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FACULTY OF SOCIAL SCIENCES
INSTITUTE OF ECONOMIC STUDIES**

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**THE HOUSING
BUBBLE IN CHINA**

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The Housing Bubble in China

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March 2012

Abstract

This paper studies the housing price boom in recent decade since 2003 in China. The study focuses on four municipalities of China, Beijing, Shanghai, Tianjin and Chongqing. Despite the fact that the whole country is suffering a sky soaring housing boom, this paper reveals a regional difference between two types of big cities. Better developed cities such as Beijing and Shanghai are experiencing greater volatility in the boom and economic fundamentals have less explanatory power to the price increases. Oppositely, less developed cities such as Tianjin and Chongqing have relatively sustainable housing prices which are better supported by economic fundamentals. Finally, this paper concludes that Beijing and Shanghai are experiencing a bubble in the housing prices, if the public expectation on economic growth cannot maintain, the bubble will burst.

JEL Classification Numbers: C22, E37, G12

Keywords Bubbles; real estate market; housing boom; speculative investment; economic fundamentals

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1. Introduction

China is considered as the biggest newly emerged economy in recent decades. After overtaking Japan's position on the GDP list, China becomes the second largest economy in the world in 2010. Correspondingly, China involves more and more into the global economy. In the year of 2011, China surpassed USA to become the largest trade partner of EU, while maintaining the position as one of the top trade partners of USA as well. At the same time, as the largest foreign exchange reserve holder, 3.3 trillion USD till March of 2012², China plays an important role in maintaining a stable economic environment around the world. Under such a circumstance, what are happening in China are no longer remote and mysterious orient stories but realistic topics which are closely related to Europeans, Americans and people from all other countries. Furthermore, from the perspective of economic studying, China is also a valuable studying target. The fast growing economy and society in China generate numerous phenomena that have never been spotted in the history, hence enact valuable observations which may help to test, develop and complete the current economic theories. Considering China as the elephant in the room, relative research on China is not only for sake of Chinese people, but also for the interest of rest of the world. This paper is going to shed some light on one of the most controversial topics in China, whether the rapidly rising housing price is a bubble or not, hence provides a comprehensive observation on China's housing market.

Compared with the most thoroughly studied countries such as USA and OECD countries, China has an obvious shortage on the perspective of economic studying – the incompleteness of data. But we do not have time to wait until a comprehensive database is well constructed and then start to work on researches. After the financial crisis in 2007, we have already gained some experiences on how does a crisis in one country spread to other countries through contingent effects under the globalizing framework. The housing market is a sharply

² Source: People's Bank of China. <http://www.pbc.gov.cn/publish/html/2012s09.htm>.

increasing uncertainty in China that certainly will affect the stability of the overall economy in the future. By that time, the shock most likely would not be limited within China, as the USA did in 2007, hence results damage to the global economy. This paper attempts to exploit simple data and reveal some significant result from that.

The sky soaring GDP growth rate and great changes not only bring accumulated wealth and opportunities. The corresponding fluctuations are also costly. Classical macroeconomic models tell us that the fluctuation of economy generates welfare losses. The housing market is a good representative of this phenomenon.

The housing market in China was established in 1998, on which year the welfare-oriented public housing distribution ended and the residential mortgage system was established. The housing market experienced a quick development since that moment, reported by the National Bureau of Statistics of China, the housing transaction volume has increased almost 14 times from 1998 to 2007, housing floor area sold has also increased by 10 times.

Accompanied with the booming housing market, the skyrocketing prices of housing are more and more frequently under debates. Economists are debating that whether this phenomenon in Chinese housing market is a bubble or just reflecting the strong demand driving by GDP growth and the urbanization procedure, which significantly accelerated since 1990s. As the data reported in 2008, the urbanization level has surged to 45.68% from the level of 30.1% in 1998; the urban population is growing at a rapid pace of 5.8% per year in the last decade³, the explosion of urban population, especially in the metropolitan cities, enlarged the demand of housing significantly.

On the other hand, some people argue that the growth rate of the housing prices have already exceeded the “proper level”. In 2009, data revealed by the bureau of Statistics of Beijing in 2009 shows that the ratio of housing price to disposable income in Beijing arises to the level of 27:1. And according to my

³ National Bureau of Statistics of China, < Series Statistics Report 10th: 60 years of the New China > http://www.stats.gov.cn/tjfx/ztfx/qzxzgc160zn/t20090917_402587821.htm, <Dec. 1st, 2010>

estimation in this paper, this ratio exceeds 20 during some periods. This ratio would not be understandable as a equilibrium status. In other coastal big cities, the almost same things are happening. Over the last decade, housing prices in urban area of China have increased significantly, some metropolitan cities, such as in Beijing, Shanghai and Shenzhen, the price tripled or even quadrupled. Considered the slowly increased households' income, more and more families in the big cities have already been excluded the housing market due to unaffordable prices. It is not surprising that the topic of housing price attracts so many social concerns.

An unstable housing market does not only mean that consumers cannot pursuit proper residence, but also greatly affect the stability of the whole economy. It has been recognized for a long time that the housing market plays an important role in the economy. The influence of housing market on economy has two-fold meaning- firstly, the value of the realties and volume of house trading constitute a big share of GDP, the fluctuation in housing market would generate great effect on economic fundamentals. Second of all, there exist contagion effects on the relevant markets when the housing market experiences booming or busting, which may change the consumers' expectations and behavior during the decision making procedure hence influence the whole economy. We have been witnessing in the past four years in the global financial crisis. The housing boom started since the middle of 1990s, studied by Case and Shiller (2004), stimulated a rapid growth in the mortgage sector hence generate a great amount of financial derivatives which led to a booming in the financial sector as well. While the housing market started to decline, consumers began to re-evaluate their real estate investment and stopped to repay the mortgage of some unworthy projects. The increasing default rate squeezed the profit of banks and finally led to a systematic failure of the whole financial system and spread to a global crisis. The recent crisis is not the only example, we also gained some experiences from the previous crisis, say, the Asian crisis in 1997, when real estate bubble contributed great effects to the collapse of the local economy, as analyzed by Quigley (2001). Considering the past experiences, it would be necessary to detect uncertainties, which is called bubble in the context of this paper, in the housing market.

The structure of this paper is as follow. Section 2 discusses relative researching literatures which contribute on two main perspectives, the identification of bubble in section 2.1 and determinant of housing prices in section 2.2. Section 3.1 and 3.2 introduce the basic hypothesis of this paper and the methodology exploited correspondingly. Section 3.3 provides detailed description of the data source and section 3.4 depicts specific measurement of economic indices. Section 4 provides detailed analysis to test the hypothesis of this paper. Relative figures which do not appear in the main text can be found in Appendix A. Appendix B contents regression tables and Appendix C provides detailed description of the linear and log-linear model which are used in section 4.

2.Literature Review

Numerous papers have been developed to study the housing market. For the interest of this paper, three main perspectives are concerned. This paper is studying housing price bubble, so the definition of bubble is an essential point as well as the market determinants. Furthermore, a bubble should be distinguished from a spotted surge of prices due to some economic shocks.

2.1 Identification of a Bubble

In order to detect the existence of a bubble, the first priority is to figure out what exactly constitutes a bubble. Different from other economic concepts, bubble is a widely recognized phenomenon but lacking of a clear and common definition. The term “bubble” in economics can be traced back to several well known historical events. One of the most famous cases is the Tulip Mania in Holland in the 1600’s. Garber (1986) studies this case thoroughly. At the beginning, the price of tulip bulbs began to rise due to some rumors of increasing demand in France. Then traders involved into this market with great passion hence push the price soaring up dramatically. Though the prices of tulip bulbs were ridiculously

deviate from their intrinsic value, trader kept buying them and expected that the price would grow even higher. No doubtfully, the prices crashed after all. Garber delivers a comprehensive study about this case which leads to the conclusion that a bubble did exist in this price boom of tulip bulbs.

The well known Dot-com bubble which burst in 2000 provides us a modern example. From the year 1994 to 2000, investors showed significantly high expectation about the future growth of the stock in the internet sector and related fields. The speculative invest caused a price boom of relative stocks. At the beginning of 2000, the NASDAQ composite index had been spotted a 605% increase compared with the counterpart in 1994. The soaring price and speculation about future profit of high-tech companies generated an overheated invest environment. Under such a circumstance, investor ignored the real economic and financial fundamentals such as Price/Earnings ratio, and instead, they rushed into the market simply because the stocks they were buying had an “e-” prefix or a “.com” at the end of the name⁴. When the bubble burst in the year of 2000, many of companies who used to have the sky-high share price had never made any profit. The burst of bubble led to heavy losses to the US stock market investors.

Bubbles are frequently observed in the real estate market as well. Case and Shiller (2004) provide us some examples of housing bubble in the history. He stated in his paper that housing prices increased rapidly from the middle of 1980s in many cities all around the world, such as Boston, Los Angeles, London, Sydney and Tokyo, and this rapid increase could not be explained by economic fundamentals. After reached the peak around 1990, the prices started to decline in those cities. Among them, Japan beard the most damage and still tried to climb up from the trough. In the year of 2005, 14 years after the crash of the bubble, the real estate price level was only half of the counterpart at the peak in 1990.⁵

By observing historical events, we can see that two important features are shown commonly in a price bubble. The first one is a sharply increase in the price of certain commodity or asset, which most likely followed by a sharp decline after

⁴ “Nanotech Excitement Boosts Wrong Stock”, <http://www.techdirt.com/articles/20031204/0824235.shtml>

⁵ “Take It From Japan: Bubbles Hurt”, http://www.nytimes.com/2005/12/25/business/yourmoney/25japan.html?_r=1&pagewanted=all

reaching the peak. The second feature is that this rapid increase cannot be explained by economic fundamentals or rational reasons, and mostly the motivations driving prices up are based on some specific beliefs about future, such as speculation of future profit and expectation of higher future price.

Considering these two common features, economists developed more abstract and precise definition about bubbles. Kindleberger (1987) provides a well known definition to define a bubble as “a sharp rise in price of an asset or a range of assets in a continuous process, with initial rise generating expectations of further rises and attracting new buyers – generally speculators – interested in profits from trading in the asset rather than its use or earning capacity.” In this definition, we can notice that expectations and speculative investment play an important role in forming a bubble. Being more specific on speculative investors, Stiglitz (1990) gives out a similar definition that a bubble exists if “the reason that the price is high today is *only* because investors believe that the selling price will be high tomorrow – when “fundamental” factors do not seem to justify such a price”.

From these two definitions we can see that buyers in a bubble do not care about the “true value” of the commodity, as housing in this paper, but the future price. It is the main reason why the change of prices cannot be explained by the economic fundamentals. Combining historical observations and previous definitions, the concept of housing bubble in this paper can be specified as follow: A housing bubble is constitute with two factors, an exhibition of rapidly increasing price and a deviation from the intrinsic value which can be explained by economic fundamentals.

One problem of such a definition is that to test the bubble in the price, we need identify the “true value” of the asset and compare with the market price thus conclude whether there is a deviation or not. We know that the price of an asset should equal to the present value of all expected future cash flow. Siegel (2003) analyzes this situation and gave out a more feasible and operational definition: “the future realized return of the asset justifies the original price over a time period long enough so that the present value of cash flows received by investors during this period constitute at least one-half of that price. A simple measure of

this length of this time is the duration of the asset, or time-weighted average of all future expected cash flows.”

This definition provides us a practical measure to test the existence of “improper prices”. Two key factors involves into the calculation of present value, the expectation of cash flows and discount rate. Hence we can derive the intrinsic value of housing price and compare with the spot price.

But there are several potential problems of using this method. First of all, the data of real estate market is not as complete as the data in the stock market, which means that the price index may not reflect all information affecting housing prices. Intuitively, we may fail to build up a reliable hypothesis test on such a data set.

Secondly, the housing prices are determined by many factors, for instance, the cost of land, cost of construction, policy effect and so on. It can hardly be considered as a “random walk” as the stock index. Furthermore, there are many factors which are hard to be quantified, for example, the political effect on public expectation significantly affects the price of real estate, but the policies are not consistent and hard to predict. In this case, it would be necessary to discuss the effective factors which may influence the housing price, hence find a practical measure to detect the bubble in the housing market.

2.2 Determinants of Housing Price

Housing price may be determined by many different factors. We can analyze it from both supply and demand side of housing market. In a series of researching of Mayo (1985, 1987a, 1987b), he and his colleagues found that the pattern of housing demand that in developing countries was in many perspectives similar to the counterparts in developed countries. This finding gives us great convenience to introduce many mature measures which is used to study housing bubbles in developed countries into the study of Chinese counterpart.

Some researchers (Blanchard et al. 1982, Schwab, R. M. 1982) studied the dynamics of housing prices and found that it can be explained by market fundamentals and deviation from the equilibrium prices. From the supply side,

construction cost which include construction material cost, land price and labor force wages would be the main reason for the fluctuation of housing price. Intuitively, a higher cost may lead to a higher price level. From the demand side, the housing prices are mainly influenced by two categories of factors, which are the affordability and willingness to buy of individual consumers. Naturally, people with higher income would have higher affordability for certain price level. There are some widely used measures to evaluate the affordability of housing. One of the most widely used indicators is the Price-to-Income ratio, which is measured by the median housing price in specific area divided by the median of household income in the same area. Case and Shiller (2004) adopted this indicator and observed significant evidence that during the development of housing price boom from 1990s to 2000s in USA, the area with potential housing bubble shows higher level of Price/Income ratio and higher standard deviation of this ratio. I also incorporate this ratio to measure the affordability in this paper.

On the other hand, the willingness to buy of individual consumers may be affected by more complicated factors such as the interest rate, inflation rate, mortgage rate of bank loan and some others. It would be necessary to shortly analyze the motivation of purchasing a house or flat. Under most of the situations, individuals would buy a home either for personal usage, to live in it, or as an instrument of investment. If we consider the practical usage of housing, population increase and income increase would increase the demand of residence, and then push up the price level. Mankiw and Weil (1989) study the influence of demographic factors on housing price level in USA. The Baby Boom is considered as the main driving force for the booming housing market in 1970s.

Taking housing as an invest instrument, buyers would take into account the interest rate as the opportunity cost, mortgage rate as the capital cost of such an investment and the future payoffs. As we argued above, the future payoff is generated by the future cash flow, mostly the rental in future period. But we cannot ignore another possible option for investing in housing, speculative investment. Shiller (2007) indicates that housing has become a popular speculative investment in recent decades, and then provides higher possibility for the existence of bubbles in the market. In my research, regular investing in

housing for the future rental is less likely to be the main motivation than the speculation on housing. Because in China, the ratio of housing price to the monthly rental is very high, some places have exceeded 600, so that the intrinsic value derived from discounted future rental is far below the current price level. There will be more detailed analysis in the following part.

Additionally, there are other factors may affect the housing prices, for instance, the location of the market. Bodman and Crosby (2003) study the median housing price in five most popular cities of Australia. By using simple linear regression to model the correlation between housing price and macro-fundamentals the paper illustrates the existing of overvaluation in some cities meanwhile the same situation did not happen in other cities, which means the regional variation may be decisive in the forming of housing bubble. This influence of regional differences is also considered in this paper.

2.3 Price Boom or Price Bubble?

Back to our initial concerning about housing market, the high price level itself does not have severe damage to the economy though it may generate complains and inequalities. The real problem is the consequence of burst bubble. So we need to find out whether the high price level is sustainable along time. Because Stiglitz (1990) argues that in some specific models, the bubble which generated by rational expectations need never break. Compared with my argument, the bubble that Stiglitz mentioned should be captured by the economic fundamentals hence can be considered as “rational expectation”. And in this paper, only the unsustainable high prices are considered as bubbles.

Due to the development of financial market, real estate is no longer a minor choice of speculative investing (Shiller, 2007). More and more investment institutions and individuals are beginning to consider housing as a good investment opportunity. Case and Shiller (2003) considers the boom of housing price as a consequence of “a feedback mechanism or social epidemic”. In the procedure of housing appreciation, the expectation of home buyers, which is simply built upon the belief that the price will keep growing up, leads to

emotional speculative interests, thus pushes up the price level. The rising price will stimulate a higher expectation of future prices and form a feedback circle of prices and expectations until the breakdown of market. Shiller provide three cases in his paper, the US housing boom of 1950, the US farmland boom of the 1970s, and the UK housing boom of 2004, as practical evidence.

Furthermore, Zhou and Sornette (2006) studied the prices of new-sold houses in 50 states of the United States, by comparing the actual growth rate with the "exponential rate" which they derived through constructing an exponential model in the paper and the authors predicted the turning point of the bubble will probably occur around mid-2006. Their research proves the possibility to identify a housing bubble through quantitative analysis.

Overall, if the booming price is simply determined by economic factors, except the speculative behavior, the fluctuation of housing price should be explained by respective economic indicators and variables. Speculation on housing is built on the belief that the price level will keep growing in a relatively long period in the future, and there is a good chance to resell the house with a much higher price hence generate attractive profit. Expectations like this cannot be captured by economic fundamentals, it is possibly could be discovered by surveys. Case and Shiller (1988) show a practical survey result on the difference home buyers' behaviors in the boom and post-boom environments. Their research reveals that home buyers in pricing boom have higher expectation for future prices, and their behavior is more influenced by investment motives. Under such a circumstance, a reverse of belief would lead to a collapse of the market.

3. Hypothesis, Methodology and Data

3.1 Hypothesis

By studying previous literature, the housing price bubble can be defined as a rapid increase in housing price which cannot be explained by economic fundamentals and seemingly unsustainable in a long run. We can see from this definition that three conditions play key roles to recognize a bubble. The first one is a rapid increase in housing price level. Secondly, the surge of high prices should be uncorrelated with economic indices thus indicate an irrational expectation on future price. The last one is that the high price level should not last in the long run which indicates that the bubble would burst at some breaking point. If all three conditions are satisfied simultaneously, we can confirm the existence of a bubble. In the following part, this paper is going to test the satisfaction of all three conditions.

3.2 Methodology

To test the three conditions defining housing price bubble, this paper adopts analytical method and quantitative method to discuss the potential bubble. The first condition of pricing surge can be spotted by depicting the time series. The second condition is more complicated. It can be decomposed into several sub-problems. According to previous analysis, the housing price is determined by supply-side factors and demand-side factors. Supply factor is the cost of building, including construction cost and material cost. We are going to test the correlation between housing prices and these two costs. To analyze demand side factors, a simple linear regression and a log-linear regression are used to test the correlation between economic fundamentals and housing prices. If the housing prices can be explained by economic indices, we can say that the consumers have rational expectation on housing price, the price increases should tribute to economic growth rather than a bubble. On the contrary, if the prices cannot be explained by

the economic indices, we can expect that active speculative activities exist in the market, and there is high possibility for a bubble existence. If both first and second conditions are satisfied, bubbles are suspected in the market. Because the potential bubble is still growing, we cannot reach conclusion of bubble burst from data. So we can analyze the potential factors which may support the irrational expectation and see if they are sustainable in a longer time horizon. Similar analytical measures are also adopted by previous researches, for instance Case and Shiller (2004), Shiller (2007), Bodman and Crosby (2003) and Siegel (2003)

3.3 Data

This paper focuses on the housing markets in four municipalities of China – Beijing, Shanghai, Tianjin and Chongqing. The time expansion covers the period from 2003 to 2011. The selection of researching target is decided due to following reasons.

First of all, selecting big cities can guarantee the similar background of variables we are not going to study in this paper, such as demographic structure and policies. The housing market in China has been built up merely since 1998, which leads to a significantly divergent maturity of the local housing markets in different area. Beijing, Shanghai Tianjin and Chongqing as four of the most developed cities in China, have relatively mature housing market. More importantly, each of these four cities has a population over 10 million people, which guarantees a sufficiently big market to avoid the distortion on prices from asymmetric information and monopoly.

At the same time, the regional differences are also considered when I select the proper cities. One important feature of China's economy is the imbalanced development among different regions. In the previous researching on other countries, similar regional differences are also reported such as Bodman and Crosby (2003).

The four cities in this paper represent two different types of cities in China. Beijing and Shanghai represent the kind of big cities which are better developed in economy and have more international connections such as Shenzhen,

Hangzhou and Guangzhou, which mostly allocate along the eastern coast line. Tianjin and Chongqing represent cities relatively less developed cities which mostly allocate in the inner territory of the mainland. The economic differences can be observed between these two types of cities such as housing price, average income and GDP. And the housing price booms are more obviously observed in the first type of cities than that in the second type of cities.

Secondly, with the advantages of attractive opportunities, active markets and diversified cultural activities, the big cities are always the first priority to those ambitious people who want to expand their career. Meanwhile, the big cities are also the main targets of private capital that is looking for the new opportunity to invest, which is one of the main reasons boom the real estate market so rapidly. So, the real estate markets in big cities are most likely to maintain bubbles compared with other subordinate local markets. It will be more efficient to narrower the research field rather that study the whole market within China.

Thirdly, for the concern of data availability, the big cities have the most comprehensive dataset of the relevant variables in the real estate market. For instance, the earliest monthly housing price index can be traced back to 1998 in the municipalities, which is impossible in other cities. Even data about municipalities are not available from 1998 because in the first several years, there are no comprehensive records about historical trading. So our data series started from the year of 2003.

Most of the data related to housing market, for instance quarterly housing prices, are sourced from the annual report of local Municipal Bureau of Statistics (MBS). The data is completed and adjusted with the data from an independent research company - Wind Information Co., Ltd (Wind Info), which is considered as the biggest and most professional financial data provider in China. Part of the economic fundamental variables such as GDP, CPI, interest rate and income data are found in the database of National Bureau of Statistics of China (NBSC). Furthermore, some survey data is provided by the statistical department of The People's Bank of China (the central bank of China, short as PBC).

3.4 Measure of Economic Indicators

3.4.1 Measure of Housing Prices

The average housing price can be found in the database of NBSC. But there is a problem about this data. As we know, there are two parallel systems of distributing residences. The first one is a housing market where commercial housings are traded and this is the one we are studying in this paper. And the other system is a national distributional system, which mostly covers the employees of government, nationalized enterprises and military institutes. The policy of this national welfare has been greatly weakened after the transform in 1998, but there are still some subsidies which provided by the central government or local governments, which causes different price bases in the statistics. Furthermore, NBSC also include the part of affordable housing which is financed by the government. This part of housing has a much lower price and has constraints when selling on the market. All these factors make the statistics of housing price provided by NBSC possibly deviate from the price level which determined by the market.

Considering about the potential deviation, the data from Wind Info is adopted in this paper. They provide the monthly data of traded commercial housing. The housing price is derived from the ratio of total turnovers to the total traded area of housing of the month. And it can be conveniently converted into quarterly data by replace the monthly turnovers and traded area with quarterly counterparts. The calculation results in RMB per square meter, which is a common measure in China for housing price. Deflated with Consumer Price Index (CPI), I get the real housing price. The housing price is not converted into international currency such as US dollars or Euros because this paper is mostly concerning about index, ratios and standard deviations, so the currency plays no important role in our study.

3.4.2 Measure of Other Indicators

Processing of Annual Data

As discussed above, this paper introduced some economic indicators to analyze the potential bubble in China's housing market. The housing price is converted quarterly time series, but it is difficult to get the quarterly data for some other variables, such as population growth rate. So I process the annual data and convert them into a quarterly base. I assume that the annual variation of the data has a uniform distribution within the year, so I divide the annual population growth rate with 4 hence get the simulated quarterly population growth rate.

When I discuss the construction cost variations, the data of Material Price Index and Construction Cost Index are also annual data. But the main purpose of this analysis is just show the trend of price change. So I simply assume that the price levels are constant within the year, we will see that reasonable fluctuations will not affect the result of analysis. In the later analysis, we can see that the correlation case can simply be ruled out by plotting graphs. Since the expanded data is not used to run regressions, there is not statistical bias problem.

Household Income

The Household Income equals to the Annual Income per Capita times the average Size of Household. Deflated by CPI, the Annual Income is converted into real term. The annual income data is obtained from the database of local MBS, which is quarterly base data. The Annual Income per Capita is a statistical result from a random sample investigation within targeted area⁶.

Price-to-Income Ratio

To calculate this ratio, we assume that the average living area of traded housing is 100 square meters, and the household annual income

$$\frac{\text{Price}}{\text{Income}} = \frac{\text{Average Housing Price} \times 100}{\text{Average Income per Capita} \times \text{Average Size of Household}}$$

⁶ It is the official explanation from the National Bureau of Statistics of China (NBSC).

CPI, Interest Rate and Mortgage Rate

The Consumer Price Index is obtained from the database of NBSC, which is quarterly data. To evaluate the opportunity cost of investment and calculate present value of future cash flow, I obtained the one year saving interest rate from PBC as well as the Mortgage Rate for a 30 years mortgage.

4. Analysis

4.1 Housing Prices Development

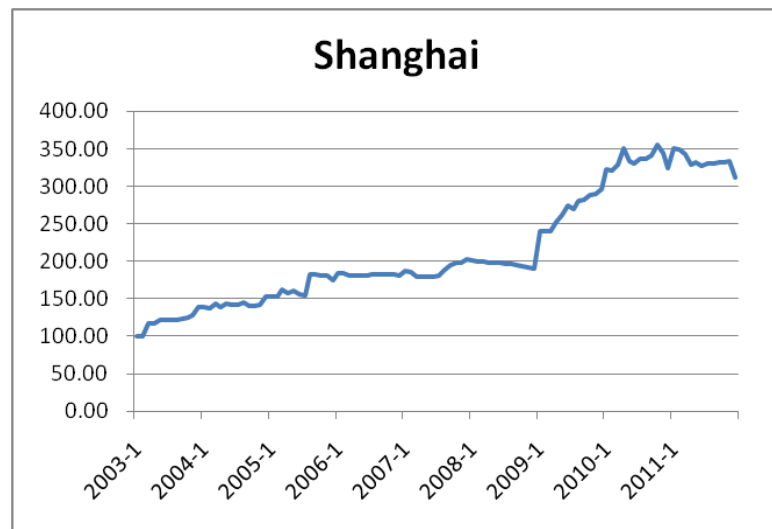
From the previously defined concept, the first characteristic of housing bubble is a rapid increasing in price. Figure 1 to Figure 4 show us the real housing prices development since 2003 in these four municipalities respectively. It is clearly shown that the real housing price increased significantly in the last decade. From 2003-2005, the price levels are relatively stable, but after 2005-1, the prices start to increase rapidly. In Shanghai, the price increase hits 350% of the counterpart in 2003 and even the least developed city, Chongqing, the housing price in 2011 is about 2.5 times greater than that in 2003. This increase is equivalent to an annual increase from 12% to 17% respectively, which highly overwhelming the GDP growth rate of China during this period. To have a comparison, Shiller (2007) reports a fast increase of housing price in USA from 1995 to 2005, which currently is considered as a potential bubble triggered the financial crisis in 2007. And according to Shiller's calibration, the real price in USA by that time increased about 70% during those ten years. This increase is quite mild compared with our observation in China. So we can see that the fast increasing housing price is an obvious fact.

Figure 1: Real housing price of Beijing.



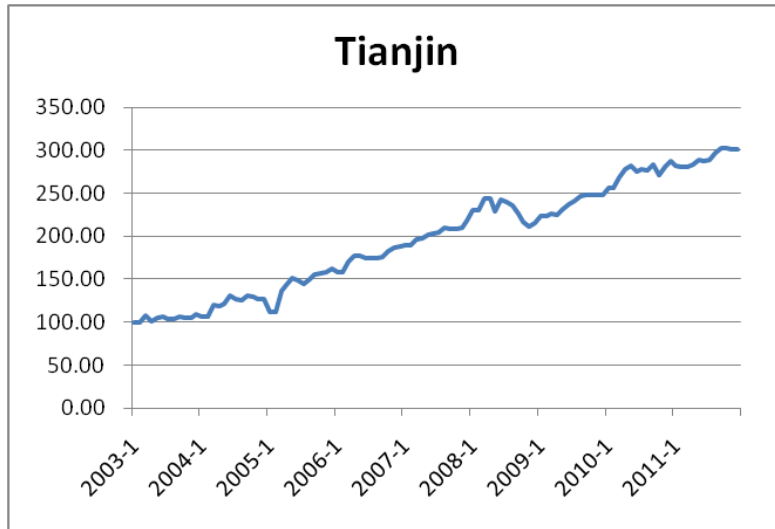
Average price of the commercial civil residence, the total turnover of the month divided by the total traded area and deflated by the Consumer Price Index, monthly, rescaled to 2003-1=100.

Figure 2: Real housing price of Shanghai.



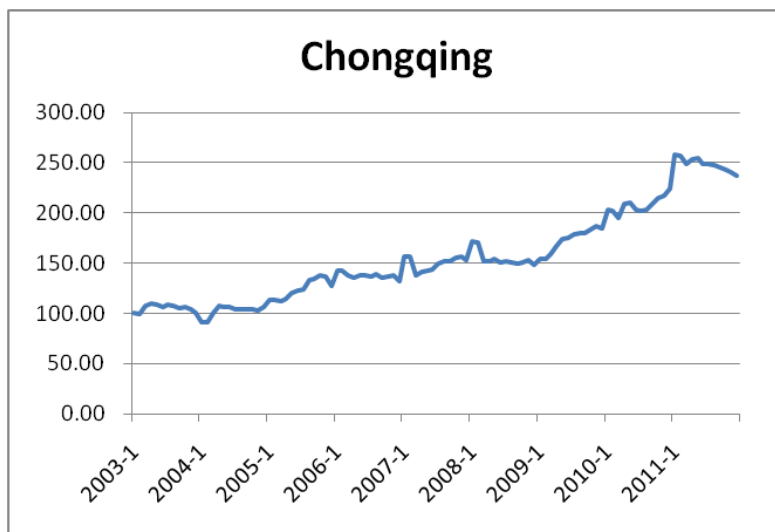
Average price of the commercial civil residence, the total turnover of the month divided by the total traded area and deflated by the Consumer Price Index, monthly, rescaled to 2003-1=100.

Figure 3: Real housing price of Tianjin.



Average price of the commercial civil residence, the total turnover of the month divided by the total traded area and deflated by the Consumer Price Index, monthly, rescaled to 2003-1=100.

Figure 4: Real housing price of Chongqing.

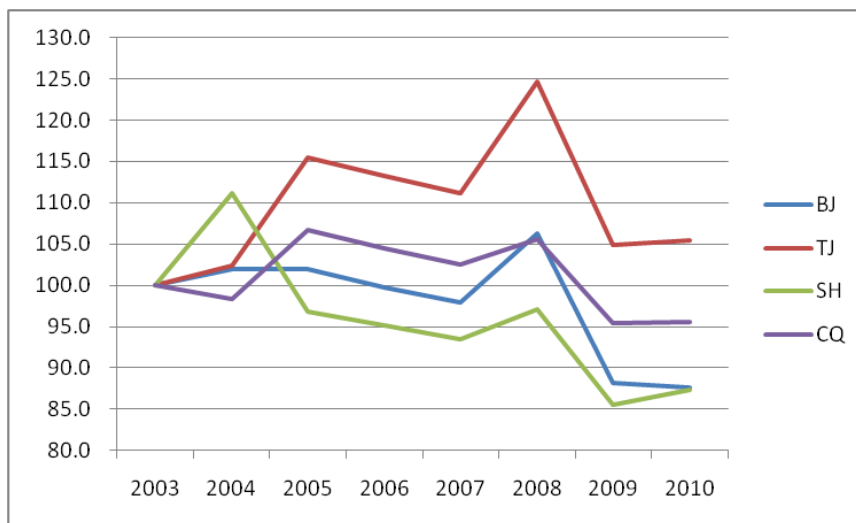


Average price of the commercial civil residence, the total turnover of the month divided by the total traded area and deflated by the Consumer Price Index, monthly, rescaled to 2003-1=100.

The prices in different cities show different developing path as well. The prices of Beijing and Shanghai show greater volatility than those in Tianjin and Chongqing, we can see this in the table 2. The housing price of Shanghai shows the largest standard deviation which reaches 75.7. It is not a surprising result because Shanghai is the most active commercialized city in China. On the other hand, as a less developed city, the housing price boom in Chongqing is relatively milder, though it is already an astonishing increase rate with a 158.2% increase in 8 years.

The first impression of the data seems to be a positive respond to our suspect of housing bubble. In the following part, we need to figure out whether it is a reasonable growing accompanied with the fast developing economy or an abnormal speculative bubble.

Figure 5: Real Construction Material Price Index.

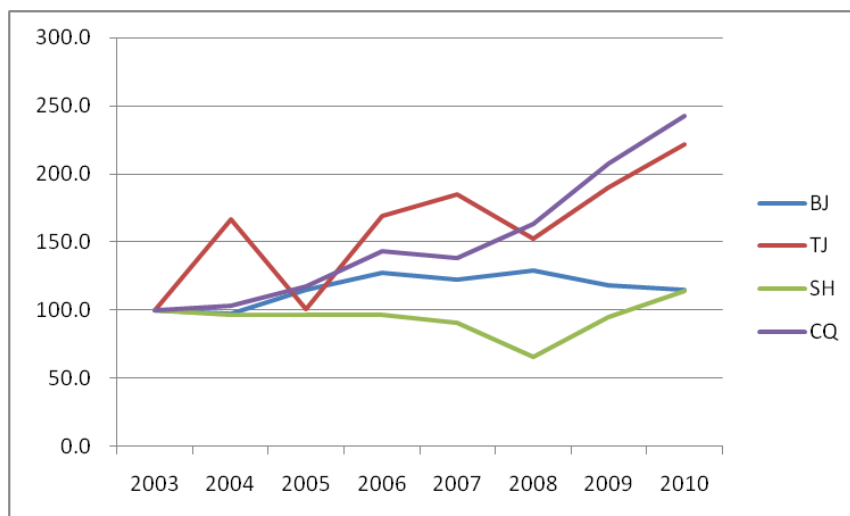


Average price index of the construction material deflated by the Consumer Price Index, annually, rescaled to 2003-1=100.

4.2 Construction Cost

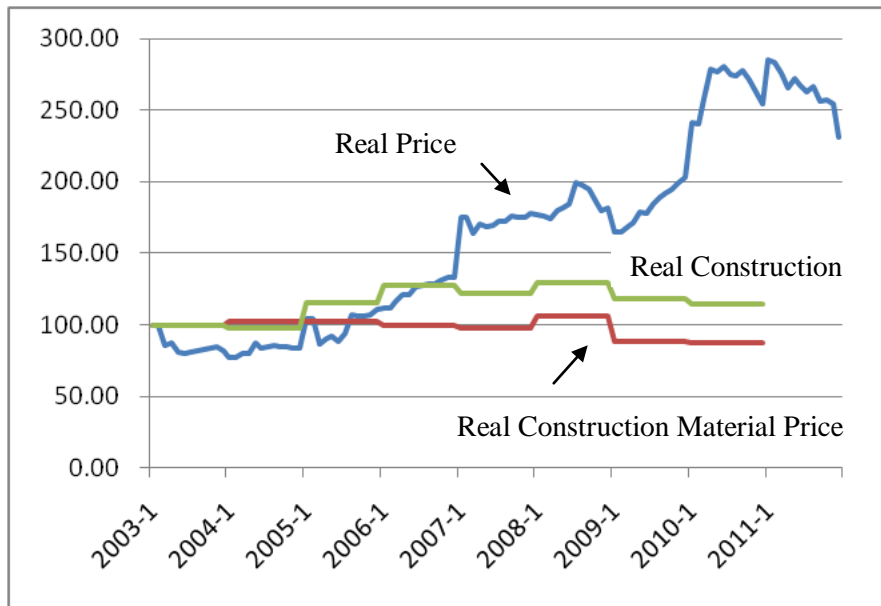
As discussed above, the cost of construction housing may affect the housing price. Intuitively, if the construction cost increase sharply as same as the housing prices we can reasonably conclude that the soaring up housing price is caused by the increasing construction cost. I adopt two different data to see the developing path of the construction cost within the same period of housing price boom. One indicator is the Real Construction Material Price Index. It measures the price change of construction related material such as steel, cement, wood and plastic. The other one is the Real Construction Cost. It measure all relative cost of constructing new housing such as wages of workers, land price and other costs. From Figure 5, we can see that the real prices of construction materials do not have clear trend of increasing from 2003 to 2010 in all four municipalities.

Figure 6: Real construction cost.



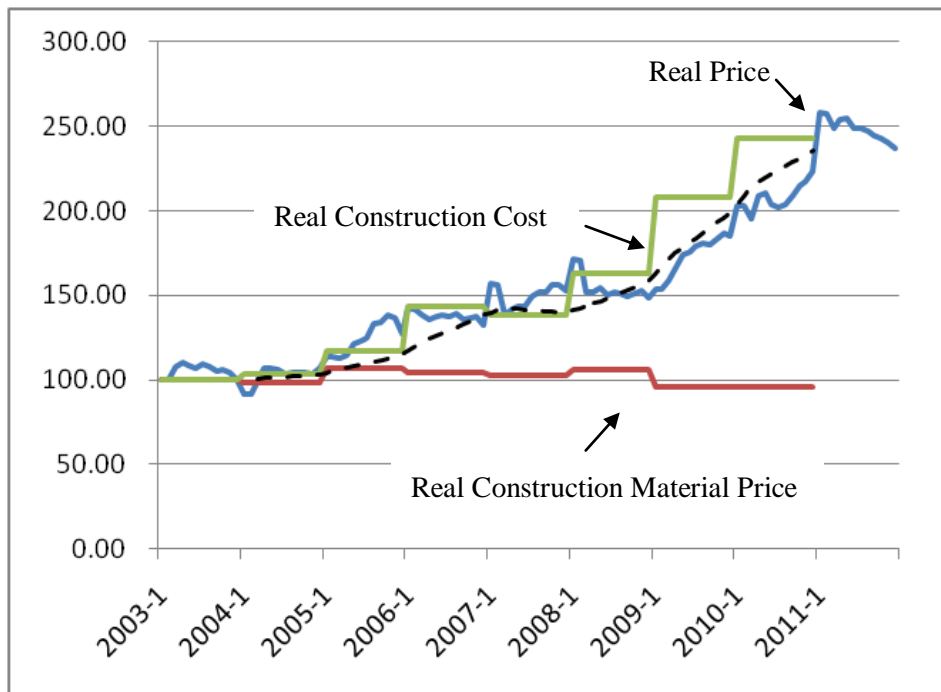
Average cost index deflated by the Consumer Price Index, annually, rescaled to 2003-1=100.

Figure 7: Comparison of Real Price, Real construction cost and Real Construction Material Prices - Beijing.



Average cost index deflated by the Consumer Price Index, annually, rescaled to 2003-1=100.

Figure 8: Comparison of Real Price, Real construction cost and Real Construction Material Prices – Chongqing.



Average cost index deflated by the Consumer Price Index, annually, rescaled to 2003-1=100. The dash line is the moving average trend line of Real Construction Cost.

A similar pattern can be observed with the Real Construction Cost in Figure 6. The construction cost in Beijing and Shanghai display a constant developing path. While the construction cost in Tianjin and Chongqing show clear increasing pattern. To illustrate the differences between housing prices and construction costs, I depict these three variables in one graph. We can see from Figure 7 that in Beijing, the costs does not match up with the price increases. The boom in real prices cannot be explained by the relatively stable construction cost and material prices. The data in Shanghai⁷ shows the similar pattern that the construction cost has no much explanatory power to housing price increases.

A different situation can be observed in Tianjin and Chongqing. Figure 8 shows that though the real material price is still stable, the Construction Cost in Chongqing depicts a clear increasing trend which matches up with the housing price since 2005. The similar pattern is observed with the data of Tianjin in Figure 14⁸, which shows an even better match-up. The construction cost in Chongqing since 2005 shows a similar growth path with housing prices.

By running simple regressions of the Real Housing Prices on Construction Cost, we can see that the statistical analysis reaches the same result as we observed in the figures. From Table 2 we can see that in Beijing and Shanghai, the Construction Cost can only explain 24% and 10% of the total Housing Price fluctuation. But in Tianjin, Construction Cost can explain 59% of the Housing Price fluctuation. Furthermore, the Construction Cost can explain 91% of the total fluctuation of Housing Price in Chongqing. This result tells us that Beijing and Shanghai are more likely experiencing an unexplained housing boom.

⁷ Figure 13 in Appendix A.

⁸ See Appendix A

Table 1: Statistics of Price/Income Ratio

| | Beijing | Shanghai | Tianjin | Chongqing |
|--------|---------|----------|---------|-----------|
| Min | 9.8 | 11.4 | 5.1 | 5.3 |
| Max | 21.7 | 18.6 | 8.5 | 8.6 |
| Median | 15.8 | 15.3 | 7.6 | 6.4 |
| S.D | 3.8 | 1.9 | 1.1 | 0.8 |

4.3 Affordability

Intuitively, a long run sustainable price level should be supported by consumers who can actually afford this price. To measure the affordability of consumers, the ratio of Housing Price to Household Income is introduced. This concept is widely used in the housing market studying. Figure 15 shows the P/I ratio among four municipalities. Table 1 shows the statistics of the P/I ratios. The most volatile city is Beijing, with a 3.8 standard deviation and median 15.8. The least volatile city is Chongqing. This observation is coherent with the previous analysis. The city with housing price which is better explained by economic fundamentals shows relatively stable P/I ratio. This data revealing fact coincides with the realistic observations. The housing markets in less developed cities are relatively stable and suffer less fluctuation.

The first impression of the P/I ratios is that they are astonishingly high compared with previous studies in other countries. Case and Shiller (2004) reports an average 4.5-7.8 P/I ratio in the eight most volatile states of USA, where he suspects a potential housing bubble in the market. And the following financial crisis in 2007 proved that the bubble actually existed by that time. If we considering the different calibration measures which is used in this paper and Shiller's paper, the gap between China's and USA's ratio would be much bigger. Case and Shiller (2004) measures the Income with Personal Income per Capita, and I adopt the concept of Household Income, which is more reasonable measure because buying a home usually is a household consumption rather than an individual consumption. By using household income, the P/I ratio would be lower

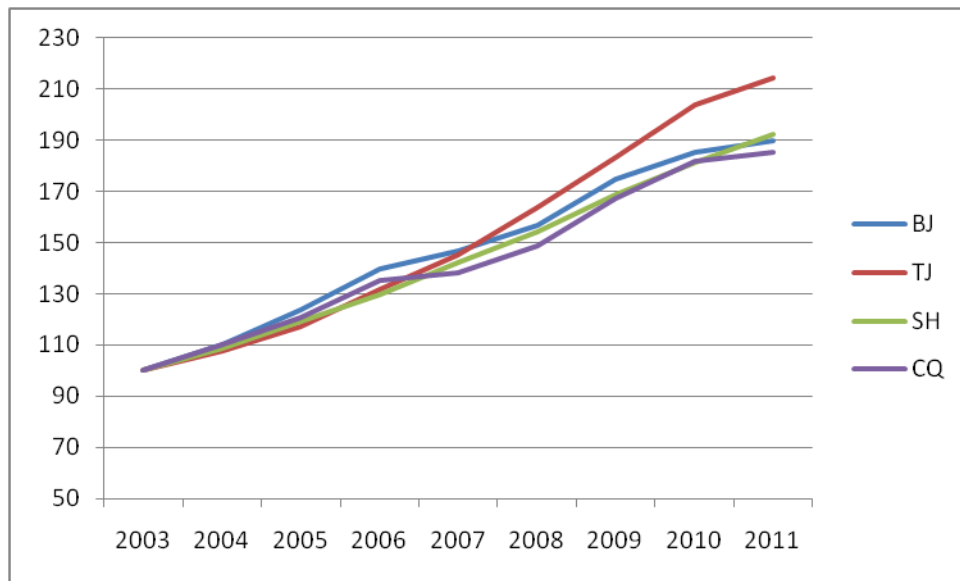
than Shiller's calibration. To be more specific, if a household has 2 working people, then the ratio in this paper is one half of the counterpart in Shiller's paper. According to my calibration, the P/I ratio in Beijing reaches 21.7 at the maximum, which means that a normal family need spend total income of 22 years to buy an average sized flat without any other expenditures. It is an extremely high ratio which almost guarantees the collapse of the market in other countries such as USA. But if we look deeply into China's society, the situation is not as vicious as depicted by the data.

First of all, the income data obtained from NBSC and Local MBSs are calculated from the taxation record and surveys, which do not cover the irregular income from shadow economy. The shadow income is an important part of households' income and it is hard to estimate. Some informal researches claim that the shadow income is equivalent to 50% or more of the officially recorded income. Take into account the shadow income, the P/I ratio would be lowered.

Secondly, the family structure in China is very different from other developed countries. Households who are going to buy a new housing may receive financial support from other family members. This phenomenon is partially due to the long tradition of China and partially because of the well known One Child Policy. For instance, a young couple at the age of 30 may be the only child in their original family, so when they decide to buy a new home, they could get the financial support from both husband's and wife's family. Sometimes, the new home buyers can even get the support from their grandparents' family. In this case, three or more households are involved into one single deal that greatly increases the affordability of housing buyers.

The third impact is the high savings rate in China. From 2003 to 2010, the savings rate fluctuates around 40%, and the total savings deposit reaches 34.36 Trillion RMB (5.44 Trillion USD) at the end of 2011⁹. The savings deposit provides a solid support to the housing market as well. It can partially explain why people still can afford buying new housing in a market where P/I ratio floats over 20.

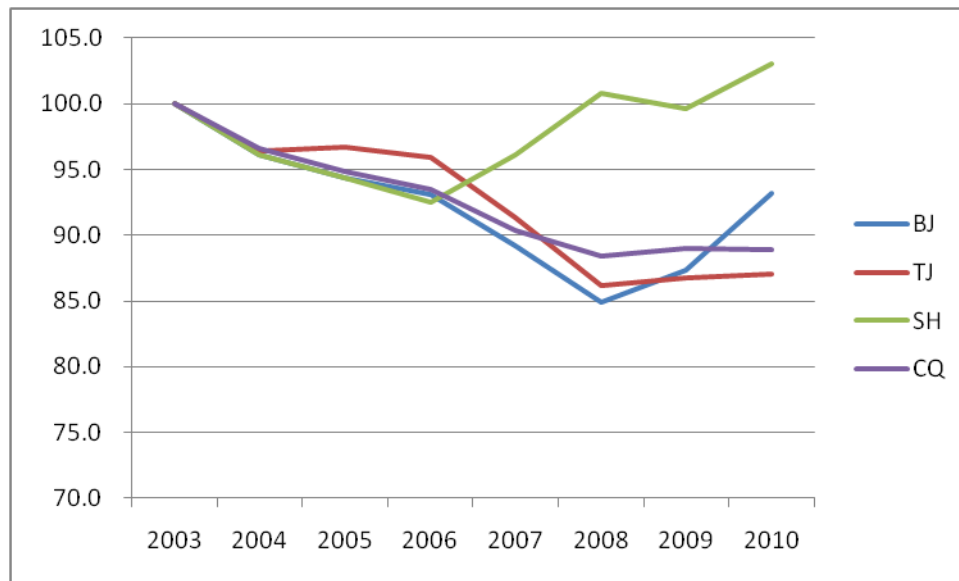
⁹ Source: People's Bank of China. <http://www.pbc.gov.cn/publish/html/2012s09.htm>.

Figure 9: The Real Household Income Index

Average Household Income Index deflated by the Consumer Price Index, annually, rescaled to 2003-1=100.

Though above influences may significantly lower the P/I ratio, it is still an unreasonable level. Figure 9 shows the growth path of Household Income Index. Compared with the growth pattern of housing prices, we can see clearly that the housing price increases exceed the growth rate of Real Income. And it is the reason that P/I ratios keep increasing, especially in Beijing and Shanghai (Figure 15). If the P/I ratio keeps increasing in this way, more and more consumers will be excluded from the market, hence decreases the demand of housing. Correspondingly, the Survey on Consumers' Preferences conducted by PBC reveals that, in 2011:2 75.6% of the people think the housing price is "too high and unaffordable". This number reaches the peak of historical record since this quarterly survey started in 2009:1.

Figure 10: Real rental index.



Average rental index deflated by the Consumer Price Index, annually, rescaled to 2003-1=100.

We have already rule out the influences of construction cost in Beijing and Shanghai. Then the main motivation of the price booms must come from the demand side of the market. For home buyers, there are two main purposes of buying housing- for living and for investing. The affordability data shows that purchasing new housing brings more and more pressure on the households. To meet the needs of living, buying new housing is not the only option. As an alternative, renting also helps people to find residences. Rental of housing could be considered as a good instrument variable to measure the demanding for living purposes. Figure 10 shows the changes of Real Rental in our target cities. Contradict to the soaring housing prices, the rentals are actually declining in all four cities. It means that the demand from living purposes should not have positive effect on housing prices. While considering social fads and customs, Chinese people may prefer to buy new flat rather than to rent one. Taking it into account, the investment consideration should play the key role in the price booms.

4.4 Investment Opportunities

Basically, there are two possible investing measures on housing. The first one is to lease the housing and collect rentals. And the other one is to resell the housing in the future and gain profit from the difference of prices, which is considered as a speculative investment.

4.4.1 Rental

Clark (1995) concludes that the rent-price ratio reveals the expectations of future rent growth. But in many big cities, the rental growth cannot match the growth rate of real estate prices, the rent-price ratio keeps going down to 1/400 ~ 1/500 in some area. In this case, it is almost impossible to gain profit just through renting. To illustrate this case numerically, I need a simple model of present value calibration. The present value of an investment is determined by the future cash flow – rentals. We can easily calculate the present value with the following formula.

$$PV = \sum_t^n \beta^t \cdot \text{Rental}_t$$

By selecting a proper discount factor β , the duration of housing n and the future rental we can derive the present value of the investing project. Considering the reality in China, we do not need to analyze all the historical data to rule out the possibility to invest into such a project in China. The result can be illustrated with a simple example.

Different from USA and other developed countries, the land in China is still “belongs to” the country theoretically, so the consumers can only purchase a property right for 70 years. It means that the duration of the investment can be 70 at maximum. Suppose an optimal situation that the leasing has no vacuum period. From Figure 13 we can see that the real rental is slightly declining, and we assume it is stable. By selecting the discount factor as CPI of the year, the present value is simply equals to the product of monthly rental and the number of periods.

Statistics shows that in 2011, the average monthly rental is 3280 RMB per month in Beijing¹⁰. At the same time, the average housing price is 18919 RMB per square meter. Assuming a flat with the living area of 100 square meters, we can calculate the project can generate a total return 45% in 70 years, which is equivalent to an annual return around 0.5%. It is a very thin margin of profit. If we adopt a discount factor 1% greater than CPI, the project would be non-profitable. So we can basically rule out the possibility to gain positive profit from leasing.

4.4.2 Speculative Investment

After ruling out the possibility of leasing, we can see that the most possible investing motivation is the speculative investing. Speculative behavior has been thoroughly studied in the previous years. Shiller (1988, 2004 and 2007), Goodman and Thibodeau (2008) and, Kim and Suh (1993) give comprehensive descriptions on this topic. Speculators have a high expectation on future prices and anticipate that the price will not decline in a short run. The only reason that stimulates speculators to buy in housing is the opportunity to sell it in the future with a higher price.

Chinese economy is export oriented, and this economic structure leads to the development of massive – labor industries. Those industries are facing severe competition due to the currency appreciation, gloomy world-wide economy and refinancing difficulties. So their margins have been lowered into a very narrow space. Under this circumstance, many factory owners tend to invest their money into other area and houses are attractive targets. This situation is worsened after the 2007 financial crisis in the USA. After the burst of crisis, the influences spread to China in 2008. Shrinking export forced many factory owners in the coastal cities to quit their business and eagerly seeking a proper investment for their

¹⁰ Source: Home Link, a real estate service company in China which provides comprehensive information about housing trading, leasing and relative services. Their data generated from daily trading are widely used in China. www.homelink.com.cn

capitals. The housing markets in big cities, especially Beijing and Shanghai, are attractive targets for them. The flow-in capital stimulate the demand of houses, raises the prices, push up the expectation for potential buyers and investors, thus created the “feedback mechanism” (Shiller, 2007). Correspondingly, we can observe jumping increases start from 2009 in housing prices in Figure 1 and Figure 2.

The speculative investment could be dangerous if the expectation is based on some unrealistic bases. In that case, the bubble underlying deviated prices is a great uncertainty of the economy, and when the bubble burst, all housing buyers will commit great losses. Then the key point is whether the expectations of investors are based on solid economic foundations or not.

4.5 Expectations

There are many reasons to generate a high expectation of future prices. They might be economic fundamentals, social fads or some externalities.

4.5.1 Economic Factors

China is experiencing a rapid urbanization procedure. The urban population increases rapidly. For instance, the population in Beijing increases 720,000 every year in recent decade¹¹, most of them are migrants from other regions of China. The increasing population increases the demand of housing greatly hence increases the anxieties about the scarcity of housing resources. Housing buyers may try to buy a home in case it is not available in the future. The psychological reaction may enlarge the effect of the population effects.

¹¹ Source: Beijing Municipal Bureau of Statistics.

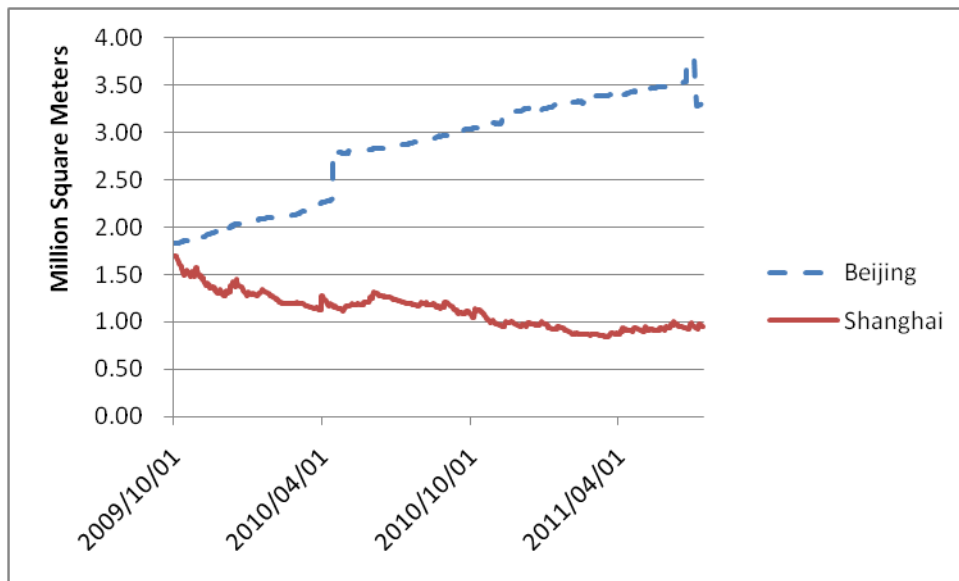
The GDP of China has been growing at a rate of 9.8% since the economic reform launched at 1978¹², which is considered as the main reason for the future housing price appreciation. At the same time, the disposable income also increases. From a normal viewpoint, the increased income will increase the purchasing power of consumers in the housing market. From previous study, it is obvious that the growth of income cannot match up with the housing prices boom. But the increasing GDP and income generate a side effect which makes people think that the housing market will keep booming as well. It is the main drive for the potential speculative bubble. It is very hard to tell whether the public can draw an appropriate forecast about the future. We will explore this in a more numerical measure later.

4.5.2 Social Fads

Social fad is another important feature that influences the demand and supply relationship in the housing market. Because of its unique history and customs, Chinese people have strong tendency to have their own properties. It is commonly seen that a new flat is a necessity for a newly married couple. For a majority of Chinese people, buying own housing mostly is preferred to renting a residence, and it is not only an economic consideration. The psychological satisfaction can hardly be measured in an economic way. This can partly explain why the housing prices increase so much and at the same time, the renting price is very stable.

The social anxiety should also be taken into account. China has experienced severe changes in last 30 years. Because of lacking well operating social welfare system and medical care system, the common atmosphere among public is safety deficiency. Under this circumstance, people look real estate as an insurance of their fortune. This kind of emotional motivation is also strong positive effect on their expectations about future housing market.

¹² National Bureau of Statistics of China, < Series Statistics Report 10th: 60 years of the New China > http://www.stats.gov.cn/tjfx/ztfx/qzxzgc160zn/t20090917_402587821.htm, <Dec. 1st, 2010>

Figure 11: The stock of reserved housing.

Source: Gao Tong Real Estate Researching Institute.

Unit of the vertical axis: million square meters.

4.5.3 Externalities

Some people may argue that the high price is somehow due to the improper governmental interferences, such as the policies which distort the market by limiting the supply of land and construction licenses. The governmental distortion created a supply deficit hence push up the price level. It sounds reasonable especially in China where governments involve greatly into the economic operation. Figure 11 shows the stock of reserved housing area in both Beijing and Shanghai. The housing reserve measures the total living area of constructed housing which is ready for selling in the market. Compared with the Housing Price graphs (Figure 1 and Figure 2), we can see that after 2009's impulses, there is no sign of supply shortage in the housing market. The housing reserve in Shanghai depicts a slightly decline trend due to a new surge of price booming from 2009 but mainly stays in a stable level. The growth of housing reserve shows that governmental interferences may not have actual effects on limiting the supply of housing, but mainly generate a psychological effect in the

public that the strengthen the impression of the scarcity of housing. This effect in some degree created a panic atmosphere among public hence push up the housing price.

The data in Beijing illustrates an interesting fact that along with jumping housing prices, the housing reserve actually increases. This phenomenon reveals that not only the consumers have speculative behavior but also the developers of housing expect that the housing price may increase more in the future. So developers do not sell the housing under current prices and expect a higher return of selling them in the future. Cases are frequently reported that developers keep most of the new constructed housing in stock and only put a small portion on the market for sale. This speculative behavior increases the tense in the market which stimulates a higher expectation for future housing prices among public.

4.6 Economic fundamentals

Considering the influences analyzed previously, we need to test whether the speculative behaviors are based on rational expectations or not. As we discussed in section 2, population growth, interest rate and mortgage rate are the factors that influence the price level most. Scott (1990) finds out that “...prices ... do not always track market fundamentals.” If the deviations are observed, we can draw the conclusion with some confidence that the booming may be driven by some immeasurable expectations.

4.6.1 Regression Models

Here I use simple linear models to test the correlations between housing prices and economic fundamentals.

The first one uses real price level as the dependent variable and regresses on population change, real income level interest rate and mortgage rate¹³.

¹³ Detailed description on model and variables are in Appendix C.

$$\text{Price} = \beta_0 + \beta_1 \cdot \Delta\text{Pop} + \beta_2 \cdot \text{Income} + \beta_3 \cdot R + \beta_4 \cdot R^M + \varepsilon$$

Considering that the price level and Income have similar trend. In this case, even they do not have correlation, the regression may returns a very high R^2 . So I use another model which both variables in logarithm to generate stationary time series which can avoid this problem.

$$\ln\text{Price} = \beta_0 + \beta_1 \cdot \Delta\text{Pop} + \beta_2 \cdot \ln\text{Income} + \beta_3 \cdot R + \beta_4 \cdot R^M + \varepsilon$$

To measure housing price with purchasing power, I analyze the feature of Price/Income ratio in the previous part of this paper. Intuitively, if the economic fundamentals have influences on consumers' behavior, there should be some correlation between the ratio and economic fundamentals. So I adopt another model to test the correlation between Price/Income ratios and economic fundamentals

$$P/I = \beta_0 + \beta_1 \cdot \Delta\text{Pop} + \beta_2 \cdot R + \beta_3 \cdot R^M + \varepsilon$$

The results of regression are depicted in Table 4, Table 5 and Table 6. The models depict similar results, though data are slightly better explained in the second model, which has bigger R-square and more significant coefficients. In general, the data from less developed cities is better explained by the economic fundamentals. This situation coincides with my previous discussion. Income is a significant variable for all cities in both linear and log-linear models and it has the greatest explanatory power among all variables. In Beijing, the Income itself explained nearly 90% of the fluctuation of housing price. In both Beijing and Shanghai, other variables besides Income have no explanatory power to the housing price, no matter in the linear model or in the log-linear model. It means that the speculative invest is more active in these two cities, because consumers are not sensitive to the interest rate and mortgage rate, even with the population growth and motivated by the income growth which represents the expectation on future. These variables are significant with the data from Tianjin and Chongqing which means that consumers concern not only the expectation but also economic factors. Their decisions are somehow based on rational expectations.

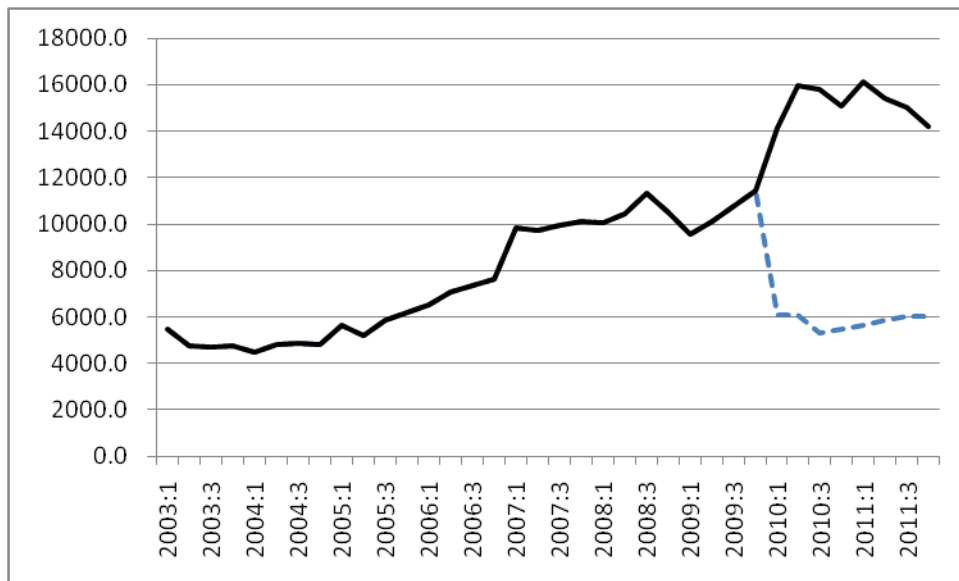
4.6.2 Predicted Housing Prices

In order to move one more step forward to see how much the housing price can be explained by the data, I use the coefficients generated from the models to predict the growing path of housing prices. Compared with the true data, we can see how much the true data deviate from the estimation. I use the first 28 quarters (2003:1 to 2009:4) to run the regression and use the estimated coefficients to estimate the housing price of the final 8 quarters (2010:1 to 2011:4). Then compare the result with the actual data.

Figure 12 shows the prediction and the real growing path in Beijing. We can see that the predicted housing prices are much lower than the real data¹⁴. And the predictions in Beijing and Chongqing deviate more than those in Tianjin and Shanghai. The forecast using Model 2 and Model 3 return similar results. The result shows that the economic fundamental has weak explanatory power to the housing prices. We can reasonably conclude that the speculative behavior is the major driving force for the high price level. According to our definition, there are bubbles in the housing markets, especially in the developed metropolitan area.

¹⁴ The predicted values in Shanghai, Tianjin and Chongqing are depicted in figure 16 to 18 in Appendix A.

Figure 12: The Predicted Housing Price in Beijing.



Parameters are estimated with the data of the first 28 quarters. The solid line is the actual quarterly housing price level. The dash line is the predicted housing price, started from 2010:1.

4.7 Burst or Not?

Knowing the existence of bubbles, the following questions would be when and how they are going to burst? There is no easy answer to these questions, especially when the bubble is still growing because there is no data evidence to follow. By comparing with the historical cases, we can draw some conclusion on this question. Shiller (2007) describes a “feedback mechanism” during the procedure of housing appreciation. The soaring up prices have some feedback effects on home buyers’ expectation hence stimulate a stronger surge of speculative investment. Similar argument may be applied to the collapsing procedure of the market. Once the belief on increasing prices reverses, new buyers would stop buying and previous speculators would sell their properties with lower prices to cut off potential losses. The declining prices might stimulate more and more speculators to sell out their reserves hence create a panic atmosphere in the market. The vicious spiral may lead to a fast break down of price level, bubble bursts. If we take a look at some historical cases like the US housing boom of 1950, the US farmland boom of the 1970s, and the UK housing boom of 2004

(Shiller, 2007), the turning points can be observed. After the turning point, prices started to decrease with a great speed, where the reverse of belief and vicious feedback mechanism played important roles. In China's case, the speculative investments are very active in the big cities and the high price level is driven by the expectation on future prices. If the beliefs reverse to a negative expectation, housing bubble will burst in an explosive way.

The forming mechanism of such a high expectation needs to be studied deeper in the future to reveal how long the bubble could remain. Once the expectation collapses, the housing bubble would no doubtfully burst. But we can observe that many economic features are supporting the expectation, such as the high growth rate of China's GDP and the urbanization procedure. In the future study, measures to identify, test and decompose individual's expectation would be critical to forecast the bursting moment of a bubble.

5. Conclusion

This paper studies the housing market in four representative cities in China. It helps to understand the housing market situation in China. This understanding is not just a curiosity but has practical meanings. Under the globalizing circumstances, the stability of China's economy is closely related to Europeans and Americans.

My study reveals that China is experiencing a surge of housing price boom. The ratio of Price to Income is high, especially in the well developed cities, Beijing and Shanghai. Researching shows that the speculative behaviors are active in the well developed cities. Considering that the growth rate of income is slower than housing price, the affordability is weakening and the housing markets have the chance to collapse. Once the public belief reverses, the bubble will burst.

Differences between developed and less developed cities are observed. Less developed cities have more stable P/I ratio and more smoothly developing

housing market. Furthermore, economic fundamentals have better explanatory power on data from less developed cities. While in developed cities, housing buyers are mainly driven by the expectation of future prices, which lead to the activeness of speculative investments. It shows that the housing price bubbles in the developed cities are more severe than those in undeveloped cities. Hence the burst of bubble may happen first in the developed cities.

In the future, it would be very interesting to observe the development of China's housing market, because it is an opportunity to observe a potential bubble when it is still developing. A deeper researching would be productive if it can conduct better and bigger data samples. If possible, a proper designed survey can help to reveal and value people's preferences hence to clarify the real motivation pushing up the expectation and then distinguish the rational expectation and the irrational housing bubble.

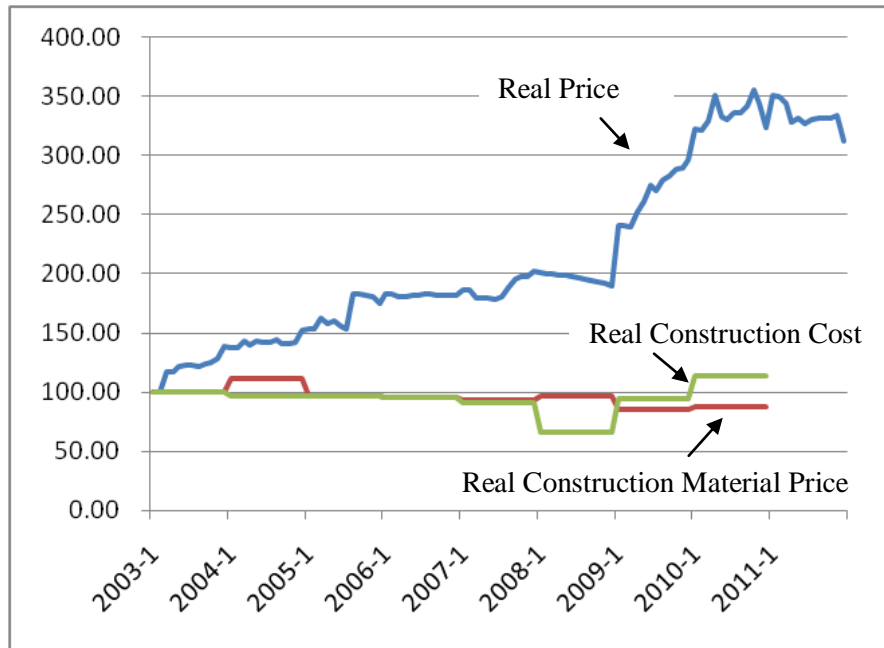
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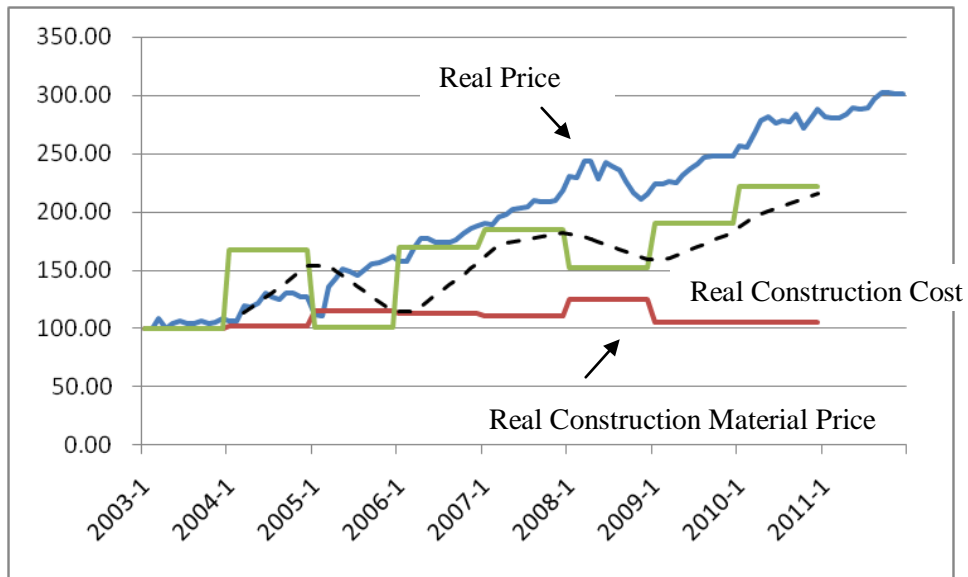
APPENDIX A

Figure 13: Comparison of Real Price, Real construction cost and Real Construction Material Prices - Shanghai.



Average cost index deflated by the Consumer Price Index, annually, rescaled to 2003-1=100.

Figure 14: Comparison of Real Price, Real construction cost and Real Construction Material Prices – Tianjin.



Average cost index deflated by the Consumer Price Index, annually, rescaled to 2003-1=100. The dash line is the moving average trend line of Real Construction Cost.

Figure 15: The Ratio of Housing Price and Household Income

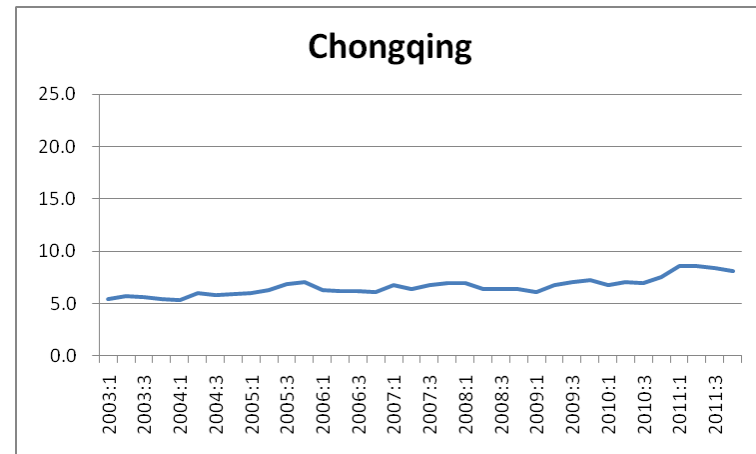
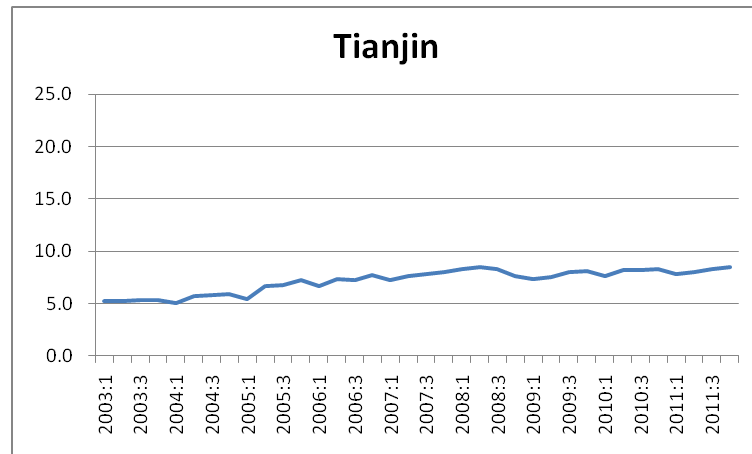
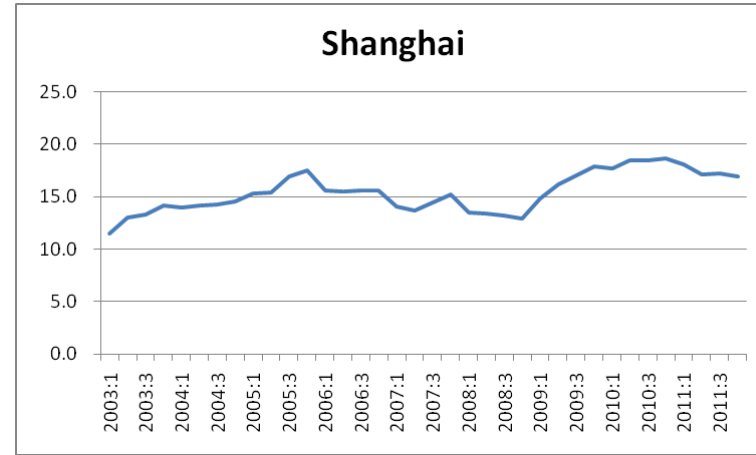
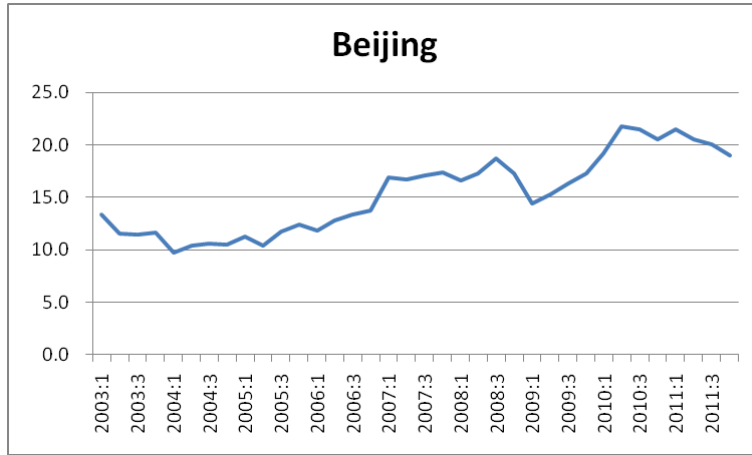
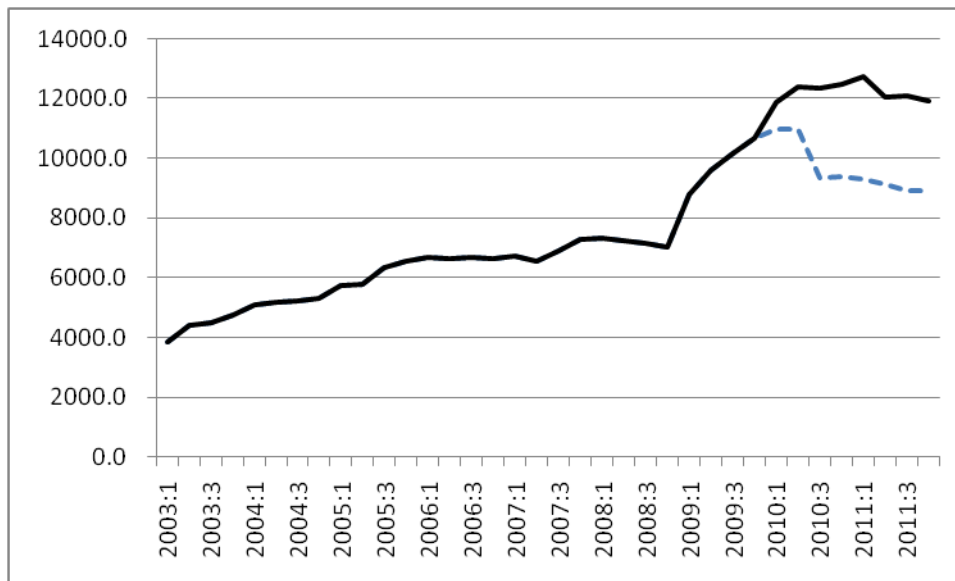
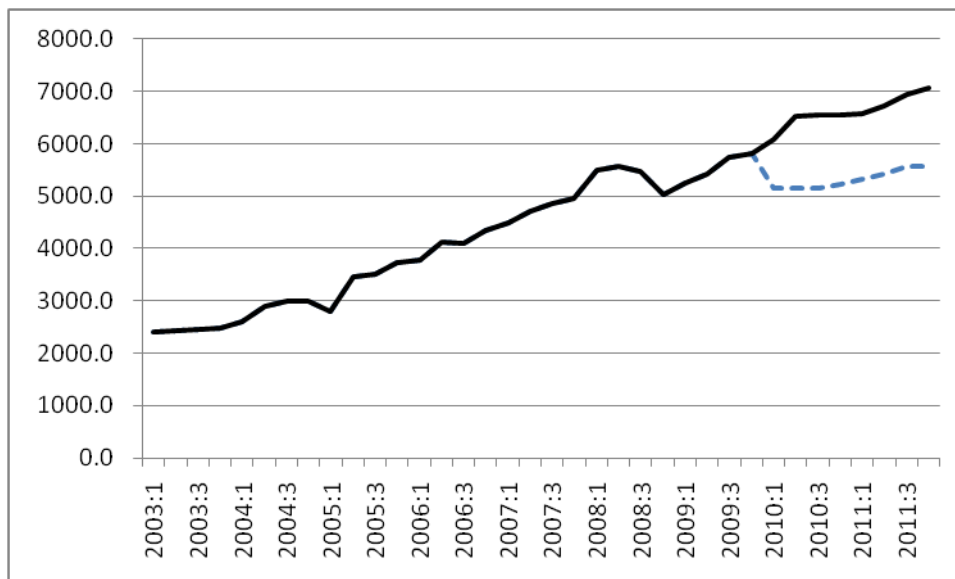


Figure 16: The Predicted Housing Price in Shanghai.



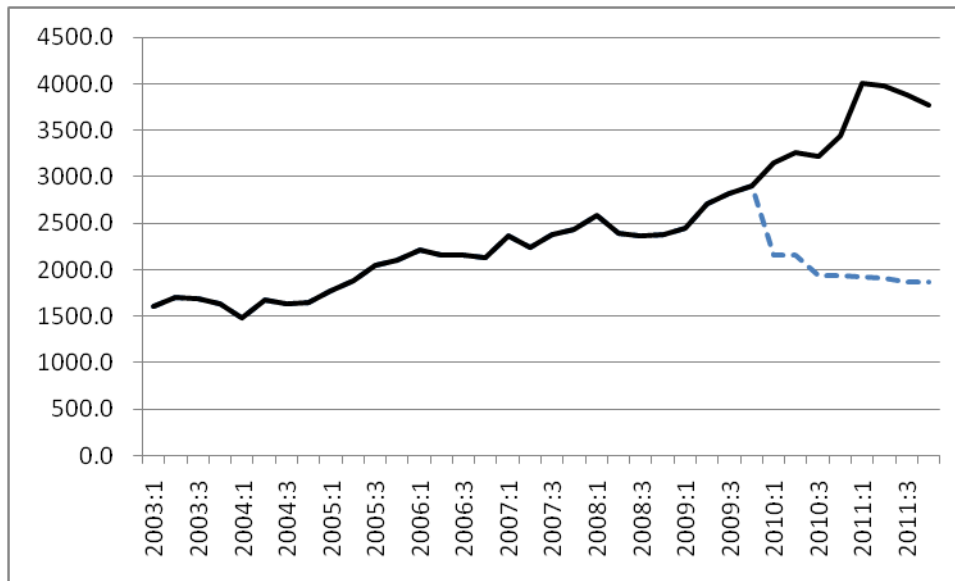
Parameters are estimated with the data of the first 28 quarters. The solid line is the actual quarterly housing price level. The dash line is the predicted housing price, started from 2010:1.

Figure 17: The Predicted Housing Price in Tianjin.



Parameters are estimated with the data of the first 28 quarters. The solid line is the actual quarterly housing price level. The dash line is the predicted housing price, started from 2010:1.

Figure 18: The Predicted Housing Price in Chongqing.



Parameters are estimated with the data of the first 28 quarters. The solid line is the actual quarterly housing price level. The dash line is the predicted housing price, started from 2010:1.

Appendix B

Table 2: Basic Statistics of Housing Price Index

| | Beijing | Shanghai | Tianjin | Chongqing |
|--------|---------|----------|---------|-----------|
| Min | 77.3 | 99.9 | 99.9 | 91.5 |
| Max | 284.8 | 355.1 | 302.6 | 258.2 |
| Median | 169.9 | 186.5 | 203.9 | 149.5 |
| S.D | 67.5 | 75.7 | 63.6 | 45.9 |

Table 3: Regression of Real Housing Price Index on Construction Cost Index

| | Beijing | Shanghai | Tianjin | Chongqing |
|----------------|---------|----------|---------|-----------|
| Coefficient | 2.71 | 1.71379 | 1.10 | 0.68 |
| S.E. | 0.49 | 0.519060 | 0.09 | 0.02 |
| R ² | 0.24 | 0.10 | 0.59 | 0.91 |

Table 4: Regression Result of Model 1.

Dependent Variable: Quarterly level of Housing Price

| | Cities | | | | | | | |
|--------------------------|---------|--------|-----------|------|----------|-------|------------|-------|
| | Beijing | | Shanghai | | Tianjin | | Chongqing | |
| | Coeff. | S.E | Coeff. | S.E | Coeff. | S.E | Coeff. | S.E |
| Change in population (%) | 149.5 | 1848.2 | 884.7 | 1140 | 8877*** | 1172 | -2574.2*** | 786.2 |
| Household Income (Level) | 1.22*** | 0.15 | 0.57*** | 0.09 | 0.11** | 0.04 | 0.19*** | 0.04 |
| Interest Rate | 60.9 | 657 | 315 | 554 | -319.7* | 172.2 | 480.5*** | 149.8 |
| Mortgage Rate | 353.3 | 454 | -1050.9** | 455 | 435.6*** | 112.3 | 135.4 | 133.6 |
| Adjusted R ² | 0.89 | | 0.79 | | 0.95 | | 0.72 | |

*** 99% confidence level ** 95% confidence level * 90% confidence level

Table 5: Regression result of Model 2.

Dependent Variable: Quarterly Logarithm of Housing Price

| | Cities | | | | | | | |
|--------------------------|---------|------|----------|------|---------|------|-----------|------|
| | Beijing | | Shanghai | | Tianjin | | Chongqing | |
| | Coeff. | S.E | Coeff. | S.E | Coeff. | S.E | Coeff. | S.E |
| Change in population (%) | 0.19 | 0.20 | 0.2 | 0.14 | 2.33*** | 0.28 | -0.76** | 0.3 |
| Household Income (Log) | 1.64*** | 0.23 | 1.18*** | 0.19 | 0.12 | 0.11 | 0.71*** | 0.16 |
| Interest Rate | 0.03 | 0.07 | 0.04 | 0.07 | -0.08** | 0.04 | 0.19*** | 0.06 |
| Mortgage Rate | 0.04 | 0.05 | -0.13** | 0.05 | 0.13*** | 0.03 | 0.04 | 0.05 |
| Adjusted R ² | 0.90 | | 0.82 | | 0.95 | | 0.72 | |

*** 99% confidence level

** 95% confidence level

* 90% confidence level

Table 6: Regression result of Model 3.

Dependent Variable: Quarterly Price/Income Ratio

| | Cities | | | | | | | |
|--------------------------|---------|-------|----------|------|---------|------|-----------|------|
| | Beijing | | Shanghai | | Tianjin | | Chongqing | |
| | Coeff. | S.E | Coeff. | S.E | Coeff. | S.E | Coeff. | S.E |
| Change in population (%) | 9.52*** | 2.33 | 3.85*** | 1.26 | 6.42*** | 0.94 | -3.93*** | 1.28 |
| Interest Rate | -0.0037 | 1.13 | 0.15 | 0.58 | -0.15 | 0.22 | 0.81*** | 0.20 |
| Mortgage Rate | -0.36 | 0.711 | -1.91*** | 0.5 | 0.70*** | 0.15 | 0.25 | 0.23 |
| Adjusted R ² | 0.64 | | 0.34 | | 0.86 | | 0.39 | |

*** 99% confidence level ** 95% confidence level * 90% confidence level

Table 7: Parameters for predicted price level

| | Beijing | Shanghai | Tianjin | Chongqing |
|----------|---------|----------|---------|-----------|
| income | 0 | 0.0 | 0.0 | 0.0 |
| pop | 4496.99 | 3826.3 | 7486.7 | 3293.0 |
| interest | 734.896 | 1467.4 | 0.0 | 199.7 |
| mortgage | 0 | -1718.9 | 380.3 | -234.9 |
| const | 0 | 13987.5 | -1982.5 | 547.7 |

Parameters are estimated by model 1 with the data of the first 28 quarters (2003:1 to 2009:4).

Appendix C

Model 1

$$\text{Price} = \beta_0 + \beta_1 \cdot \Delta\text{Pop} + \beta_2 \cdot \text{Income} + \beta_3 \cdot R + \beta_4 \cdot R^M + \varepsilon$$

Price: Quarterly level of housing price, regional data.

ΔPop : Change in population, regional.

Income: The quarterly total income of household, regional.
Average income per capita \times average size of household

R: Interest rate of 1 year deposit, national.

R^M : Mortgage Rate national.

R and R^M are national data because it is determined by the central bank in China

Model 2

$$\ln\text{Price} = \beta_0 + \beta_1 \cdot \Delta\text{Pop} + \beta_2 \cdot \ln\text{Income} + \beta_3 \cdot R + \beta_4 \cdot R^M + \varepsilon$$

lnPrice: Logarithm of quarterly housing price, regional.

ΔPop : Change in population, regional.

lnIncome: Logarithm of the quarterly total income of household, regional.

R: Interest rate of 1 year deposit, national.

R^M : Mortgage Rate, national.

Model 3

$$P/I = \beta_0 + \beta_1 \cdot \Delta\text{Pop} + \beta_2 \cdot R + \beta_3 \cdot R^M + \varepsilon$$

P/I: Price to Income Ratio.

ΔPop : Change in population, regional.

R: Interest rate of 1 year deposit, national.

R^M : Mortgage Rate, national.