information generated every day.

17 More details about how Smant defeat Shiller's theories are contained in his website. In reality, the actual stock prices movement is larger than the movement of fundamental prices, which is the reverse way showed by Shiller.

Real estate market is in the similar condition. A rational agent may consider not only a constant growth rate calculated at a past time spot but also some fresh events raised after the installment of the fixed rate. In order to measure the expected rental prices as precisely as possible, we will apply Barsky & de Long's (1990) method to evaluate the expected house rents in the future. Originally, the authors developed this method to improve the pitfalls of three-stage model by taking new information into account. The core of the theory is to allow both growth rate and discount rate to change over time. For growth rate, they take average of past data as normal. However, during the process, they separate the past data into two parts, namely, the current past and distant past. More weight (nearly 1) is placed on current past data and less weight is assigned to distant past data. When we transfer this method into real estate market, we presume that an rational agent will place 0.4 out of 1 on past average growth rate excluding the current past 2 years and assign the rest of weight (0.6) to the average of growth rate of last two years. This is because of our data limitation. Barsky & de Long's (1990) collected more than three decades' data and define the last 10 year as current past. We only collect ten years' data in Shanghai real estate market. According to Barsky & de Long's, they all belong to current past data. However, we have to re-define them and re-design the weights for compensation. Besides, the allowance of changes on discount rate perfectly matches the situation of real estate market in the real world. Since the mortgage rate will be employed as discount rate in our model in the following sections, the application of mortgage rate should be close to the reality.

To briefly sum up, so far, we have discussed varieties of fundamental valuation methods and explained how they can be transformed to fit real estate market. After combining them together without losing any strength, one fundamental valuation model has been developed especially for testing bubbles in real estate market. The formula is shown as follows:

$$F= [(1+g_1)R/(1+r_1)]+[(1+g_2)R/(1+r_1)^2]+\ldots+[(1+g_n)R/(1+r_1)^n]$$

$$+$$

$$[(1+g_{n+1})R/(1+r_2)^{n+1}]+[(1+g_{n+2})R/(1+r_2)^{n+2}]$$

$$+$$

$$[(1+g_{n+11})R/(1+r_3)^{n+3}]+[(1+g_{n+12})R/(1+r_3)^{n+4}]+\ldots+[(1+g_{n+k})R/(1+r_3)^{n+k}]$$

{n=3; 3<k<34; R= rental price; r1= mortgage rate of 3 years; r2= mortgage rate of 5 years; r3= mortgage rate of more than 5 years}[18] We call it STAGE MODEL.

Hott and Monnin Model

During the estimation, we will apply another model developed by Hott and Monnin (2008) and Roy Kouwenberg & Remco C.J. Zwinkels (2010) for comparison. According to their theory, the rent payment is also the essential element which is used to calculate the fundamental price of a house. However, the main difference between our model and their model is that Hott and Monnin introduced some new factors such as expected rent yield and capital gains. Furthermore, the discount rate they applied is a combination of mortgage rate, maintenance costs and risk premium. The fundamental price of a house can be expressed as follows:

$$F_t = E_t\left[\sum_{i=0}^{\infty}\frac{(1-\delta)^i H_{t+i}}{\prod_{j=0}^{i}(1+DR_{t+j})}\right],$$

Where H means house rent, 8 stands for house depreciation and DR represents discount rate. Hott and Monnin further assume rent and inflation rate can be easily observed from official index and DR can be replaced by expected return to housing. This implies DR can be represented by two parts—capital gains and expected rent yield. Therefore, the formula above can be reformed to a simple one:

18 According to reality, the mortgage rate is subject change when the period of repayment of loans varies. The growth rate 'g' is hard to express numerically since it depends on current past data and distant past data and provision of rent data in Shanghai is quite limited. The formula is specially designed for Shanghai real estate market and the life span of a building in Shanghai is assumed to be 40 years based on relative report published by the Department of Construction China in 2009

$$F_t = \frac{1+g'}{E(H/P)} H_t$$

Where g'= g-8, E (H/P) is the expected rent yield and P is the house price and H is the rent. Since depreciation rate is hard to be found in real world, this factor is assumed to be zero. So, g' is equal to g. Again, in this formula, g is suggested to be constant over time.

Ⅲ Data and Methodology

Data Description

We will do least square regression analysis and estimate models by using yearly time series data of house price, citizen's disposable income, population and CPI. These data sources are collected from varieties of publications. Shanghai citizen's disposable income is quoted from online resources of Statistical Bureau of Shanghai and so is CPI. Population is available online on the website of National Statistical Bureau of China. The most difficult and complex data is house prices. In fact, house price is a very general idea and it can be further categorized into several classes. For example, price of residential houses, price of office buildings and price of houses for commercial use[19] are all branches of the house price. Rents are in the similar situation. All these data can hardly be found in a single place because all databases cannot provide a complete and continuous data stream for a long period. The main house prices and rents are collected from Shanghai real estate year books[20] and complemented by some ratios and indices from other relative websites. Besides the three kinds of house prices and rents, the data about total renting square meters per year together with three respective rental square meters (residential rental square meters, office rental square meters and rental square meters for house of commercial

19 There are more than three categories of house prices in real world. For instance, warehouses price and houses used as factories also should be involved in general house price. However, since there is very limited information available for these categories, we chose to ignore them.

20 The very first year book was published in 1999. So we can only collect 10 years' data of house prices and rents. It will surely influence the accuracy of estimation of two fundamental valuation models because both models need a long period (30 years) of historical data. However, since real estate market in Shanghai Is a new market and we only can collect so much data.

use) is also collected.

Least Square Regression Analysis

Researchers are wild about investigating relationship among some factors such as rents, income, CPI and so on. For instance, Eddie C.M. Hui & Shen Yue (2006) took a deep research on the correlation between house price and market fundamentals (CPI and Income) in order to conclude whether the house price in Beijing, Shanghai and Hong Kong moved rationally from 1990 to 2003. Morris A. Davis et al (2008) and Joshua Gallin (2004), on the other hand, like using ratios to identify bubbles in real estate market. These methods are highly debatable on the correctness and accuracy. Himmerlberg, Mayer and Sinai (2005) are the advocates who opposed these ratios' measurement. Least square regression analysis is also kind of method to research the relationship among different factors in real estate markets. It might not provide the strong evidence of existence of bubbles. But it may give some implications. As mentioned above, a house mainly has two functions. The basic function is for residence and additional function is for speculation. If houses can reflect the basic need of people, then the price should be closely linked to three factors, namely, population, disposable income and CPI. Otherwise, the only possible answer is that speculation plays a role to drive house price. Just like many researchers have argued, bubbles derive from speculation. [Kaldor (1939); Markusen and Scheffman (1977); Eatwell et al (1987)] We first investigate the correlation between house prices and these three factors to intuitively ensure whether there are bubbles in real estate market. During the regression analysis, the absolute numbers of variables are used. This is because actual number can reflect the true relations and explanatory power of independent variables.

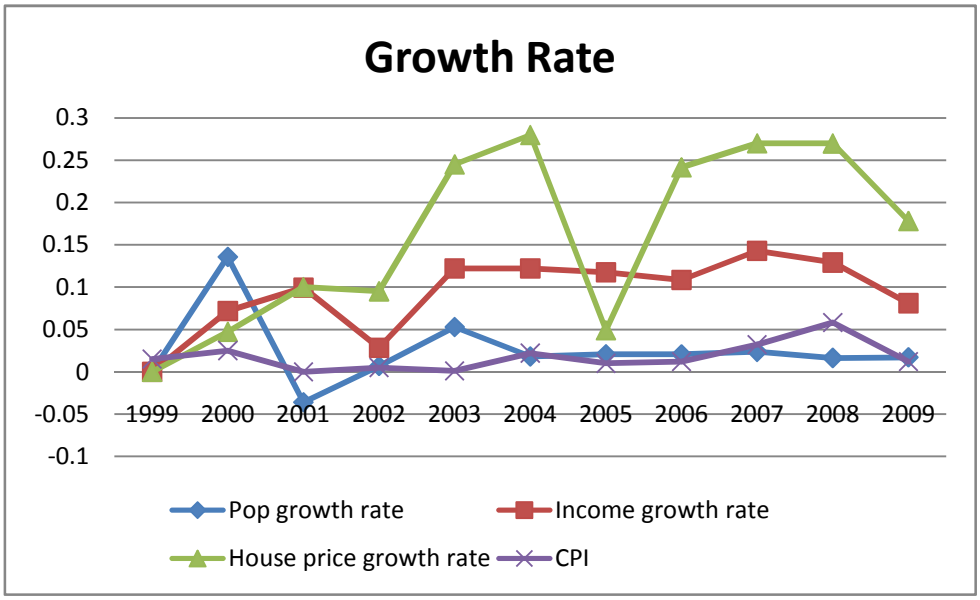
Before we take least square regression analysis, some interesting phenomenon is discovered. The following data shows the residential house prices and citizen's disposable income of the testing period from 1999 to 2009.

	House price (RMB/m^2):	Disposable Income (RMB/year):
1999	**3176**	**10931.64**
2000	**3326**	**11718.01**
2001	**3659**	**12883.46**
2002	**4007**	**13249.8**
2003	**4989**	**14867.49**
2004	**6385**	**16682.82**
2005	**6698**	**18645.03**
2006	**8316**	**20667.91**
2007	**10561**	**23622.73**
2008	**13411**	**26674.9**
2009	**15800**	**28837.78**

We assume that a young couple planed to purchase a 100 square meters house in 1999. The average house price should be 317600 RMB. We further assume both the man and the woman earned the average salary at that time. This means they will work approximately 58 years[21] without eating and any living fees to buy their home. Up to the current present, although Shanghai people's income has tripled, a couple still needed to spend 27 years to buy a house. If living costs were taken into account, the period would be even longer than 30 years. Does it indicate the house price was always at an irrational level? The further analysis has been taken to investigate the relation between the growth rates of previous variables. The Figure 9 shows how the three variables grew in the past 10 years:

Figure 9

21 317600/(10931.64*2)=58; 1580000/(28837.78*2)=27



Four colorful lines tell us that the changes of variety of growth rates never move together. During the period from 1999 to 2001, the population growth rate experienced a sharp decline whilst the house price growth rate increased steadily. In addition, from 2004 to 2006, when the growth rates of income and population were almost constant, the rate of house price dropped outstandingly for reasons. The results of least square regression analysis are shown below:

Y: House price (GR) X: Population (GR)

Regression Statistics	
Multiple R	0.07170808
R Square	0.005142049
Adjusted R Square	-0.105397724
Standard Error	0.110840838
Observations	11

Y: House price (GR) X: Income (GR)

Regression Statistics	
Multiple R	0.742133801
R Square	0.550762578
Adjusted R Square	0.500847309
Standard Error	0.074483011
Observations	11

Y: House price (GR) X: CPI (GR)

Regression Statistics	
Multiple R	0.390916652
R Square	0.152815829
Adjusted R Square	0.058684254
Standard Error	0.102284112
Observations	11

As can be observed from the three tables above, CPI and population almost have no explanatory power for changes of house price. The R squares are 15.28%[22] and 0.5% respectively. Only the growth rate of income keeps certain level of explanation. Nevertheless, it is not impressively high. The number of R square is just above a half (55%).

Logically speaking, if a house is purchased only for residential need and the house only serves its basic function, the growth rate of house price should move closely to the personal income and population. For instance, when the population of shanghai grows faster than before, then the house price should go up. This is because more people are in Shanghai and they need place to live and houses become demanding.[23] On the other hand, personal income should increase along with the house price. It is really a puzzle in Figure 9 that why a heavy decline of growth rate of house price appeared in 2006 while the income growth rate did not change that much? The findings in the least square regression analysis imply that house price doesn't move reasonably with some basic factors. Therefore, probably, there is a bubble existing in Shanghai real estate market.

In order to identify this bubble, we have to know the fundamental price of house in the period from 1999 to 2009. As mentioned above, we will use two distinct models to estimate fundamental price.

Fundamental value estimation in residential house market

Shanghai real estate market can be approximately divided into three categories:

22 Both tables contain R square numbers and these numbers indicate the explanatory power of independent variables.

23 Here we assume the supply of house is steady and there are similar amount of houses available in the real estate market every year.

residential houses, office buildings and houses for commercial use. We will compute the fundamental price for these sub-markets individually.

The residential house price and monthly rent are shown as follows:

	House price (RMB/m2)	Rent (RMB/m2)
1999	3176	25.32
2000	3326	26.4
2001	3659	28.35
2002	4007	26.4
2003	4989	26.72
2004	6385	26.74
2005	6698	27
2006	8316	27.27
2007	10561	29.55
2008	13411	31
2009	15800	NA[24]

We first transfer these numbers into two figures for straight forward illustration. According to Figure 10 and Figure 11[25], the house price was rampant within the testing period while the monthly rental price was fluctuating around 30 RMB/m^2. When applying stage model, we meet some difficulties. The standard way of calculating the expected growth rate of rental price is to roll average its growth rate from 1966 to 1996 and assign a weight of 0.4 to it. The rest of 0.6 is given to the average rate of 1997 and 1998. However, capitalization of shanghai real estate market was much later than many developed countries and so was the record of rent. We can only find the first fundamental price at 2000 by using the rent growth rate from 1999 to 2000. A further assumption has to be made that the average growth rate of rent of past 30 years is equal to the growth rate from 1999 to 2000. Although the resources are limited, the more recent data we calculate the more accurate expected rent we will get. This is because more historical data will be involved in the process.

Expected rent and fundamental price of residential houses from 2000 to 2009 are shown as follows:

	Fundamental price (RMB/m2)	Expected rent (RMB/m2)yearly
1999		

24 Since the residential rent of 2009 is not available yet, we use the average growth rate of past 10 years to calculate the finial number. It is equal to 33.5.

25 Figure 10 and Figure 11 are in appendix.

2000	5564.59	316.80
2001	7703.71	330.31
2002	6757.31	361.08
2003	5758.30	322.69
2004	5804.27	322.66
2005	5775.56	324.16
2006	5603.30	326.96
2007	7293.95	330.76
2008	9955.76	366.22
2009	11271.74	372.00

Figure 12[26] shows the movements of the actual house price and fundamental house price. As some researchers[27] suggest, the real price of house should fluctuate around it fundamental price. However, this is not the fact in Shanghai real estate market under estimation of stage model. The red line represents the fundamental price and blue line stands for real price. These two lines only cross once at the time spot between 2003 and 2004. On the left side of the time spot, fundamental price lies above real price. On the right side of it, the situation is just opposite. What's more, blue line seems to have certain power to influence the change of fundamental price after 2004. As observed from the figure, after 2006, two lines are almost parallel and fundamental price goes up together with real price. However, it never exceed real price again. Most probably, that area contains a bubble and this suspicion is also proven by Hott and Monnin model.

Hott and Monnin model employs a constant growth rate and expected rent yield to find fundamental price of house. Based on this model, the fundamental price is computed and shown below along with its expected rent yield E(H/P).[28] The similar application also appears in the article of Fama and French (2002). The main difference is that Fama and French used this method to find fundamentals in the market of equity while Hott and Monnin used it to determine the fundamental price of houses.

	Fundamental price(RMB/m2)	Expected Rent yield
1999		

26 Figure 12 is in Appendix.

27 Roy Kouwenberg and Remco C.J. Zwinkels (2010) find this phenomenon when they estimated the log real price and log fundamental price of US.

28 H means rent and P is real house price

2000	3460.28	0.0955
2001	3804.45	0.0946
2002	3546.90	0.0907
2003	3808.75	0.0854
2004	4081.05	0.0796
2005	4363.55	0.0751
2006	4684.98	0.0707
2007	5439.06	0.0665
2008	6078.11	0.0627
2009	6981.79	0.0593

Figure 13 in appendix illustrates the new growth trends of fundamental house price and real house price under estimation of Hott and Monnin model. Obviously, this model generates a much lower fundamental price than previous model. Both prices show an upward trend. Unlike Figure 12, the cross point doesn't appear at the middle of testing period. The red line and blue line start almost at same price level. Due to the different growth rate, the gap between them becomes increasingly large. The most impressive distance is in 2009. The actual price is 15800 RMB whilst the fundamental price is only 6981.8 RMB. The former is approximately 2.3 times as high as the latter. By using the similar model and logarithm, Roy Kouwenberg & Remco C.J. Zwinkels (2010) identify a bubble in US real estate market in 2008 which is shown in the red circle area in Figure 16

Despite the distinct shapes of Figure 12 and 13, both of them point to the special period from 2004 to 2009. Within this period, the movements of actual price and fundamental price turned an abnormal trend. Therefore, bubble testing will be concentrated on that period in the next section.

Fundamental value estimation in office building market

Office housing market should also receive some attention. The office building price and monthly rent are shown as follows:

	Office price (RMB/m2)	Monthly Office Rent	Yearly Office Rent
1999	8543	123.2	1478.4
2000	9223	140	1680
2001	8644	130	1560
2002	8343	129.09	1549.08

2003	9771	135.8	1629.6
2004	10694	145.17	1742.04
2005	11876	154.46	1853.52
2006	12078	160.33	1923.96
2007	14223	162.1	1945.2
2008	11811	163.88	1966.56
2009	na	172	2064

During the last decade, both office price and office rent turned an upward trend. However, as can be seen from Figure 17, the growth rate of office price was much higher than Office rent. The former increased from 8543 RMB in 1999 to 14223 RMB in 2007 and then decreased slightly to 11811 RMB in 2008. The latter grew slowly from 1478 RMB to 2064 RMB. The red line in the figure looks like a straight and flat line over time.

The computation of fundamental price of office meets the same limitation as residential house. But it does not affect our estimation a lot. The fundamental price and real price of office calculated under two distinct models are shown below[29]:

	Office price (RMB/m2)	Fundamental price (RMB/m2)
1999	8543	
2000	9223	32213.04472
2001	8644	42766.09627
2002	8343	39970.92897
2003	9771	39150.78549
2004	10694	52566.60558
2005	11876	63009.58609
2006	12078	54306.96673
2007	14223	38977.42575
2008	11811	38066.56528
2009		46157.04986

==========

	Fundamental price	Expected rent yield
1999		
2000	11031.77	0.173053962
2001	9068.79	0.177603637
2002	8842.95	0.178559759
2003	9284.65	0.180338374
2004	10158.25	0.177626548
2005	11009.52	0.175171927
2006	11604.78	0.172443474

29 First table is for stage model and second table is for Hott and Monnin model.

2007	11804.39	0.170799862
2008	12170.85	0.167018144
2009	12797.48	0.166966571

Both tables have been transferred into Figure 14[30] and Figure 15 in appendix respectively. In Figure 14, the fundamental price of office is always lying above the real price of office during the whole testing period. The gap is quite large even the actual numbers have been transformed in terms of logarithm. According to stage model theory, the rental price seems to be more expensive than it should be when the office price is taken as a benchmark. It also implies the office price is not high enough and it will go up further in the future until it achieves reasonable price.

On the other hand, Figure 15 provides another explanation. Two prices' movements are very close. Especially in the middle of the entire period, two prices are almost overlapping. Although the growth trends of two prices are opposite in 2006 and 2007, they finally move to an almost same point in the figure. Based on Hott and Monnin theory, the change of real price fully reflects the office rent and rent yield. It means the office building market, as a sub-market of whole real estate market in Shanghai, was healthy during the last decade.

Both Figures and models show there is no positive bubble in office building market in Shanghai. In next section, this conclusion will be strengthened through two standard deviation method.

Fundamental value estimation in commercial house market

House for commercial use is the third category in Shanghai real estate market. Its real price, monthly and yearly rental price are presented in the following table:

	Real Price RMB/M2	Monthly rent RMB/M2	Yearly rent RMB/M2
1999	4737	268.68	3224.16
2000	5110	296	3552
2001	5396	315	3780
2002	4968	305.55	3666.6
2003	6462	302.19	3626.28
2004	6982	324.25	3891
2005	7101	327.49	3929.88

30 The two lines in Figure 14 are represented by log numbers.

2006	6479	347.14	4165.68
2007	6613	357.55	4290.6
2008	6610	368.28	4419.36
2009	6204	379.33	4551.96

Figure 18 represents the data in the table and it shows, during the decade, the commercial house price experienced three stages. Each of them contains price ups and downs and the overall trend of price growth is positive. However, the rental price of commercial house seems to be not affected much by the periodical changes of real price. It generally shows an upward growth trend over time.

When we investigate the relationship between real price and fundamental price, we have got two tables. The first is computed by stage model and the second is by Hott and Monnin model.

	Real Price RMB/M2	Fundamental Price RMB/M2
1999	4737	
2000	5110	156540.09
2001	5396	112556.04
2002	4968	132946.12
2003	6462	80008.44
2004	6982	104039.33
2005	7101	106222.40
2006	6479	103309.63
2007	6613	99277.61
2008	6610	99639.86
2009	6204	102007.82

==========

	Fundamental price	Expected rent yield
1999		
2000	5930.31	0.680633312
2001	5950.97	0.687870472
2002	5537.84	0.692086616
2003	5314.97	0.703575831
2004	5991.73	0.675094648
2005	6203.32	0.655460569
2006	6748.63	0.640884242
2007	6941.28	0.641142596
2008	7134.57	0.641994857
2009	7313.79	0.64465407

As can be observed from Figure 19 and Figure 20, when stage model is applied, the fundamental price of commercial house always stays above the real price. It has

the similar situation to the office building market. Furthermore, the gap between the red line and blue line is even larger than the previous figure. It is reasonable since the commercial house price is lower than office price and rental price is much higher than office rent according to the data we collected. Based on stage model, we have confidence to expect the commercial house price will be rampant in the future. In Figure 20, as can be seen, although the real price doesn't fit fundamental price, it still oscillates around the fundamental price. The difference between them is not significant over time. So, Hott and Monnin theory indicates the house for commercial use market runs quite well and there should be no bubble in this sub-market.

Ⅳ Results (Bubble Identification)

Jeremy J. Siegel (2003) introduces a so called two standard deviation measurement as an operational method to identify whether there is a bubble in stock market. He rolls average of historical real equity returns and finds the mean is equal to 7%. In addition, he also takes Mehra and Prescott (1985)[31] theory into account and presumes another mean return which equals to 4.5%. Two mean returns are assumed to be an expected return is the future. If the real return is overvalued or undervalued by two standard deviations from the mean, then the bubble is identified. In this paper, the main idea of his theory is used. However, we will not use return as a benchmark. Instead, the varieties of fundamental values will be employed. The fundamental prices in different sub-markets and real prices both vary over time. We believe that only the fundamental price reflects the true value of a house. The real price is allowed to deviate from it fundamentals. However, it is not reasonable if the actual price fluctuates too much and deviates too far from its fundamentals. Two standard deviations are set as the bound. If the actual price exceeds the upper or lower two standard deviations, then we identify it as a bubble.

Figure 21 and 22 show the positive bubbles in Shanghai residential house market. Both Stage Model and Hott and Monnin model indicate that there is a bubble

31 Mehra and Prescott suggest that the return of stock is much smaller than 7% because of the high risk in the economy.

in the market. Under Stage Model the mean fundamental price is equal to 7148.85 RMB per square meter and the upper two-deviation bound is 11142.47 RMB per square meter. Since real price is never below lower two-deviation bound, we need not to consider negative bubble. However, the real price does exceed upper bound in 2007 and after that time spot, it never turns back. Bubble is quite clear and it is continuously growing until the recent year. In 2009, the house price is 15800 RMB per square meter. The maximum residential price in normal range can be 11142.47 RMB. Therefore, the exact bubble size is 42%.

Figure 22 represents the testing result calculated by Hott and Monnin model. It is quite similar to Figure 21 shows. The difference is that the bubble in Shanghai real estate market appears earlier in this figure. As can be seen from Figure 22, the real price exceeds upper bound just after 2005. And then, it is still rampant and never changes the trend. Obviously, the size of bubble in Figure 22 is almost twice as large as in Figure 21. The mean fundamental price computed under Hott and Monnin Model is 4624.9 RMB per square meter. The upper two-deviation value equals to 6987.1 RMB per square meter. Therefore, in 2009, the biggest bubble size should be 126.13%.

When we turn to the office building market, we find two totally different bubble identifications drawn by two models. Figure 23 represents the result computed by Stage Model. It shows, over the whole test period, the real office selling price is never above the lower two-deviation bound. As can be observed, the mean fundamental price in Figure 23 is 44718.51 RMB per square meter. The upper bound and lower bound are 63350.74 RMB and 26086.27 RMB respectively. On the other hand, the real office selling price during ten year is only 10520.6 RMB per square meter. According to this figure, the gap between actual price and lower bound always exists. Furthermore, it keeps an approximately constant distance over time. This phenomenon implies that there has been a large negative bubble in office building market of Shanghai for long time. The largest negative bubble appears in 2002 and its size is -212.67%. This result leads to another puzzle which will be discussed in the final section.

Figure 24 shows that office building market operates well. There is neither a negative bubble nor a significant positive bubble during past decade. According to Hott and Monnin theory, the mean of fundamental price is 10777.34 RMB per square meter and upper two-deviation bound and lower two-deviation bound are 13538.45 RMB and 8016.24 RMB. Compare to the previous result, all these three key numbers are much smaller. It directly influences the bubble identification. As can be seen from Figure 24, the purple line always moves within two borders accept at 2007. At this year, the real price slightly exceeds the blue line and reaches 14223 RMB per square meter and after that, real price declines and goes back to the normal area again. The bubble size is equal to 5.05%.

To some extent, Figure 25 and Figure 26 are just copies of Figure 23 and Figure 24. However, due to the larger gap between lower standard bounds and real price, the negative bubble identified under stage model in much bigger than previous one. In Figure 25, it indicates the mean of fundamental price is 109654.7 RMB per square meter. And the two bounds are 151702.7 RMB and 67606.72 RMB respectively. Comparatively, the average real price in the past ten years is only 6060.18 RMB per square meter. The largest negative bubble appears in 1999 which is equal to -427%.

Figure 26, on the other hand, shows that the movement of real price of commercial house perfectly matches the two standard deviation bounds. During the testing period, it never exceeds both border lines except the very first year. In this figure, the mean of fundamental price is 6306.74 RMB per square meter. The two bounds are 7681.17 RMB and 4932.31RMB. In 1999, the real price is 4737 RMB. So, the negative bubble is 4.12%.

Ⅴ Conclusion

In this paper, we applied two models to test whether there is a bubble in Shanghai real estate market in the past decade. We first use original least square regression analysis to find some clues of bubble in this market. For instance, the population, personal income and CPI cannot generally explain the changes or movements of real house price from 1999 to 2009 where there should be a close

relationship between them in logic.

Although there may be a bubble in real estate market of Shanghai, we cannot say the whole market has the bubble. In the past research, fewer authors noticed real estate market can be divided into many sub-markets. In shanghai, for example, the whole market generally consists of three segments: residential house market, office building market and commercial house market.

In order to identify bubbles, we have to calculate the fundamental price for each segment and then compare it with real price. The computation of fundamental price is not straight forward. In most articles about fundamentals, some assumptions must be drawn in advance. It also applies in our theory. A serious assumption runs through the entire research. It presumes that a house only has two functions. The first is for residence and the second is for trading. Since the residence is considered as a basic function a house serves, the rental price can truly reflects the fundamental value of it. Furthermore, this assumption is also recognized by many researchers. It is a core idea for both stage model and Hott and Monnin model.

According to the evaluation of stage model and Hott and Monnin model, we find that there is a bubble in residential house market. However, the appearance and size of the bubble is different based on two distinct models. Stage model shows that a bubble appeared in 2007 and Hott and Monnin model tells us the bubble had already existed in 2005. What's more, the bubble size under Hott and Monnin model is larger than that under stage model.

When we turn to office building market and commercial market, we find two totally opposite results. Based on the computation under stage model, there is a huge negative bubble in both markets. These two bubbles exist through the whole test period (1999-2009) and they have no trend to disappear or get smaller. On the other hand, according to the calculation under Hott and Monnin model, we find two markets operate much better than the situation under previous model though there is a slight positive bubble in 2007 in office building market and a negligible negative bubble in commercial house market in the very beginning year (1999).

Ⅵ Further research

We already know that the office selling price and commercial house selling price are significantly undervalued based on stage model. Then why these price levels can be kept for so long time? What's more, there is no trend so far that these real prices will return to the normal area. If real prices of office and commercial are so low relative to their fundamental prices, why business men are willing to rent them rather than purchase them? There have been arbitrage opportunities existing in these two markets for last decade. Suppose an agent can simply mortgage an office building and lend it to business men for high rental price. This is risk free method to make money. But it clearly contradicts to common economic theory which suggests there cannot be an arbitrage opportunity in the world for long time. This puzzle is really worth doing further research.

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Appendix:

Figure 2

Hong Kong house price from 1991 to 2009

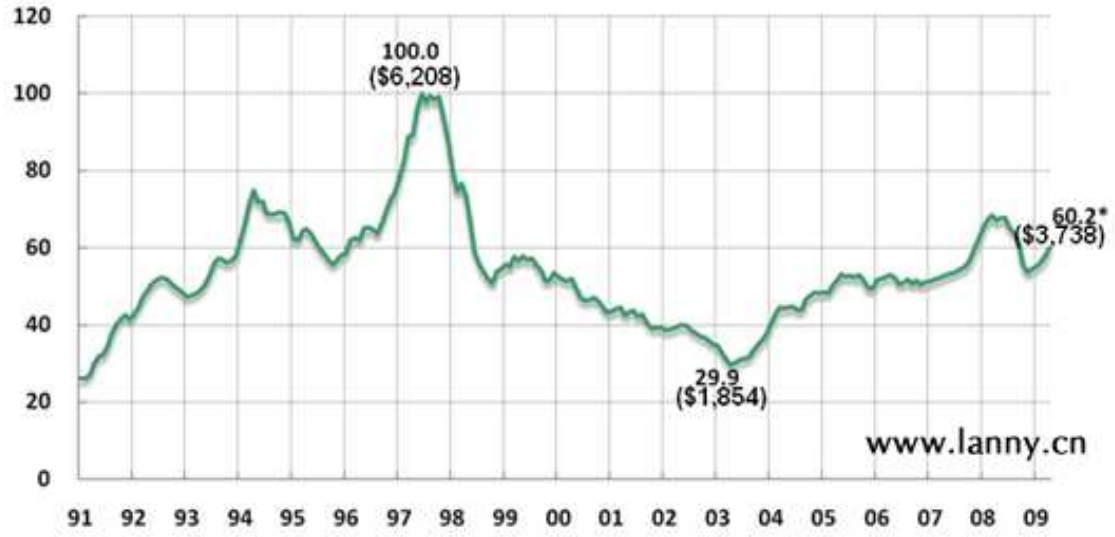


Figure 3

Figure 1. Appearances of "Housing Bubble" and "Housing Boom" in U.S. Newspapers and Wire Services, 1980–2003[a]

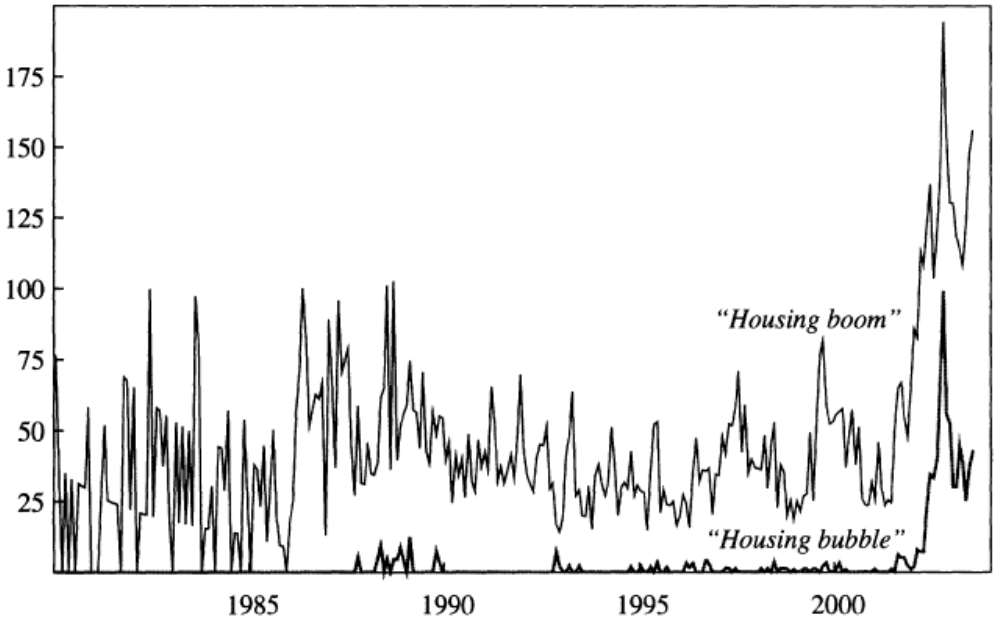


Figure 5: The comparison between accuracy of one stage model and three-stage model in stock market

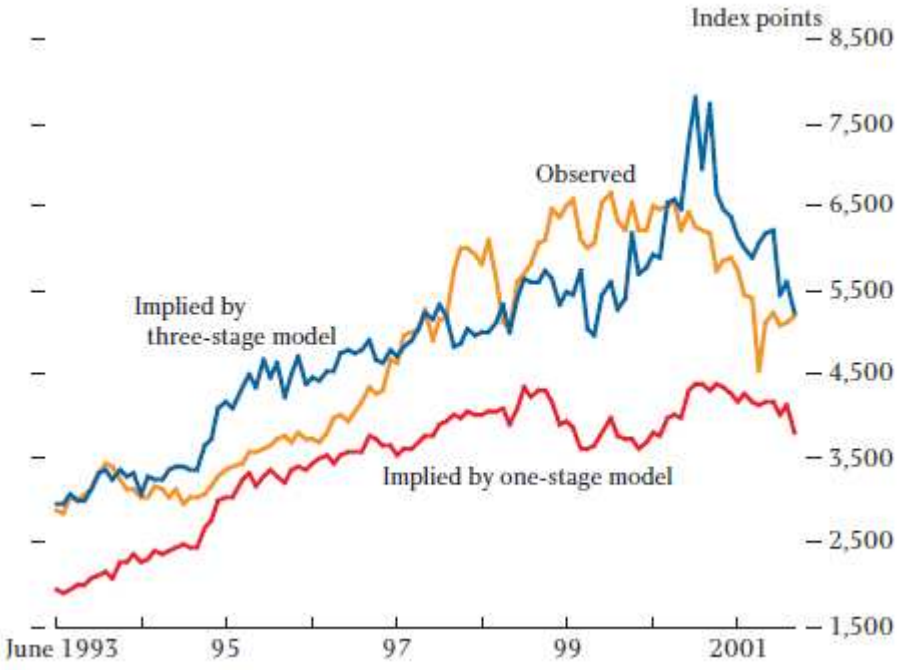


Figure 10:

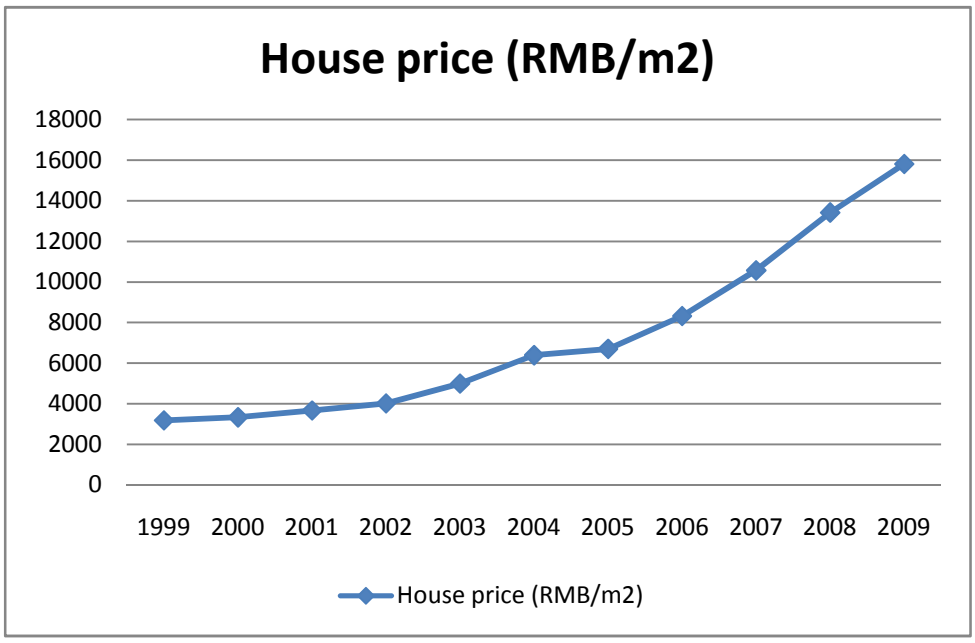


Figure 11:

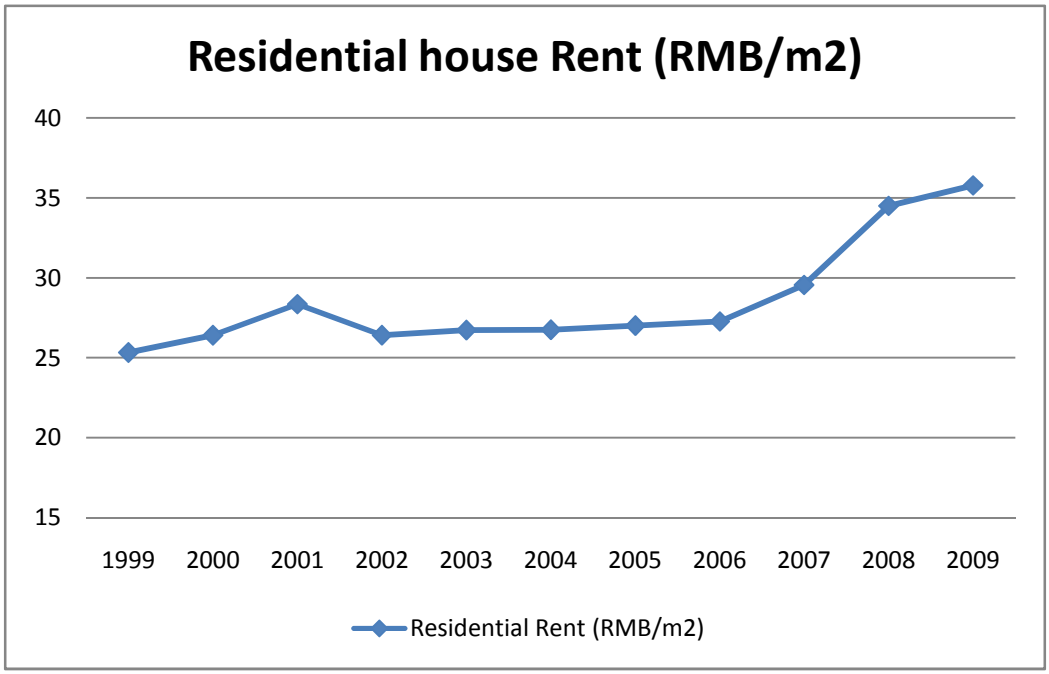


Figure 12

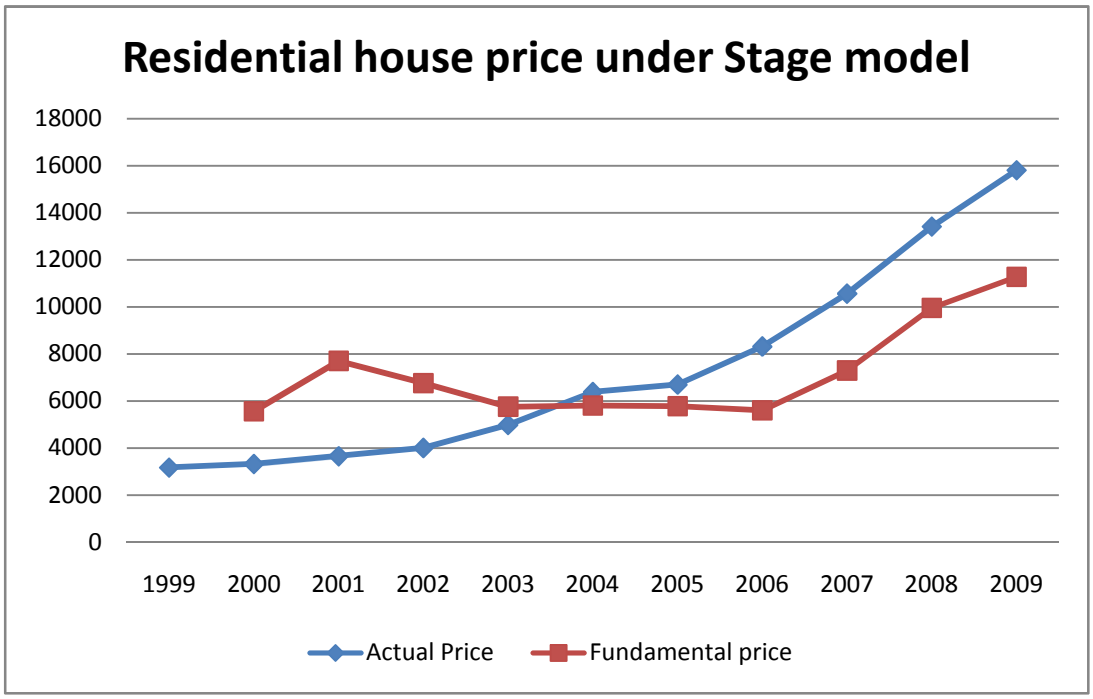


Figure 13

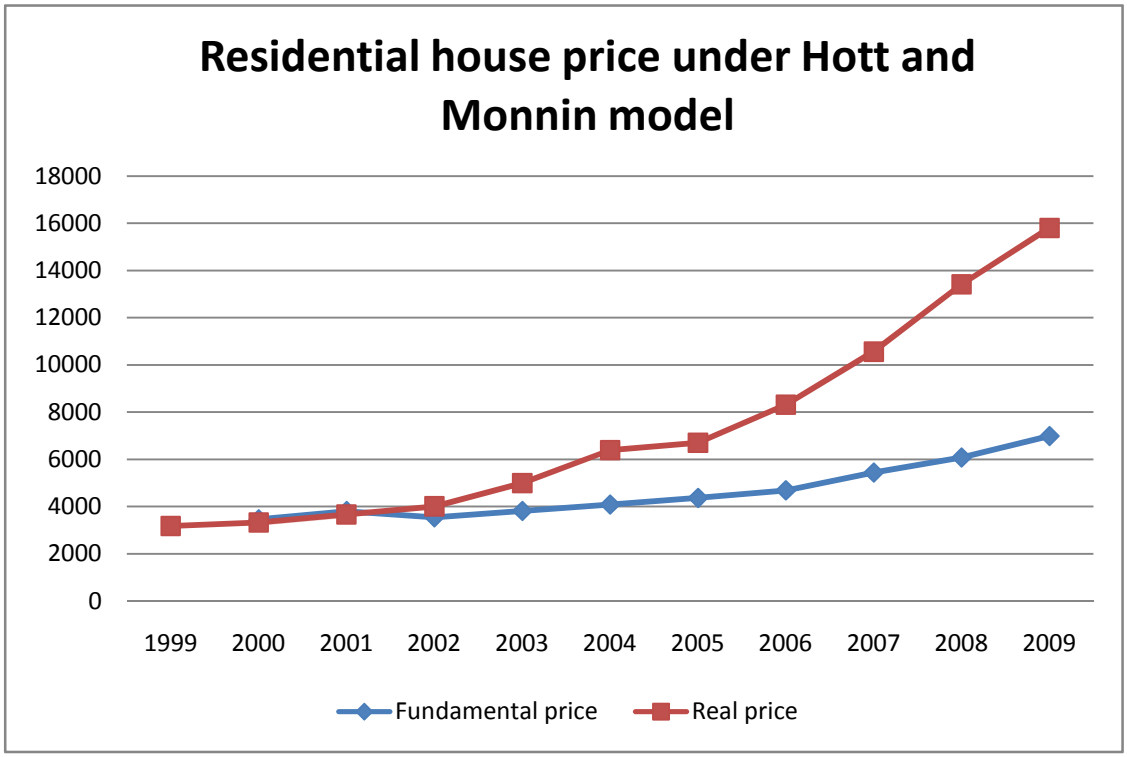


Figure 14:

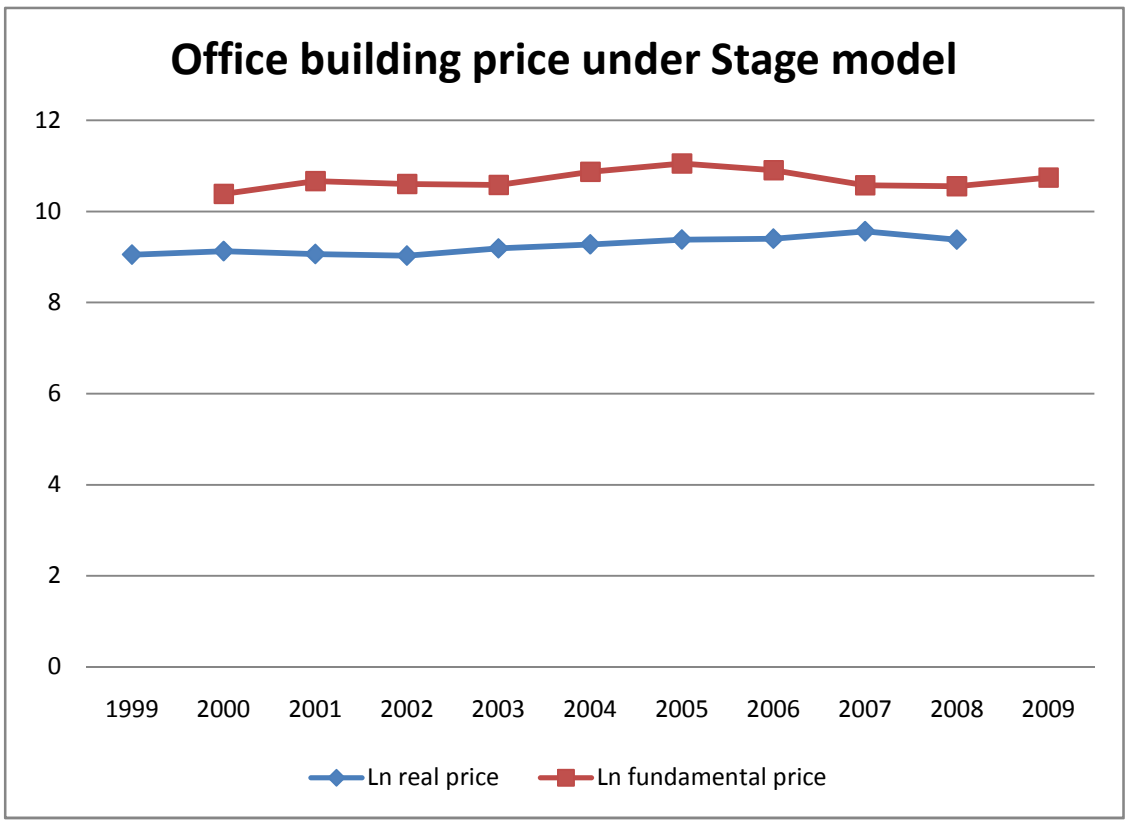


Figure 15:

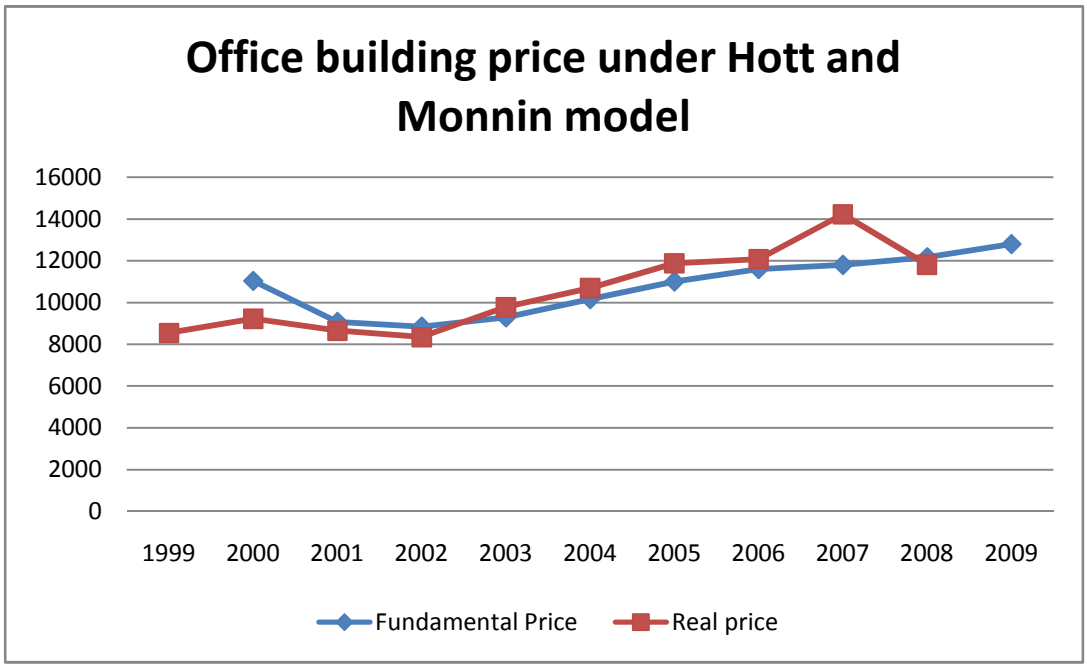
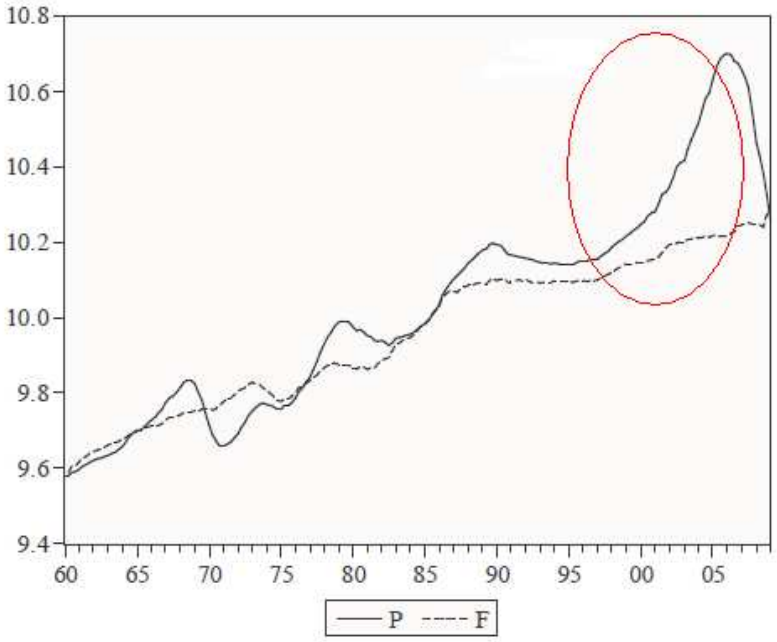


Figure 16:



Notes: Figure 1 displays the log-real U.S. house price index P and the log-real fundamental value estimate F based on rents.

Figure 17

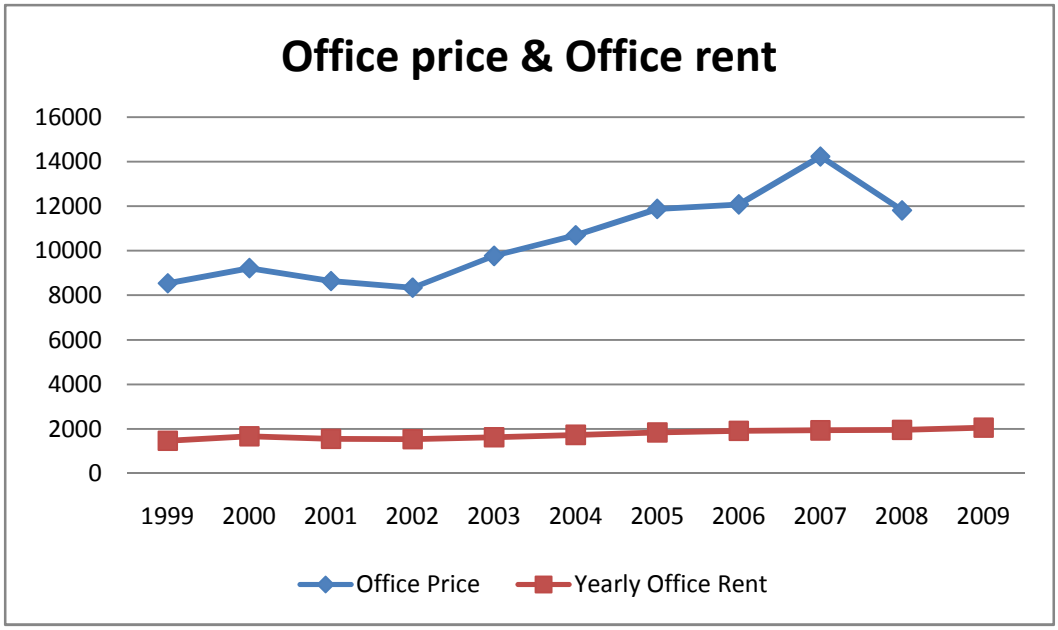


Figure 18

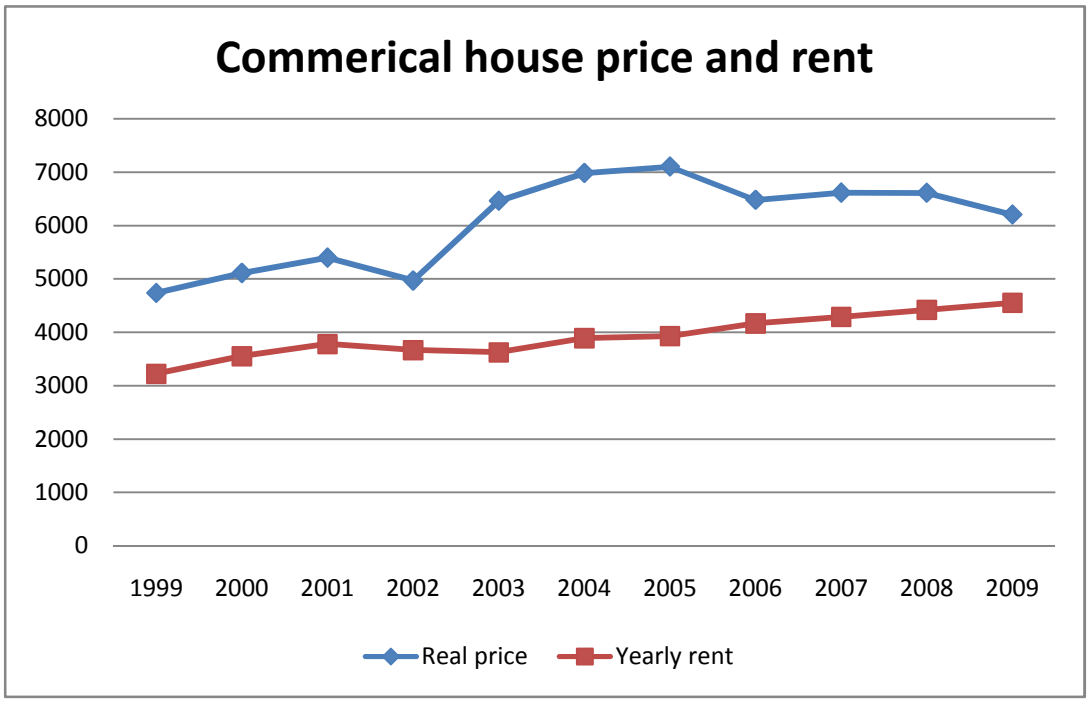


Figure 19:

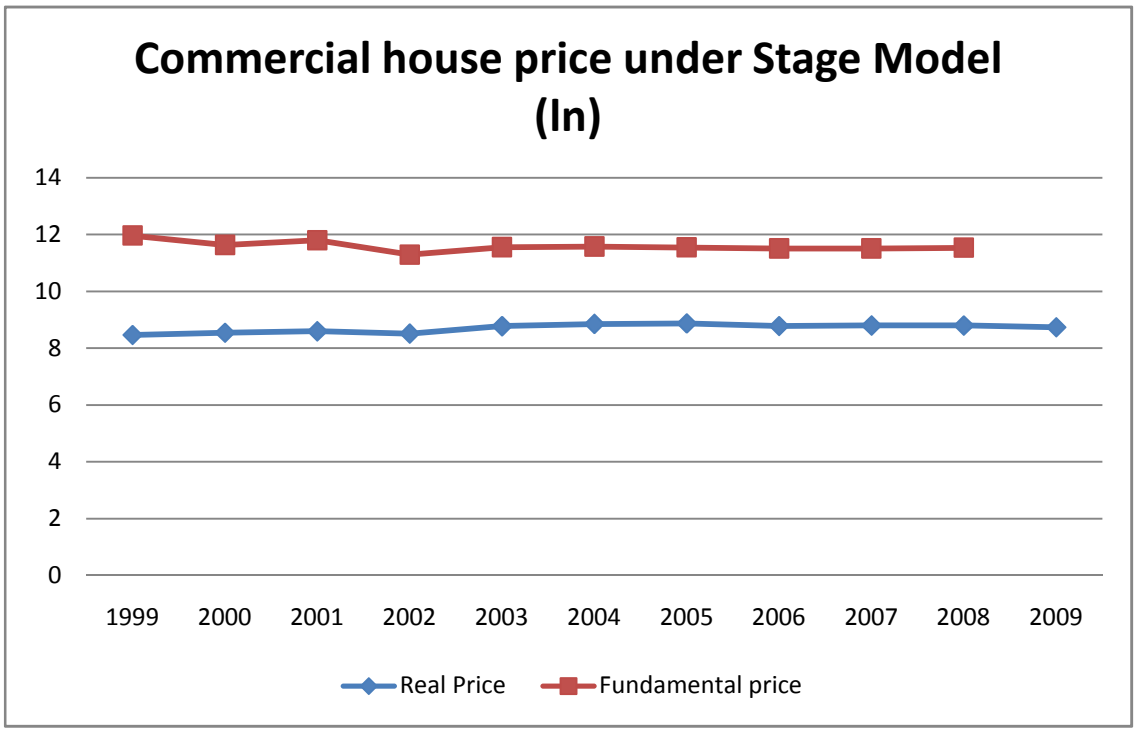


Figure 20

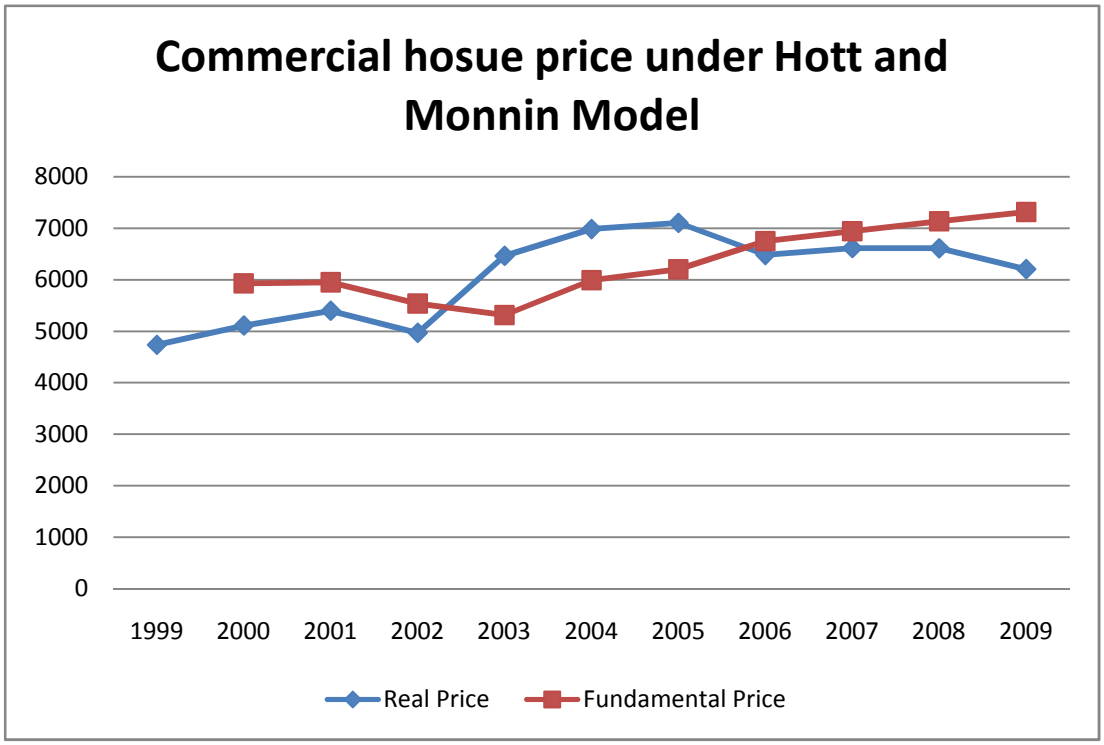


Figure 21(Bubble identification in residential house market)

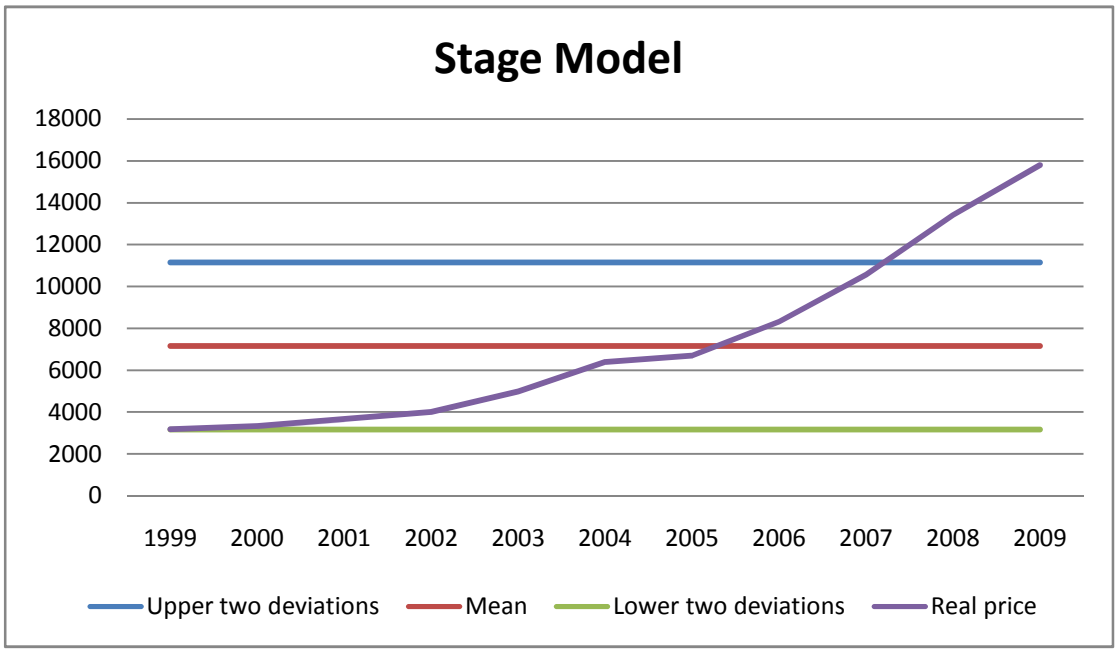


Figure 22 (Bubble identification in residential house market)

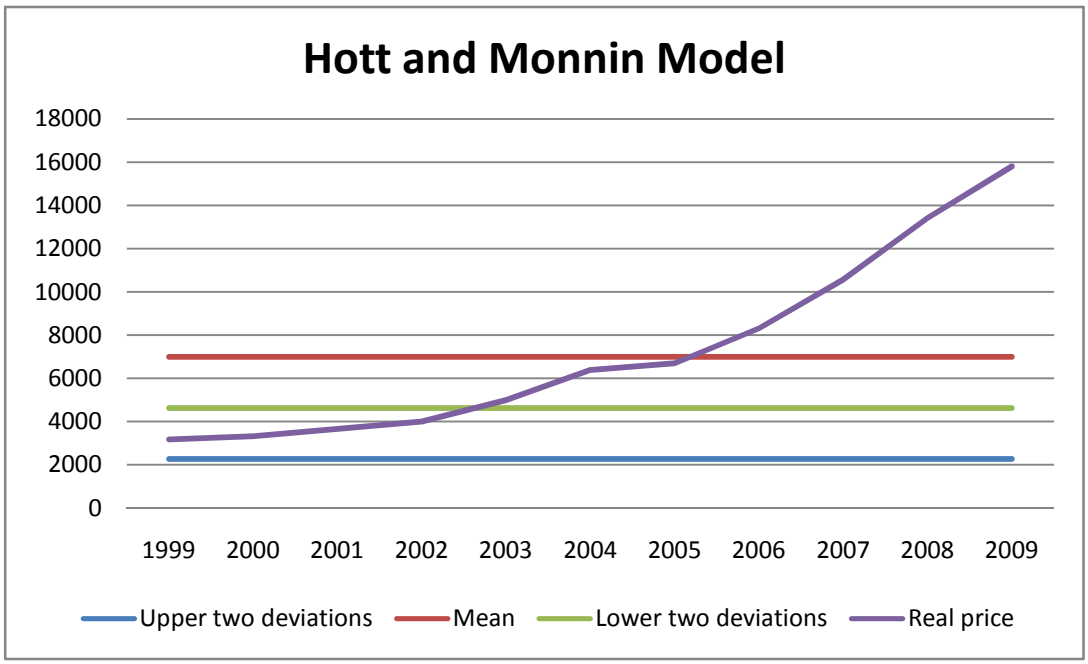


Figure 23 (Bubble identification in office building market)

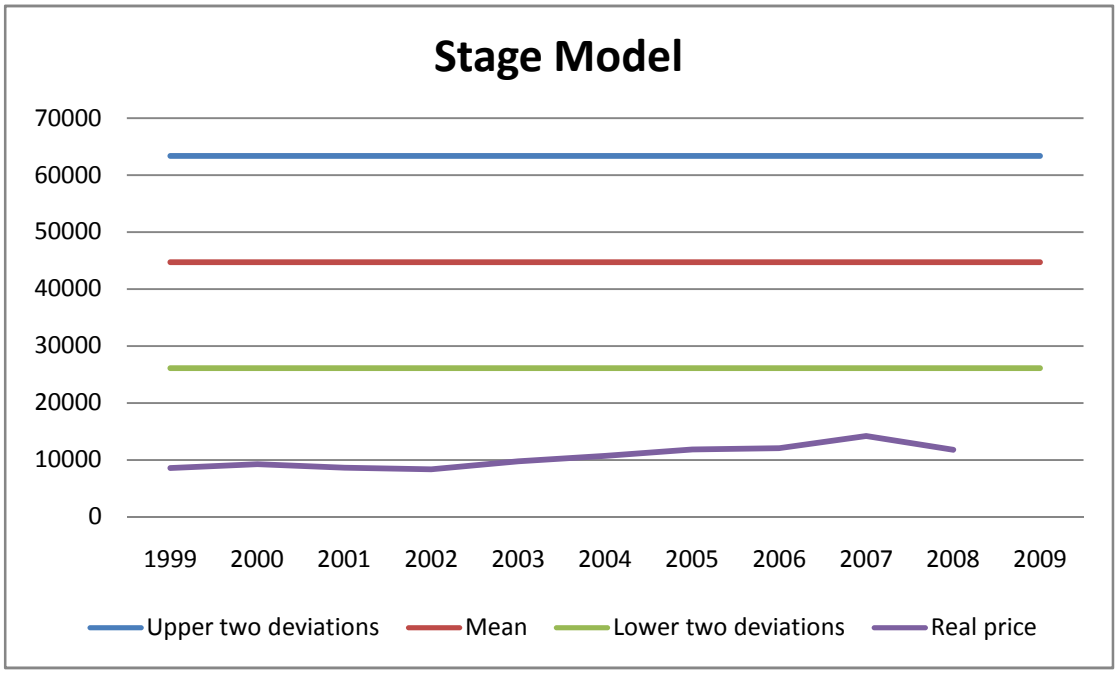


Figure 24 (Bubble identification in office building market)

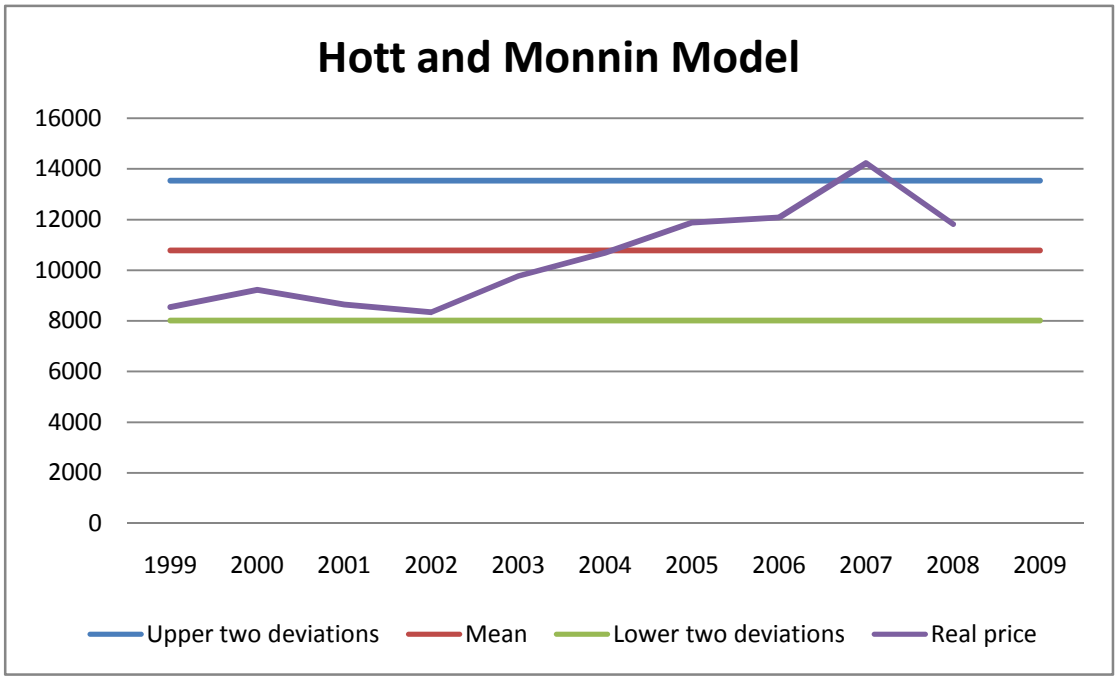


Figure 25 (Bubble identification in commercial house market)

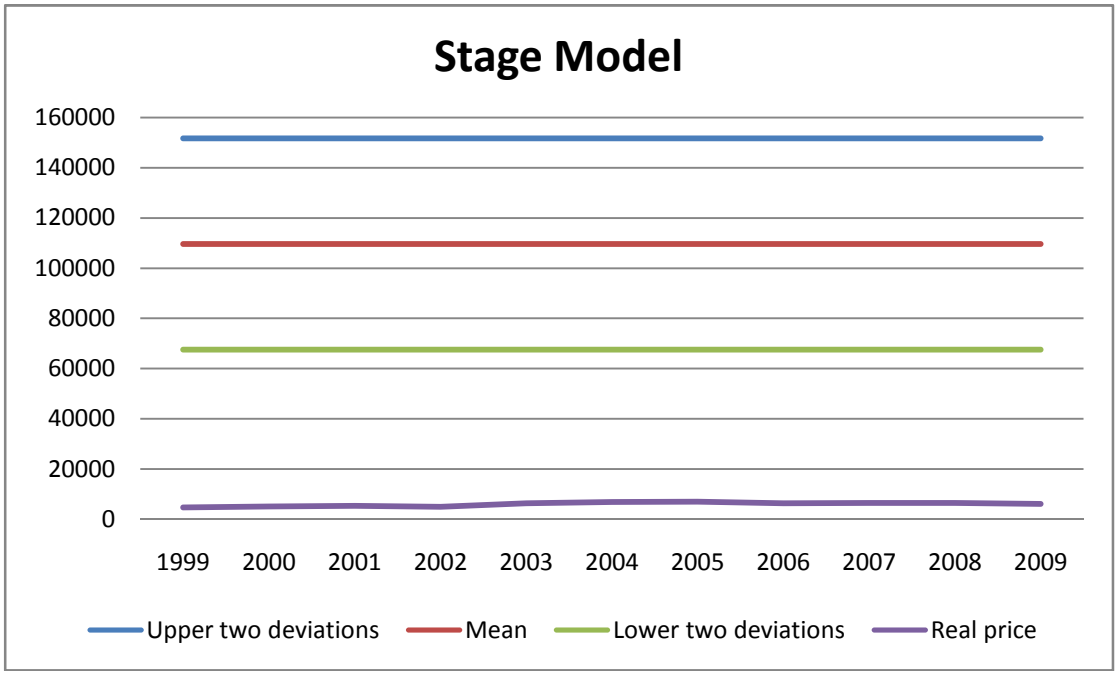


Figure 26 (Bubble identification in commercial house market)