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以總體經濟指標探討中國大陸房價之泡沫化現象

Using Macroeconomic Indices to Explore Housing Price Bubble

Student:張棋茹 Chi Ju Chang

Advisor:林左裕教授 Tsoyu Calvin Lin

中華民國　106　年　06 月

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Abstract

According to the previous literatures and news, the housing price in China has been increasing dramatically and resulted in some problems. This study estimate six regions' housing price bubbles including Shanghai, Beijing, Guangzhou, Shenzhen, Chongqing and Wuhan. First, this study uses some basic analysis to explore the data such as, descriptive statistical analysis, correlation analysis, unit root test and Granger Causality test. Second, this research measures the impact of macroeconomic indicators on these six regions using State Space model, that is, whether these six regions have a housing price bubble or not.

This study uses macroeconomic indicators to investigate Shanghai, Beijing, Guangzhou, Shenzhen, Chongqing and Wuhan housing price bubbles. Choosing six regions of China's housing price index and nine independent variables from 2005 Q3 to 2016 Q4 in this research. First, this study separates each region with different macroeconomics indices to estimate the significant of the housing price. Second, through many tests and found out the best models with the housing price bubbles in six regions.

This study concludes that there are various significant relationship evidences for each region and it has different variables affect the housing price. The results of State Space model show, Beijing and Guangzhou suggest higher hosing price bubbles and need to strengthen control to avoid more housing bubbles.

Keywords: China's Housing Price Bubble, Macroeconomic Indices, State Space model

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Chapter 1

Introduction

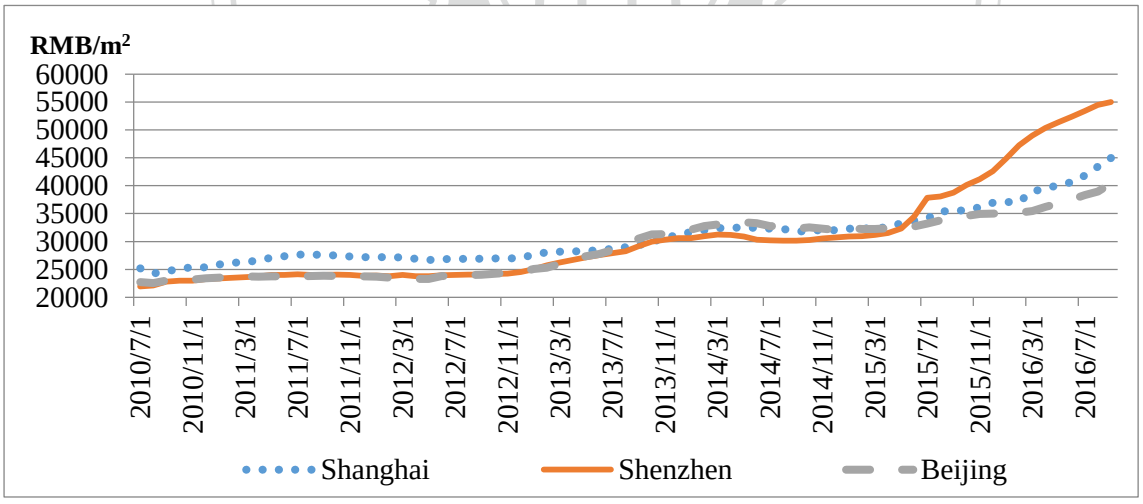
1.1 General Background and Research Motivation

According to China's economic development, real estate investment had become a hot investment product. However, land supply and demand are not synchronized, and excessive demand leads to the problem of rapidly increasing housing price. Thus, the house price increases dramatically that results in the house bubble problems. Some articles discussed that there may be a housing bubble and it will eventually burst (International Monetary Fund, 2016). If the housing bubbles happen, then housing bubbles not only affect real estate market but also whole economy condition.

In addition, the house price drastically increases and makes people cannot afford to buy a house recently. As the house in people's livelihood is necessary, people cannot live without a house. There are many reasons that cause house price to increase that over investment is one of the reasons. In fact, many houses are bought by investors but they are not for living. People bought a house just for investment and they held it. Once the demand of house is more than the supply of house that house price will increase. Thus, the over investments is one reason that causes house price increase. It is necessary for government to control the over investment situation in real estate market.

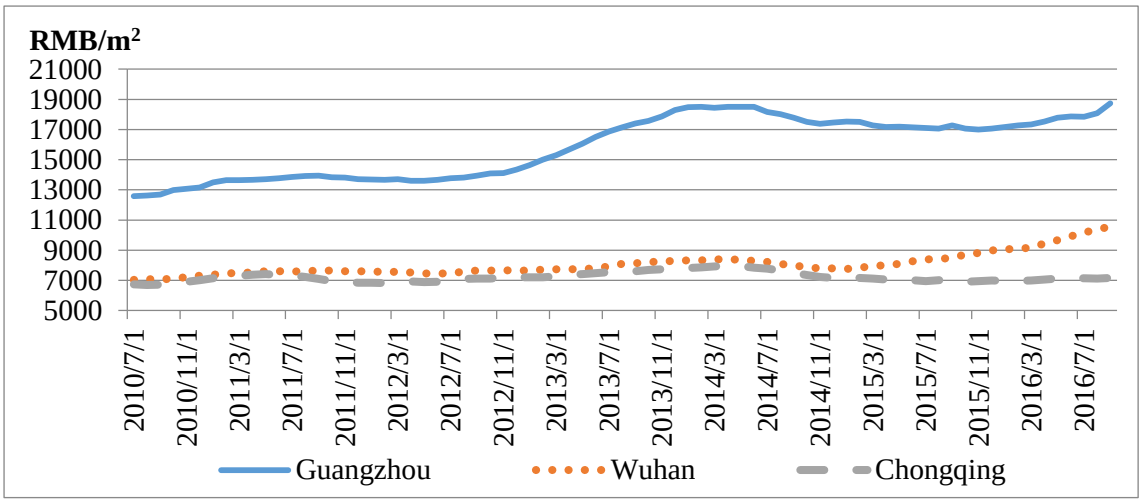
Belke and Wiedmann (2005) found that one of the reasons is the speculation behavior and it will affect real estate market. If people have some money to invest, they may consider buying a house to earn the spread of house investment. The interest rate is lower, and then people would be easier to do this. When the real estate market is crowded of these speculators, their behavior will affect an increasing housing price. To sum up, there are some reasons that will cause increasing house price including excess demand and investment behavior.

Figure 1-1 and Figure 1-2 show the Shanghai, Beijing, Chongqing, Guangzhou, Shenzhen and Wuhan house price per square meter. Shenzhen has the highest house price per square meter among these six cities. The following discussions about the trend of housing price are based from 2010 to 2016. Shenzhen house price increased from 21000 RMB/m^2 to 55000 RMB/m^2. Shanghai house price increased from 24000 RMB/m^2 to 45000 RMB/m^2. Beijing house price increased from 22000 RMB/m^2 to 41000 RMB/m^2. Among these three regions, Shenzhen has the highest housing price. Guangzhou house price increased from 12000 RMB/m^2 to 19000 RMB/m^2. Chongqing house price increased from 6600 RMB/m^2 to 7100 RMB/m^2. Wuhan house price increased from 7000 RMB/m^2 to 11000 RMB/m^2. The largest fluctuation of the house price is Shenzhen and the smallest fluctuation of the house price is Chongqing. The development of trade, finance and technology is the earliest in Shenzhen reflecting why the house price in Shenzhen is higher. Shanghai and Beijing are the main regions that also had a higher housing price.



Source: Datastream

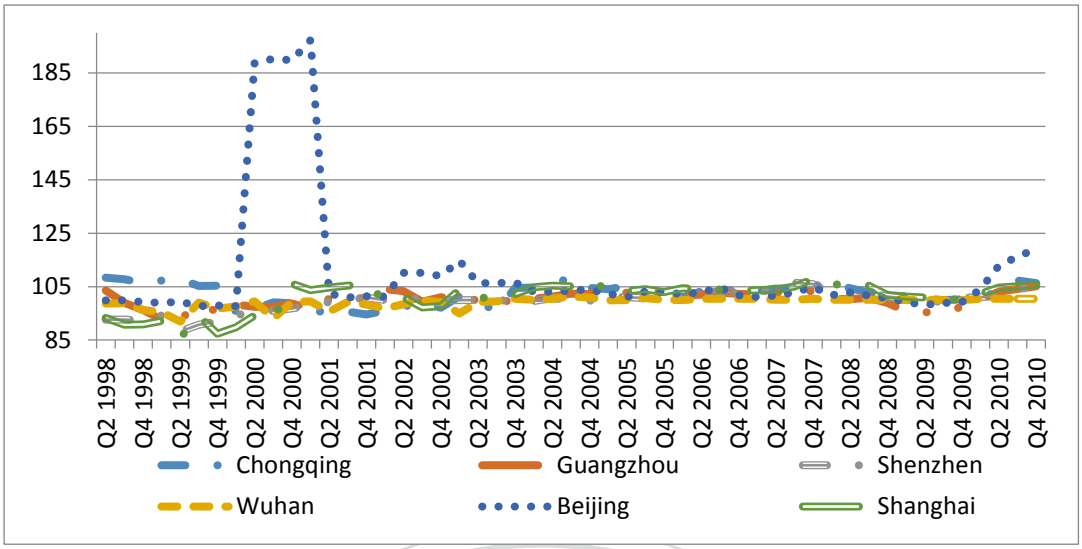
Figure 1-1 Shanghai, Beijing and Shenzhen House Price Per Square Meter



Source: Datastream

Figure 1-2 Guangzhou, Chongqing and Wuhan House Price Per Square Meter

Besides of macroeconomic variables the housing rent also has some impacts on housing price. The housing rent can calculate the housing price and show some effects on housing price. Some papers also use housing price to house rent as an index to estimate the housing bubbles. Figure 1-3 shows the housing rent trends and it shows that all regions have smooth change. However, the largest difference of housing rent of these six regions is Beijing during 2000 Q2 to 2001 Q1. Zhang (2015) used the housing rent to estimate whether the housing price is affordable in China. These results indicate income inequality is one of the reasons that increases house price in China. Thus, it is necessary to discuss the housing price of Shanghai, Beijing, Chongqing, Guangzhou, Shenzhen and Wuhan whether it has the housing bubbles or not.



Source: Datastream

Figure 1-3 Housing Rent Index of Six Regions

The annual house price continues to rise in China and may result in bubble problems. The subprime mortgage crisis had a huge effect on China economy. Then, China's government implement some policies are to reduce these conditions. The economics crisis may cause an increasing house price and affect a stable development of the economy. Therefore, China government adapted some policies to decrease the housing price and to strengthen the policy for the real estate market. However, sometimes China government will adapt policies to lower higher housing price and it is useful for real estate market. Despite these limitations of buying houses policies, it is a good question to ask whether it is really effective to decrease housing prices.

Before studying housing price, it is necessary to discuss China's government policies of the house. As the interest rate is low, it encourages a company to expand their industry and also improve the economy. Investors would like to purchase a house that indicates the house price will increase due to the demand. Once the prices rose too fast in a short period, then it will raise the housing price problems. The housing price problems mean that housing burden, high investment costs, and reduced consumption problems. China's government had some

policies to reduce the higher housing price, such as the restriction order of house in some regions in some periods. The restriction orders of a house and international economy both effects on housing price.

Hsu (2012) pointed out that an increasing money supply is one of the reasons create in housing bubble phenomenon. If the government uses the Quantitative Easing Monetary Policy then the interest rate will reduce. Thus, the interest rate will stimulate people to invest or purchase in houses. Our main goals are to determine which factors will cause the higher housing price and the scale of housing bubbles. Apart from money supply, this study will conclude diverse independent variables to estimate the housing bubbles.

1.2 Research Purpose

Base on the motivations and backgrounds, the purposes of this research are as followings:

(1) To use the State Space Model to estimate the house bubbles in China. Shanghai, Beijing, Guangzhou, Shenzhen, Chongqing and Wuhan house price index are selected as dependent variables in this paper.

(2) To determinate the different variables that will affect the house bubbles in the six China regions. Also, to determinate the positive or negative relationship between housing price index and independent variables.

(3) To use the Macroeconomic index to estimate the China's house price and the size of the bubbles.

1.3 Research Process

This research includes five chapters and the research process shows in the following Figure 1-4. Chapter one discusses the background why this study need to makes a research on China's housing price. Chapter two explores literatures on four parts including house price, China's house price, house bubbles and variables selection. Chapter three makes a brief introduction about the data and some analysis of all variables. In which, correlation analysis, unit root teat and Granger Causality test are used to estimate these variables before the empirical study. Chapter four is empirical results about housing bubbles in Shanghai, Beijing, Guangzhou, Shenzhen, Chongqing and Wuhan. Chapter five is mainly conclusions and suggestions.

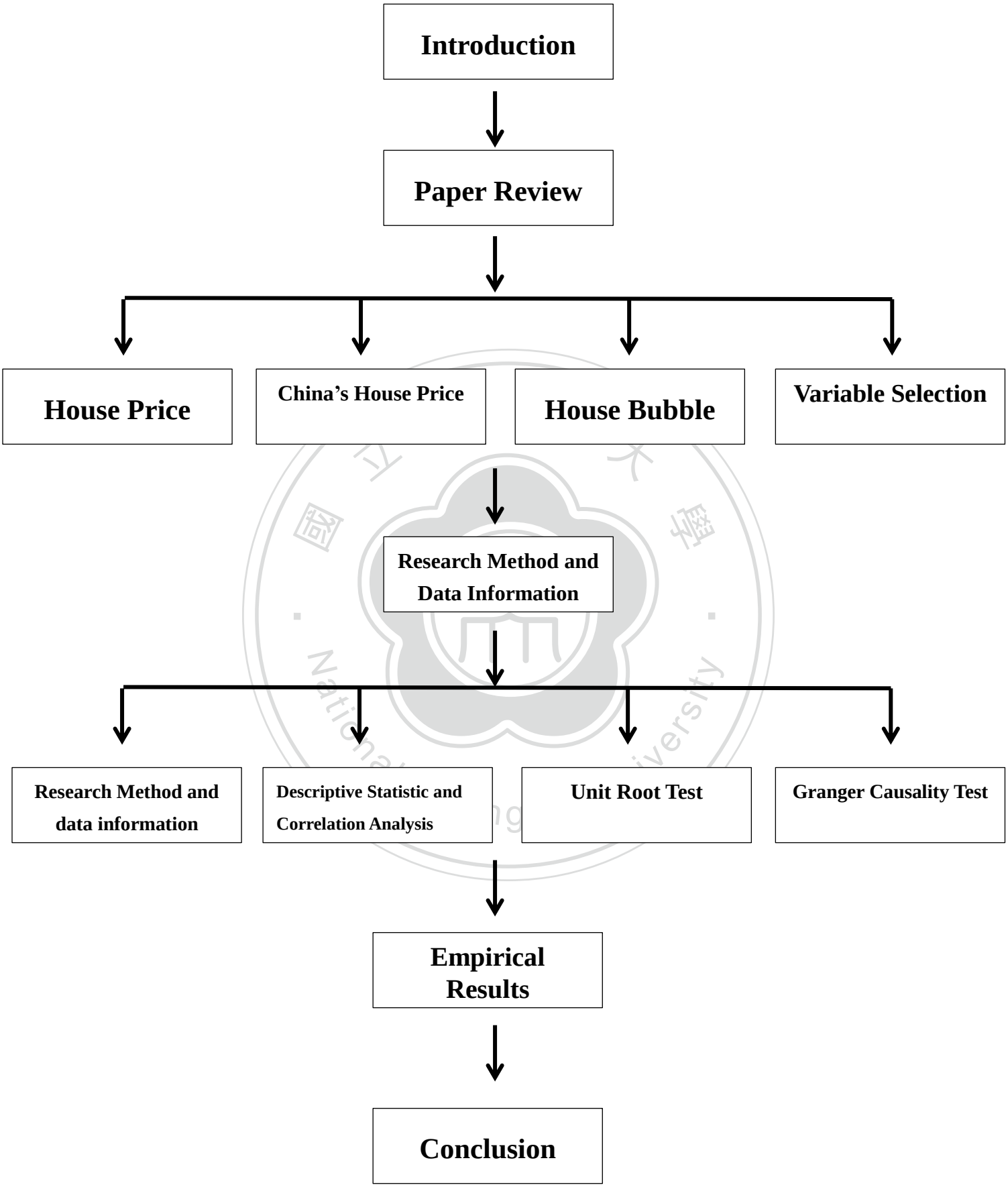


Figure 1-4 Research Process

Chapter 2

Literature Review

The literatures review mainly discuss house price and house bubbles. The first section focuses on house price and real estate market situation. The second section discusses the factors that affect China's house price fluctuation and different house price phenomenon by cities in China. The third section emphasizes on house bubbles and its definition. The fourth section explains different variables selection to determine the housing price in literatures.

2.1 House Price

Jin and Zeng (2004) used three quantitative dynamic equilibrium models to figure out the relationship between business cycle, residential investment and house prices. Residential investment and house price affect business cycle as well as real GDP growth rate. In the paper, consumption goods sector, capital investment goods sector and house investment goods sector are all included. The results indicated that monetary policy has an important characteristic in residential investment and house price. In other words, the monetary shock will produce remarkable volatility between residential investment and house price.

Courchane and Holmes (2014) used inflation, mortgage rates, personal income, population, a rental index and the stock market index as variables to find a relationship with housing price. In this literature, there are some different findings between the USA and Canada. On the mortgage rates side, Canada's mortgage rates have a positive and significant impact on Canadian house price. However, the changes in the USA's mortgage rates have a negative and significant impact on house prices. On the inflation rates side, both changes in inflation rate have negative impacts on

house prices. In summary, the fundamental variables affect house price in both countries.

Hott and Monnin (2008) used income, mortgage rate, housing rents and CPI index to calculate the fundamental value of house price. The data was based on four countries, Switzerland, Netherlands, Japan and the United States. The results showed that there is long-term deviation of real house price and fundamental value. If there is a shock, then the house price will go back to fundamental value.

Lin (2012) used interest rate, inflation and GDP index to estimate the relationship between Taipei's house price and monetary policy. This paper indicated that there are some long term relationship between house price and monetary policy. In addition, house price and monetary policy have influence on each other. Easing monetary policies and sustained low interest rates are the reasons that resulting the higher housing price.

2.2 China's House Price

After the financial crisis in 2008, China used the easing monetary policy to improve the economy. The central bank decreased the interest rate that attracted people to purchase or invest a house. The government also gave other preferential policies for the people. The oversupply of money is one of the reasons that cause higher house price. Once China's real estate market collapses, it will affect the raw material price such as iron and steel. This situation also affects many countries, especially Asian countries (Hsu, 2012).

As Chivakul et al. (2015) said, China overbuilt many cities and caused some oversupply house problems. The real estate investment rises every year but results in lower economic benefits.

A rapid development of urbanization and economic growth are the main reasons that result in higher house price. Once people have more money, then they may invest in a house or increase the demand for a house. The more purchasing power of people, and the more demand for real estate market products. The paper indicated three conclusions about higher house prices. First, the higher house price to income ratio was in Shanghai and Beijing; second, the house price to rent ratio decreased in Shanghai, Shenzhen and Beijing; third, there are many empty houses, which could mean that empty house ratio was higher in some cities (Chao and Wu, 2014).

In order to decrease housing prices soaring, the State Council of the People's Republic of China introduced a series of regulations on the inhibition of housing prices and other. First, the real estate transactions gradually increased the percentage of their owned funds. The regulations limit purchasing behavior of residents for the high price of the cities. The government raised the relevant tax, especially in a high house prices area in Shanghai and Chongqing (Lin, 2011).

Sometimes China government will start policies to release the higher housing price which it is useful for real estate market. While the limitation of buying a house may not always has a great impact on reducing housing price. Furthermore, not every city is suitable for such limitation policy or mortgage rate policy.

Another situation of China's real estate is called "Ghost Town". If a city overbuilds or overinvests, they will have many empty houses. For example, Ordos is one of the most famous ghost towns and it was reported in many papers. In those cities, the streets and other facilities are completely built. However, in those cities, there are less people than expecting live inside the cities (Lin, 2013).

Hui and Yue (2006) used Beijing and Shanghai housing price to determine if

there is a bubble in the housing market. Granger causality tests and response analysis are used in their study. The results suggested that Shanghai had the housing bubbles in 2003 while Beijing had no evidence of housing bubbles in 2003.

Hsu (2012) discussed the housing policies in China and had some brief results. Strengthen the sales management of commercial and residential houses, market monitoring and limitation the quantity of people are buying a house. In order to decrease the excess investment, the policies finally reduced the volume of buying a house. However, the policies only reduced the volume but the housing price still increases.

Wang and Xie (2010) used Partial Least Squares Method to estimate house price and also include some variables, like GDP, income, land cost, raw material price, interest rate, inflation and money supply. This paper figured out that monetary policy has a great impact on housing price rather than other variables.

Tai, Miao and Zhang (2010) used HP filter and the C-D production function to determine the housing price bubbles. This paper pointed out Beijing and Tianjing had a smooth housing price bubble while Shanghai and Chongqing had an increase housing price bubble.

2.3 House Bubble

There are many different methods to estimate the house bubbles. Some papers discussed housing price between the market price and fundamental price. Black et al. (2006) used fundamental house price, expected value of future real disposable income and discount rate to construct real house price. They used United Kingdom house price data and it covered quarterly from 1973 fourth quarter through 2004 third quarter. In this paper, the results indicated that endogenous factors play an important role in determining the actual house price, especially when real house price far from fundamental value. The reasons that deviate from fundamental values maybe rise from policy interventions on the houses and financial markets. It figured out there maybe other will affect real house prices and let the prices have deviations from fundamental values. Fraser et al. (2008) also used house prices and fundamental house values from 1970 to 2005 in New Zealand to explore highly house price problems.

Some papers discussed housing bubbles between house fundamental price and macroeconomic variables. Bourassa et al. (2001) used the change of employment, real wage, construction cost and interest rate to determine why housing price drive from fundamental value. This paper used the data from the United States, Australia and Sweden house market variables.

There are some reasons that will cause the housing bubbles and then discusses in next part. Moreover, there are some independent variables will be selected to use in this literature to estimate the relationship between house price index.

2.4 Variables Selection

Fernández-Kranz and Hon (2006) used house price and income elasticity to make the research in fifty Spanish provinces. It showed that the house prices are higher than the long term equilibrium during the period from 1998 to 2003. There were many variables used in this paper, such as price per square meter, gross domestic product, consumer price index and stock market index.

Courchane and Holmes (2014) used inflation, mortgage rates, personal income, population, rental index and the stock market index as variables to find the relationship between house price. In this comparative study, there are some different findings in the USA and Canada. On the mortgage rates side, Canada's mortgage rates have a positive and significant impact on Canadian house price. However, the changes in the USA's mortgage rates have a negative and significant impact on house price. On the inflation rates side, both changes in inflation rates have a negative impact on house price. In summary, the fundamental variables affect house price in both countries.

Goodman and Thibodeau (2008) aimed to explore the reasons if the speculative factors or fundamental values caused the rising house price in the United States. This paper used the house price separated from demand and supply side from 2000 to 2005. There were some variables that were related to the location information, such as the density of the central city and central city dummy variable. The results indicated that the closer the house is to the central city, the higher house price will be.

Glaeser et al. (2008) provided the house bubbles model to combine house supply. It indicated that lower house supply will decrease the level of house bubbles, it will influence and decrease house price. The other factors included construction cost, income index, educational level and some economies changes. The research result

showed the housing bubbles were related to the oversupply during booms and sometimes cannot be explained by the fundamental values.

Adams and Füss (2010) used the macroeconomic variables to estimate fifteen countries across thirty years and estimated the house price change in long term to short term periods. GDP, money supply, consumption and employment were used as the economic activity variables. The interest rate, construction costs and population growth were included in this paper. The higher economic activity increases housing demand and leads to the increase of house prices. The long term construction costs will lead to higher rents and house price.

Mikhed and Zemčík (2009) used income, rent, stock market, construction cost and mortgage rate to estimate real estate market in the United States. Hui and Yue (2006) used Beijing and Shanghai housing price to determine if there is a bubble in the housing market. Income, GDP and stock price index were the variables used in this literature. The results suggested that Shanghai had the housing bubbles in 2003 while Beijing had no evidence of housing bubbles in 2003.

Zhang (2015) used the housing rent to estimate whether the housing price is affordable in China. These results also indicated income inequality is one of the reasons that increase house price in China.

Case and Shiller (2003) used three dependent variables in the United States from 1985 to 2002, and many independent variables. Change of population, change of employment and mortgage rate were selected in this paper.

In the previous studies, the common independent variables are income, GDP, consumer price index, stock price index, interest rate, housing rent, construction costs, mortgage rates and money supply. Based on the above commonly used variables, this

study selected nine variables to explore the housing price in China.

In summary, there are some variables used in previous paper including housing prices, mortgage rate, house rent and construction cost. Economic variables such as GDP, CPI, inflation, capital income, money supply and stock market index are commonly used in literature.

Based on the above mentioned literatures review, this study chooses nine independent variables to estimate China's housing price bubbles. Furthermore, different regions are affected by various variables and this study will separate variables to explore each region.

Chapter 3

Research Method and Data Information

In the research method and data Information mainly discuss six parts. The first section focuses on research method and will briefly show the models on next chapter. The second section discusses the variable information and data source. The third section emphasizes on basic statistical analysis of all variables. Then, the fourth to sixth sections emphasizes on correlation analysis, unit root test and Granger Causality test.

3.1 Research Method

There are many different methods to estimate the housing bubbles. Some papers discussed house price between the market price and fundamental price. Black et al. (2006) used fundamental house price, expected value of future real disposable income and discount rate to construct real house price. Some paper discussed house bubbles between house price and macroeconomic variables. Bourassa et al. (2001) used the change of employment, real wage, construction cost and interest rate to determine why housing price drive from fundamental value. There are still some methods to estimate the housing bubbles, and State Space model is used in this study. State Space model includes two parts, one is a signal equation and the other is state equation. The State Space model determines the bubbles and then calculates the fundamental value of the house price. Since there are different reasons that will affect the housing bubbles and separate in each region in this research. In order to choose the best variables to describe the State Space model, this study try to figure out most significant relationship to variables of each regions. Take Shanghai State Space model for example, this study try all variable combinations and if there is no significant

relationship to housing price index then will replace another variable which is selected in this study.

The following are the main State Space model with all variables. However, each region has different factors that will influence its house bubbles. Thus, there are various variables included in each region and the empirical results will show for six regions. The HPt means the house price index in each region. The SVt means the house bubbles including positive bubbles and negative bubbles. Since there are sometimes that house fundamental prices are above house price index, thus this study views as negative house bubbles. When the house price index are above fundamental house price, and then this study consider it as positive bubbles.

$$HP_t = \alpha_0 + \beta_1 M1_t + \beta_2 M2_t + \beta_3 Rmb\_Usd_t + \beta_4 Int_t + \beta_5 Cpi_t + \beta_6 Stock_t + \beta_7 Pmi_t + \beta_8 Cost_t + \beta_9 Frc_t + SV_t + \varepsilon_i$$

$$SV_t = \delta_1 SV_{t-1} + \gamma_i$$

$$Var(\gamma_t) = \exp(\omega_t)$$

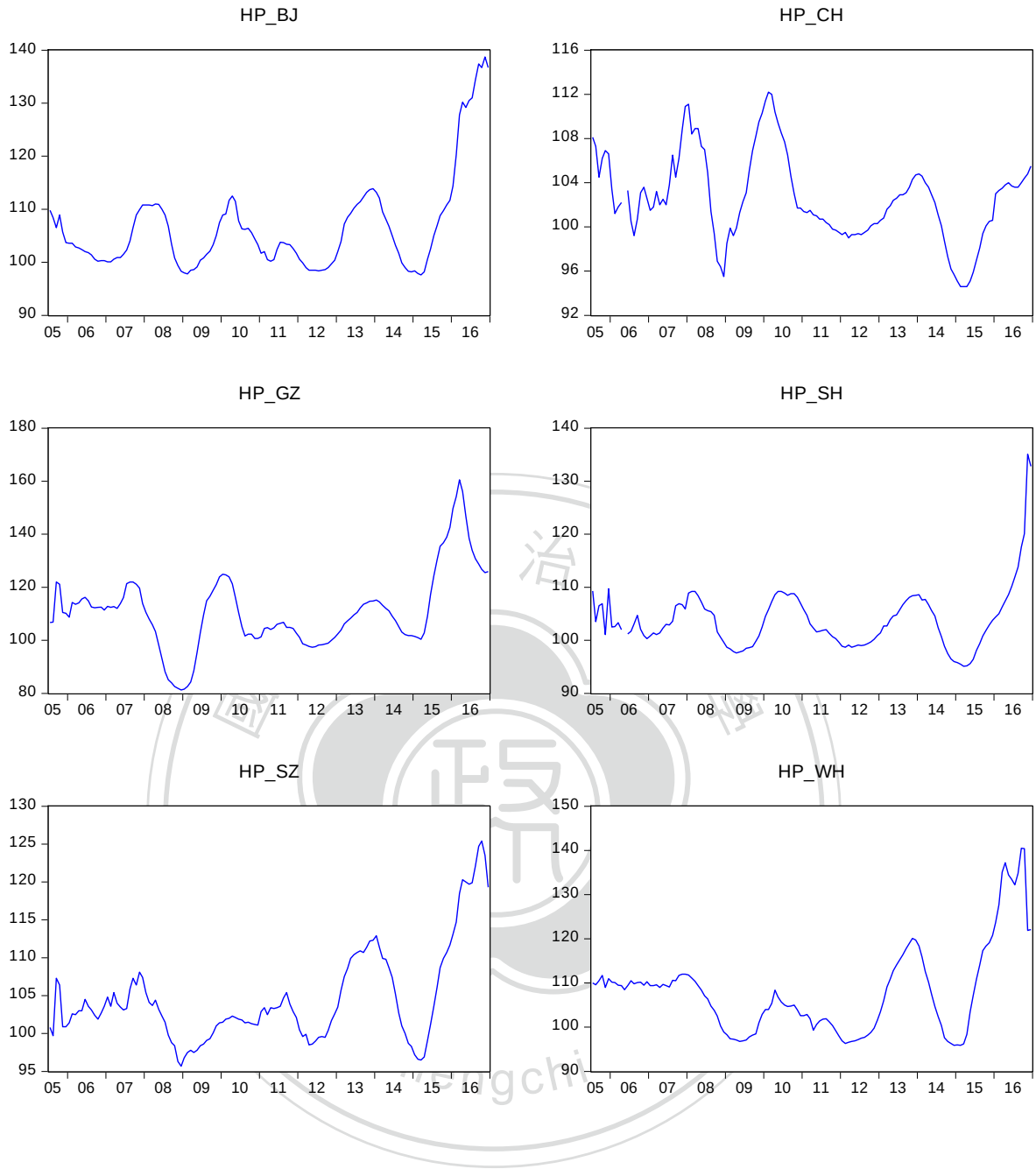
3.2 Variable and Data Information

In this study, Shanghai, Beijing, Guangzhou, Shenzhen, Chongqing and Wuhan house price index are selected in this paper. The six cities rank the most population among China and also have various characteristics on housing price. The data are collected by DataStream and Taiwan Economic Journal (TEJ) monthly from 2005 Q3 to 2016 Q4. Table 3.1 shows the house price index and other data information of each region used in this study.

First, the house price indexes are collected from Datastream which is from National Bureau of Statistics of China. In the Beijing, Shanghai, Guangzhou and Wuhan, there was an increase from May 2015 to 2016. However, compared with other regions, Shenzhen and Chongqing house price are more violent and changeable. For instance, Shenzhen and Chongqing house price had dramatically increased from September 2008 to September 2010. Not only house demand and supply but also some economic variables and government policies will affect housing price in China. Figure 3-1 shows the house price index of six regions selected in this study.

Second, in the independent variable parts, there are nine independent variables used in this paper and the data from Datastream and Taiwan Economic Journal (TEJ) from 2005 Q3 to 2016 Q4. The selected variables contain the monetary aspects, economics situation, stock market and house construction field. The reason why choose these nine variables is independent on the previous literatures that are commonly used to determine the housing bubbles. In the monetary aspects, M1 and M2 are the change of currency supply, and the data are from the Datastream which is from The People's Bank of China. INT is the overnight interbank call-loan rate, and the data are from the Taiwan Economic Journal (TEJ). M1, M2 and INT are represented how the monetary policies change will have impact on house price. In the

foreign exchange, FRC is the foreign reserve change percentage and RMB_USD represents the RMB exchange to US dollars. FRC calculates the change percentage from this year to last year, meaning that this year minus last year and then divided by last year. These two variables are represented the global economy situation and how it will affect China's real estate market. STOCK is the Shanghai A shares to represent the situation of the stock market. Some paper discussed that the stock market will also affect real estate market and selected in this study to figure out whether it will have some significant relationship with housing price. In the economic situation, CPI represents the consumer price index and PMI is the purchase management index in China. In the house construction, COST is the price index of raw materials for construction. While house construction increase then the house price will be affected. Except for RMB_USD, INT, CPI, STOCK, PMI, COST and FRC are collected from TEJ, other variables including house price index are all selected from Datastream.



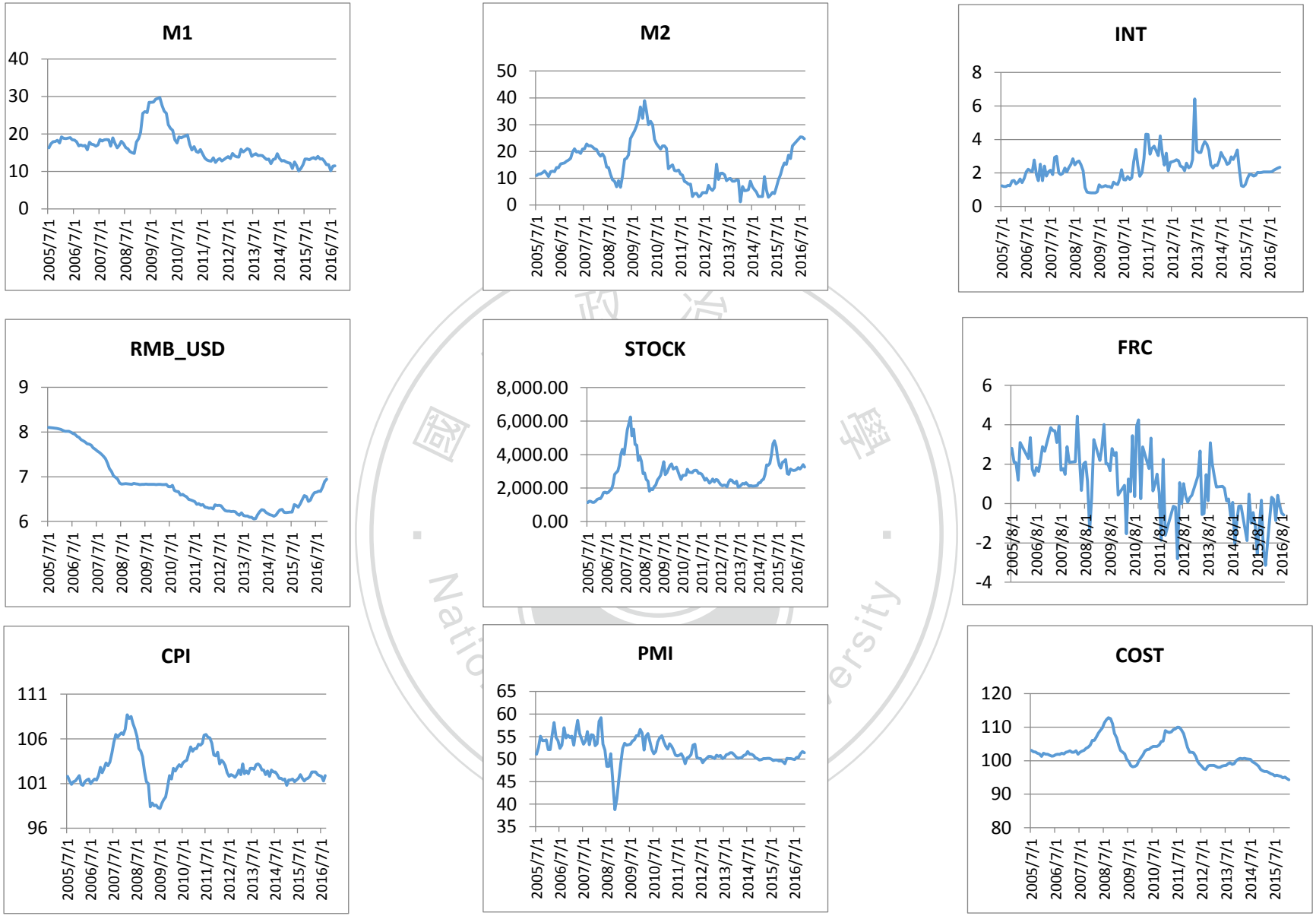
Source: Datastream

Figure 3-1 House Price Index of Six Regions

Table 3-1 Data Information Table

Variable Code	Variable Explanation	Measurement	Data Source
Dependent Variable			
HP_BJ	Second hand residential house price index in Beijing	(Based on the same period previous year)	Datastream National Bureau of Statistics of China
HP_SH	Second hand residential house price index in Shanghai	(Based on the same period previous year)	Datastream National Bureau of Statistics of China
HP_GZ	Second hand residential house price index in Guangzhou	(Based on the same period previous year)	Datastream National Bureau of Statistics of China
HP_CH	Second hand residential house price index in Chongqing	(Based on the same period previous year)	Datastream National Bureau of Statistics of China
HP_SZ	Second hand residential house price index in Shenzhen	(Based on the same period previous year)	Datastream National Bureau of Statistics of China
HP_WH	Second hand residential house price index in Wuhan	(Based on the same period previous year)	Datastream National Bureau of Statistics of China
Independent Variable			
M1	Change of M1(%)	Raw Data	Datastream The People's Bank of China
M2	Change of M2(%)	Raw Data	Datastream The People's Bank of China
RMB_USD	RMB to USD(USD)	Raw Data	Taiwan Economic Journal(TEJ)
INT	Overnight Interbank Call-Loan Rate	Raw Data	Taiwan Economic Journal(TEJ)
CPI	Consumer Price Index	Based on the same period previous year	Taiwan Economic Journal(TEJ)
STOCK	Shanghai A shares	Raw Data	Taiwan Economic Journal(TEJ)
PMI	Purchase Management Index	Raw Data	Taiwan Economic Journal(TEJ)
COST	Price Index of Raw Materials for Construction	Based on the same period previous year	Taiwan Economic Journal(TEJ)
FRC	Foreign Reserve Change Percentage	$\frac{Month_t - Month_{t-1}}{Month_{t-1}}$	Taiwan Economic Journal(TEJ)

The nine independent variables calculate with different method and have some interesting trend. In the monetary policy section, M1 changed between ten to thirty and have a variety of increasing trends during 2009 Q2 to 2010 Q1. Additionally, M2 had greater change than M1 and had a diversity of increasing trends during 2009 Q3 to 2010 Q4. As Figure 3-2 shows, M1 and M2 had the same dramatic change in 2009 and 2010. Since the financial crisis happened in 2008, China's government started easing monetary policy in order to release the economy and resulted in the higher change due to money supply. Compare to monetary supply, interest rate also affected housing price and had lower value during 2009 and 2010. In the foreign exchange market, the foreign exchange between RMB to US dollars had a decrease from 2005 Q3 to 2014 Q3. Shanghai A shares had a smoothly change in 2016 and 2015 rather than the previous years. The foreign reserve change percentage had dramatic changes every year and sometimes were positive while sometimes were negative. In the economic situation, consumer confident index will reflect people's willingness to purchase goods or a house. The consumer confident index decreased during 2008 Q3 to 2009 Q2 that indicate it may influent on house price. The purchase management index can reflect the economy growth in a country and it decreased in 2008. However, except the purchase management index decreased in 2008, this index had a smoothly trend in other periods. COST means the price index of raw materials for construction and will influent the house price. When the construction of raw materials increased, and it may make housing prices rise.



Source: Datastream

Figure 3-2 Trend Graph of Nine Independent Variables

3.3 Descriptive Statistics Analysis

Mean, median, maximum, minimum and standard deviation are showed on the descriptive statistics of variables table on Table 3-2. As the table shows that there are a little change of each variables. First, the most standard deviation of house price index is Guangzhou and this means the change of house price greater than other regions. Second, the most mean of house price index is still Guangzhou and it indicates that Guangzhou's house price is greater than other regions. Third, compare with Figure3-2, the house price range between maximum and minimum are largest in Guangzhou. Besides these house price index variables, there are some interesting findings in independent variables used in this study. In terms of money supply, M2 has a high degree of change rather than other. In addition, these three monetary supply variables' mean and median have not much difference. On the other hand, stock market price had more violent change and had the highest price in 2007.

Table 3-2 Descriptive Statistics of Variables Table

Variable	Mean	Median	Maximum	Minimum	Std. Dev.
HP_BJ	104.3038	103.3	113.9	97.6	4.5969
HP_CH	102.3587	101.95	112	94.6	3.8805
HP_GZ	108.476	108.7	142.6	81.3	11.7161
HP_SH	102.7462	102.2	109.7	95.1	3.8306
HP_SZ	103.2096	102.55	112.3	95.7	4.0706
HP_WH	105.8096	105.55	120.8	95.9	6.6802
INT	2.2707	2.215	6.43	0.81	0.8916
M1	16.8098	16.05	29.74	10.1	4.3945
M2	13.8922	12.28	36.63	2.9	7.8849
PMI	52.1673	51.7	59.2	38.8	3.0516
RMB_USD	6.7809	6.6689	8.0998	6.0557	0.6283
STOCK	2826.352	2592.855	6251.53	1148.88	1006.401
COST	102.1311	101.915	112.84	94.9	4.365
CPI	102.8374	102.4	108.5	98.2	2.2115
FRC	1.1387	1.3179	4.4302	-3.1388	1.7109

3.4 Correlation Analysis

In the correlation analysis, one part discusses about the relationship between house price index and independent variables, other part discusses about the relationship between each independent variables.

In Beijing, only RMB exchange to US dollars is negative related to house price index and the other variables are all positive to Beijing house price index. In Shanghai, only Shanghai A shares has negative relationship with house price index, and the other variables are all positive to house price index. In Guangzhou, house construction costs, consumer price index, foreign reserve change percentage and overnight interbank call-loan rate are negative related to house price index, and the other variables are all positive to house price index. In Shenzhen, house construction costs, foreign reserve change percentage, M1, M2 and RMB exchange to US dollars have negative relationship with house price index, and the other variables are all positive to house price index. In Chongqing, only overnight interbank call-loan rate is negative related to house price index and the other variables are all positive to house price index. In Wuhan, house construction costs and M1 have negative relationship with house price index, and the other variables are all positive to house price index.

In independent variables, CPI is negative related to M1 and RMB exchange to US dollars. Bothe foreign reserve change percentage and M2 have negative relationship with overnight interbank call-loan rate. House construction costs are negative related to PMI and stock market. Lastly, overnight interbank call-loan rate has negative relationship with M1, M2, PMI, foreign reserve change percentage, RMB exchange to US dollars and stock market.

Table 3-3 Correlation Table

	HP_BJ	HP_SH	HP_GZ	HP_CH	HP_SZ	HP_WH	CPI	COST	FRC	INT	M1	M2	PMI	RMB_USD	STOCK
HP_BJ	1.0000														
HP_SH	0.7728	1.0000													
HP_GZ	0.4720	0.1923	1.0000												
HP_CH	0.6257	0.6858	0.3371	1.0000											
HP_SZ	0.7358	0.5343	0.6111	0.2758	1.0000										
HP_WH	0.7685	0.6025	0.6331	0.3454	0.8307	1.0000									
CPI	0.3138	0.4729	-0.1069	0.2414	0.2370	0.1706	1.0000								
COST	0.0084	0.3328	-0.5175	0.1779	-0.2115	-0.1752	0.6418	1.0000							
FRC	0.0155	0.3019	-0.1156	0.4189	-0.0694	0.0767	0.0967	0.3091	1.0000						
INT	0.1345	0.1106	-0.1497	-0.2133	0.3622	0.0951	0.4306	0.1237	-0.2655	1.0000					
M1	0.0061	0.0627	0.0692	0.5420	-0.2832	-0.1773	-0.3294	0.0758	0.4801	-0.5630	1.0000				
M2	0.2757	0.3512	0.3333	0.7312	-0.0360	0.1057	0.0192	0.1542	0.4607	-0.4614	0.8394	1.0000			
PMI	0.1415	0.2810	0.3705	0.5924	0.0958	0.1670	0.1055	-0.0201	0.4595	-0.2728	0.4559	0.5766	1.0000		
RMB_USD	-0.0529	0.1922	0.1832	0.3887	-0.1085	0.2340	-0.0046	0.2459	0.5256	-0.4251	0.3920	0.4315	0.5308	1.0000	
STOCK	0.0957	-0.0529	0.3057	0.1144	0.0533	0.0718	0.3691	-0.0513	0.0405	-0.0845	0.0654	0.3396	0.2222	-0.0320	1.0000

3.5 Unit Root Test

Since all variables are time series data and the unit root test use in this study to estimate whether data is all stationary. The Table 3-4 shows the unit root test of Shanghai, Beijing, Guangzhou, Shenzhen, Chongqing and Wuhan housing price index including independent variables. The Augmented Dickey Fuller test and Phillips Perron test with intercept results shows in Table 3-4.

HP_BJ, HP_SH, HP_GZ, HP_CH, HP_SZ and HP_WH represent the housing price of Beijing, Shanghai, Guangzhou, Chongqing, Shenzhen and Wuhan. M1, M2, RMB_USD, INT, COST, CPI, FRC, PMI, STOCK are the independent variables. The results that indicate some variables reject the null hypothesis as non-stationary and some variable accept the null hypothesis at level order. After taking the first difference, all variables reject the null hypothesis and correspond as stationary data.

Table 3-4 Unit root Test Table

	ADF Test		PP Test	
	Level	1st Difference	Level	1st Difference
HP_BJ	-2.4313	-4.8012 ***	-1.3811	-4.7033 ***
HP_SH	-2.9342 *	-10.7766 ***	-2.0240	-10.7851 ***
HP_GZ	-2.6668 *	-6.0770 ***	-2.2658	-5.8131 ***
HP_CH	-3.3416 **	-3.3676 **	-1.3811	-7.6559 ***
HP_SZ	-2.7309 *	-6.6181 ***	-2.4441	-6.6645 ***
HP_WH	-5.5331 ***	-3.8056 ***	-1.8833	-8.2644 ***
M1	-2.1967	-4.4486 ***	-1.7342	-11.3995 ***
M2	-2.7623 *	-4.6387 ***	-2.0793	-13.2015 ***
RMB_USD	-2.5942 *	-8.0659 ***	-2.5192	-8.2429 ***
INT	-4.4957 ***	-11.2028 ***	-4.2378 ***	-22.2251 ***
COST	-2.2059	-5.8096 ***	-1.6293	-5.9703 ***
CPI	-2.7315 *	-5.1225 ***	-2.5648	-11.4633 ***
FRC	-2.4756	-12.5493 ***	-6.2906 ***	-21.6620 ***
PMI	-3.2416 **	-10.8010 ***	-3.7887 ***	-16.3930 ***
STOCK	-2.2855	-10.6563 ***	-2.7150 *	-10.9367 ***

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

3.6 Granger Causality Test

The Table 3-5 to Table 3-10 shows the Granger Causality Test of Shanghai, Beijing, Guangzhou, Shenzhen, Chongqing and Wuhan housing price index with its related independent variables. The Granger Causality Test use to determine the time leading or lag between housing price and independent variables.

For Beijing, the results describe that CPI Granger causes Beijing housing price, M1, STOCK and RMB_USD. While Beijing housing price do not Granger causes the CPI and RMB_USD. Only Beijing housing price Granger causes M1. Derived from these results, Beijing housing price have some relationship between CPI. It indicates that consumer confident will have some impact on Beijing housing price. If people have confidence of the economy and they would to invest or purchase in houses.

For Shanghai, the results mention that M2 and COST Granger causes Shanghai housing price and Shanghai housing price also Granger causes M2 and COST. The money supply has impact on the economy and also affects the Shanghai housing price. The construction cost also has the Granger effect on housing price, if the construction cost is too high and the housing price maybe increase. There are still some variables that have the time leading or lag relationship.

For Guangzhou, COST, CPI and RMB_USD Granger causes Guangzhou housing price while Guangzhou housing price Granger causes COST, CPI and M2. The construction cost, consumer confidence and exchange rate have time leading impact on Guangzhou housing price. Since Guangzhou developed for a long period, both business and economy have effect housing price. Guangzhou housing price have time leading to construction cost, consumer confidence and money supply.

For Chongqing, CPI, M2 and INT Granger causes Chongqing housing price

while Chongqing housing price Granger causes COST, CPI, PMI and M2. The consumer confidence, money supply and interest rate have time leading impact in Chongqing housing price. It is a common logic that interest rate affects the housing price and if the interest rate increase that people may not want to borrow the money to invest or purchase in houses. However, if the interest rate decreases then people would like to borrow money to buy or invest a house.

For Shenzhen, only COST Granger causes Shenzhen housing price while Shenzhen housing price Granger causes M1. Compare with other regions, there are less time leading or lag impact on Shenzhen housing price. The Granger causes test indicates that construction cost has leading impact on Shenzhen housing price.

For Wuhan, the results show that there does not have any variable Granger causes Wuhan housing price and Wuhan housing price also Granger causes M2 and RMB_USD. The Granger cause test indicates that there are some other variables have impact on Wuhan housing price.

According to the Granger Causality Test, there are some variables that can be viewed as the time leading variables to estimate the housing price. Consumer confidence can be considered the variables to estimate Beijing, Guangzhou and Chongqing house price. Construction cost can be regarded as the variables to estimate Shanghai, Guangzhou and Shenzhen house price. Money supply can be looked upon as the variables to estimate Shanghai and Chongqing house price. Exchange rate can be recognized as the variables to estimate Guangzhou house price. Interest rate can be considered as the variables to estimate Chongqing house price.

Table 3-5 Granger Causality Test in Beijing

Independent variables	Dependent variables					
	HP_BJ	M1	RMB_USD	CPI	FRC	STOCK
HP_BJ	-	3.1960 **	2.1295	1.5707	0.6318	1.2841
M1	0.1038	-	0.0291	2.1770	4.1780 **	0.9778
RMB_USD	2.2113	0.9885	-	4.0287 **	4.9125 ***	0.9116
CPI	3.0812 **	8.7174 ***	6.1839 ***	-	0.2786	2.8401 *
FRC	0.4605	0.5271	2.0262	4.4540 **	-	1.0117
STOCK	1.4143	1.3610	1.4910	6.5838 ***	0.7625	-

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

Table 3-6 Granger Causality Test in Shanghai

Independent variables	Dependent variables					
	HP_SH	M2	CPI	PMI	INT	COST
HP_SH	-	5.6637 ***	2.0421	0.0862	0.4453	9.2392 ***
M2	9.3404 ***	-	15.8189 ***	2.7760 *	0.8646	6.5049 ***
CPI	2.1008	11.3789 ***	-	2.9214 *	2.2554	5.5254 ***
PMI	0.3451	3.1272 **	13.2741 ***	-	0.8143	8.5884 ***
INT	1.4322	9.8549 ***	0.9869	2.5691 *	-	1.0926
COST	9.9802 ***	5.8426 ***	5.7379 ***	0.6007	0.4121	-

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

Table 3-7 Granger Causality Test in Guangzhou

Independent variables	Dependent variables					
	HP_GZ	COST	CPI	PMI	M2	RMB_USD
HP_GZ	-	2.8466 *	5.4261 ***	0.2842	9.4262 ***	2.2875
COST	5.5372 ***	-	5.7379 ***	0.6007	5.8426 ***	2.5468 *
CPI	5.9708 ***	5.5254 ***	-	2.9214 *	11.3789 ***	6.1839 ***
PMI	0.3363	8.5884 ***	13.2741 ***	-	3.1272 **	1.1575
M2	0.3582	6.5049 ***	15.8189 ***	2.7760 *	-	0.9519
RMB_USD	2.7794 *	6.6311 ***	4.0287 **	5.3057 ***	3.5228 **	-

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

Table 3-8 Granger Causality Test in Chongqing

Independent variables	Dependent variables					
	HP_CH	COST	CPI	PMI	M2	INT
HP_CH	-	9.9767 ***	5.8085 ***	2.6359 *	5.4937 ***	0.0718
COST	2.2833	-	5.7379 ***	0.6007	5.8426 ***	0.4121
CPI	3.6960 *	5.5254 ***	-	2.9214 *	11.3789 ***	2.2554
PMI	1.4670	8.5884 ***	13.2741	-	3.1272 **	0.8143
M2	8.0690 ***	6.5049 ***	15.8189 ***	2.7760 *	-	0.8646
INT	2.3711 *	1.0926	0.9869	2.5691 *	9.8549 ***	-

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

Table 3-9 Granger Causality Test in Shenzhen

Independent variables	Dependent variables					
	HP_GZ	COST	CPI	FRC	M1	RMB_USD
HP_SZ	-	0.4591	0.5551	1.3718	3.2353 **	2.2739
COST	5.4393 ***	-	5.7379 ***	0.3054	12.4327 ***	2.5468 *
CPI	0.9093	5.5254 ***	-	0.2786	8.7174 ***	6.1839 ***
FRC	0.6026	4.8308 **	4.4540 **	-	0.5271	2.0262
M1	1.7273	2.2106	2.1770	4.1780 *	-	0.0291
RMB_USD	0.0823	6.6311 ***	4.0287 **	4.9125 ***	0.9885	-

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

Table 3-10 Granger Causality Test in Wuhan

Independent variables	Dependent variables					
	HP_WH	FRC	CPI	M1	M2	RMB_USD
HP_WH	-	0.6145	1.4372	1.3478	3.3631 **	3.5930 **
FRC	0.4265	-	4.4540 **	0.5271	1.0336	2.0262
CPI	1.2593	0.2786	-	8.7174 ***	11.3789 ***	6.1839 ***
M1	0.1974	4.1780 **	2.1770	-	3.2365 **	0.0291
M2	0.4466	3.8728 **	15.8189 ***	7.4566 ***	-	0.9519
RMB_USD	0.0385	4.9125 ***	4.0287 **	0.9885	3.5228 **	-

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

Chapter 4

Empirical Results

4.1 Results of Shanghai

State Space model in Shanghai includes five variables, that is, CPI, M2, PMI, INT and COST. The SVt means the house bubbles including positive bubbles and negative bubbles. Shanghai house price index is the dependent variable and CPI, M2, PMI, INT and COST are the independent variables. CPI has positive significant relationship to Shanghai house price index at 5% level. M2 and INT have the positive significant relationship to Shanghai house price index at 1% level. PMI and COST have no significant relationship with Shanghai house price index. The findings indicate that consumer price index, M2 and overnight interbank call-loan rate are related to the Shanghai house bubbles. However, purchase management index and construction cost have no significant related with Shanghai house price index.

The Shanghai State Space model, results and graphs show as below:

$$HP\_SH_t = \alpha_0 + \beta_1 Cpi_t + \beta_2 M2_t + \beta_3 Pmi_t + \beta_4 Int_t + \beta_5 Cost_t + SV_t + \varepsilon_i$$

$$SV_t = \delta_1 SV_{t-1} + \gamma_i$$

$$Var(\gamma_t) = \exp(\omega_t)$$

Table 4-1 Consequence of Shanghai State Space Model

	α_0	β_1	β_2	β_3
Coefficient	14.8627	0.6491	0.1174	0.0869
z-Statistic	505.6735 ***	2.4604 **	8.5849 ***	1.2782
	β_4	β_5	δ_1	ω_t
Coefficient	0.0704	0.1555	0.9468	0.1087
z-Statistic	2.7213 ***	0.4346	10.5687 ***	0.0721

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

As the Figure 4-1 shows, Shanghai house bubbles are between 6 to -6. First of all, there are both positive bubbles and negative bubbles in the different period. The negative bubbles from 2006 Q2 to 2010 Q1 indicates that the house price deviate from the fundamental value. This situation means that fundamental values are higher than house price. Since the financial crisis happened in 2008, the real estate market in China also affected and had negative bubbles. After that period, the housing market recovered due to some government policies and had positive bubbles. These policies reduced the housing bubbles in Shanghai from 2010 to 2011. The positive bubbles from 2015 Q4 to 2016 Q4 indicate that the house price is higher than the fundamental value. In summary, Shanghai bubbles are not stable and affected by other factors.

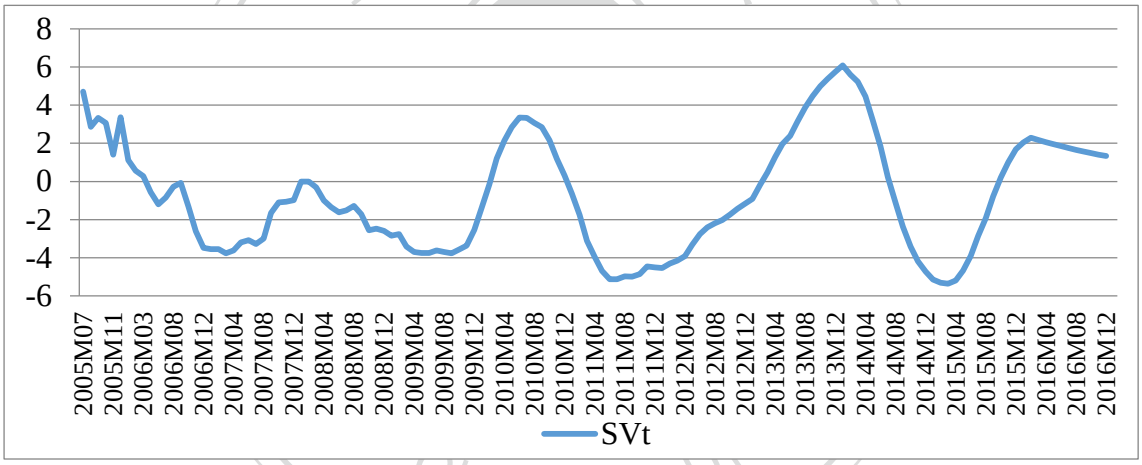


Figure 4-1 SV_t in Shanghai House Prices

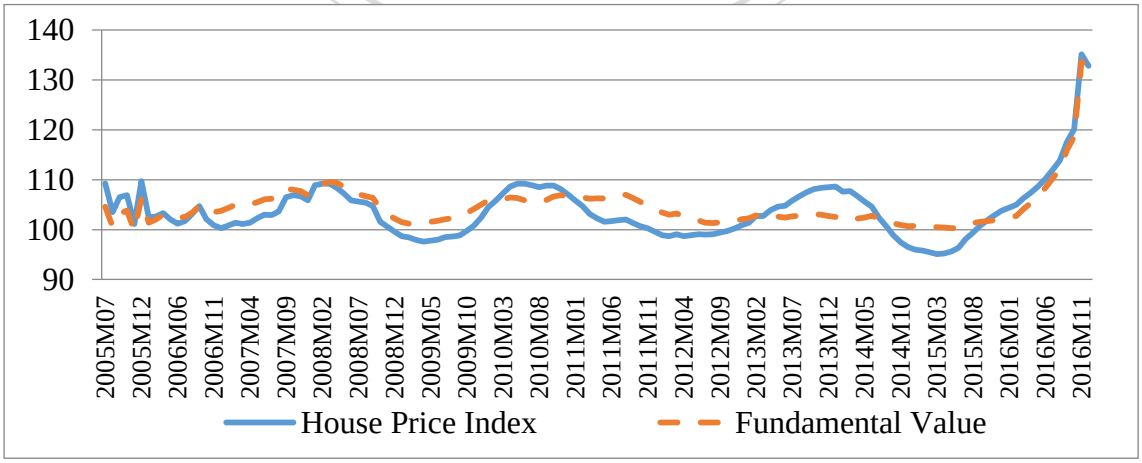


Figure 4-2 House Price Index and Fundamental Value in Shanghai

4.2 Results of Beijing

State Space model in Beijing includes five variables, that is, CPI, FRC, M1, RMB_USD and STOCK. The SVt means the house bubbles including positive bubbles and negative bubbles. Beijing house price index is the dependent variables and CPI, FRC, M1, RMB_USD and STOCK are the independent variables. CPI, FRC, M1 and RMB_USD have the positive significant relationship to Beijing house price index at 1% level. STOCK has no significant relationship with Beijing house price index. The findings indicate that consumer price index, foreign reserve change percentage, M1 and RMB to USD are related to the Beijing house bubble. However, Shanghai A shares has no significant related with Beijing house price index.

The Beijing State Space model, results and graphs show as below:

$$HP\_BJ_t = \alpha_0 + \beta_1 Cpi_t + \beta_2 Frc_t + \beta_3 M1_t + \beta_4 Rmb\_Usd_t + \beta_5 Stock_t + SV_t + \varepsilon_i$$

$$SV_t = \delta_1 SV_{t-1} + \gamma_i$$

$$Var(\gamma_t) = \exp(\omega_t)$$

Table 4-2 Consequence of Beijing State Space Model

	α_0	β_1	β_2	β_3
Coefficient	-75.9394	1.4401	0.1225	0.4494
z-Statistic	-8446.1120 ***	9.9930 ***	4.6831 ***	3.1993 ***
	β_4	β_5	δ_1	ω_t
Coefficient	3.2128	-0.0006	1.0484	0.8035
z-Statistic	30.6635 ***	-0.0014	10.8407 ***	18.2358 ***

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

As the Figure 4-3 shows, Beijing house bubbles are between 50 to -5. In general, there are both positive bubbles and negative bubbles in the different periods. For instance, the negative bubbles from 2006 Q2 to 2007 Q3 indicates that the house price deviate from the fundamental value. Namely, the fundamental values are higher than house price. Even so, the Beijing housing bubbles are mostly positive and result in the house price higher than fundamental values. The positive bubbles from 2007 Q4 to 2008 Q3, 2009 Q2 to 2010 Q3 and 2011 Q3 to 2016 Q4 indicate that the house price is higher than the fundamental value. Besides, the house bubble increase dramatically in recent days and is getting higher. Compare with the previous ten years and as the results show, Beijing's housing price isn't entirely affected by government policies.

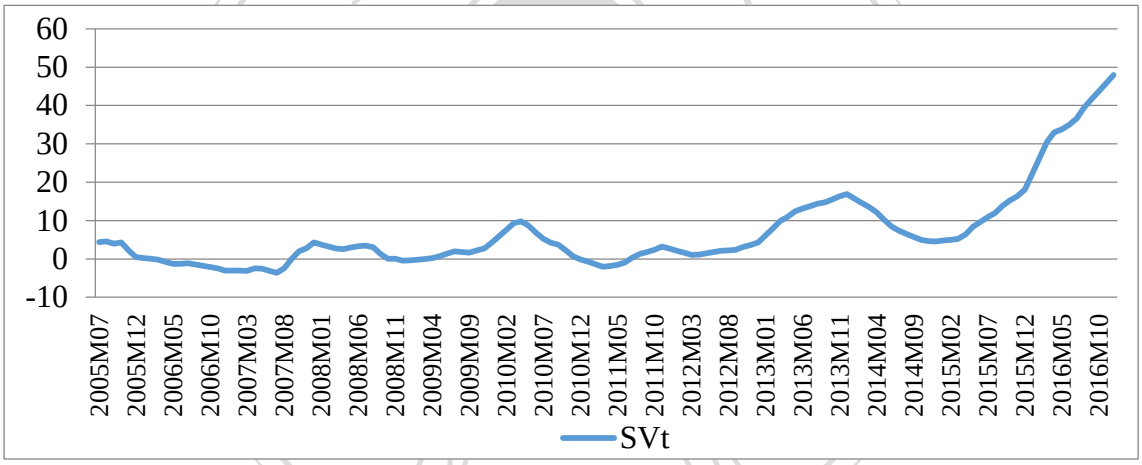


Figure 4-3 SV_t in Beijing House Prices

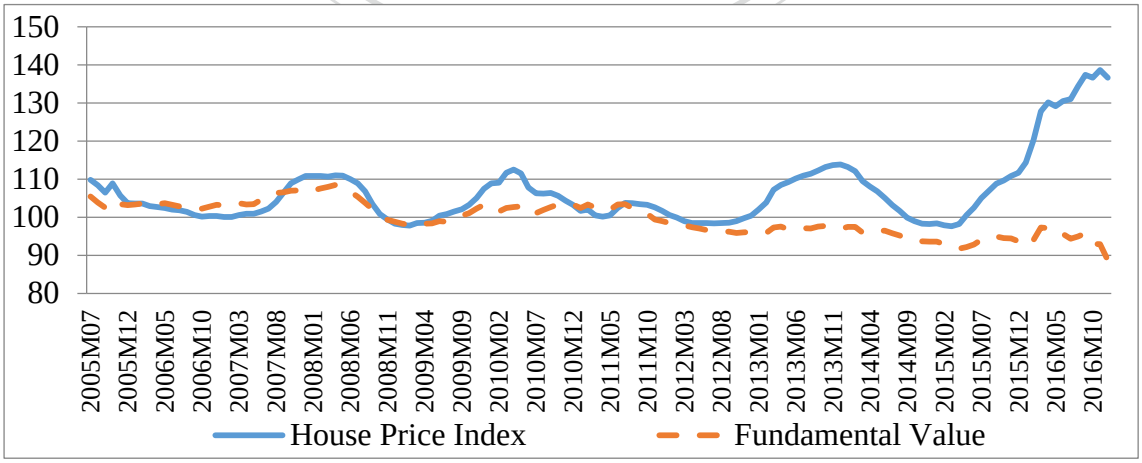


Figure 4-4 House Price Index and Fundamental Value in Beijing

4.3 Results of Guangzhou

State Space model in Guangzhou includes five variables, that is, COST, CPI, M2, PMI and RMB_USD. The SVt means the house bubbles including positive bubbles and negative bubbles. Guangzhou house price index is the dependent variables and COST, CPI, M2, PMI and RMB_USD are the independent variables. CPI and RMB_USD have the positive significant relationship to Guangzhou house price index at 1% level. COST has the negative significant relationship to Guangzhou house price index at 1% level. M2 and PMI have no significant relationship with Guangzhou house price index. The findings indicate that construction cost, consumer price index and RMB to USD are related to the Guangzhou house bubble. However, M2 and purchase management index have no significant related with Guangzhou house price index.

The Guangzhou State Space model, results and graphs show as below:

$$HP\_GZ_t = \alpha_0 + \beta_1 Cost_t + \beta_2 Cpi_t + \beta_3 M2_t + \beta_4 Pmi_t + \beta_5 Rmb\_Usd_t + SV_t + \varepsilon_i$$

$$SV_t = \delta_1 SV_{t-1} + \gamma_i$$

$$Var(\gamma_t) = \exp(\omega_t)$$

Table 4-3 Consequence of Guangzhou State Space Model

	α_0	β_1	β_2	β_3
Coefficient	-19.1762	-0.6605	1.0534	0.3667
z-Statistic	-1198.0500 ***	-7.0116 ***	6.0445 ***	1.6054
	β_4	β_5	δ_1	ω_t
Coefficient	0.1901	11.9806	0.9923	2.1055
z-Statistic	1.5738	57.8986 ***	11.0598 ***	0.1086

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

As the Figure 4-5 shows, Guangzhou house bubbles are between 30 to -30. Overall, there are both positive bubbles and negative bubbles in the different periods. The negative bubbles from 2005 Q3 to 2013 Q2 indicate that the house price deviate from the fundamental value. In Guangzhou's case, the fundamental values are higher than house price for a long period. Broadly speaking, Guangzhou bubbles are mostly negative and result in the higher fundamental values than house price. Additionally, the positive bubbles from 2015 Q3 to 2016 Q4 indicate that the house price is higher than the fundamental value. One of the possible reasons is that early development in Guangzhou and the supply of land may have been inadequate. This situation would be similar with Shenzhen since they all develop early.

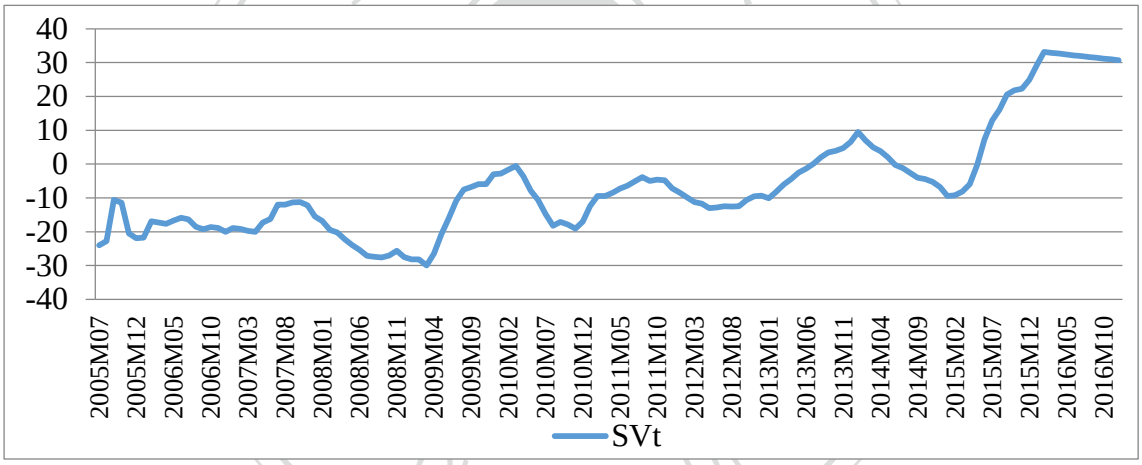


Figure 4-5 SV_t in Guangzhou House Prices

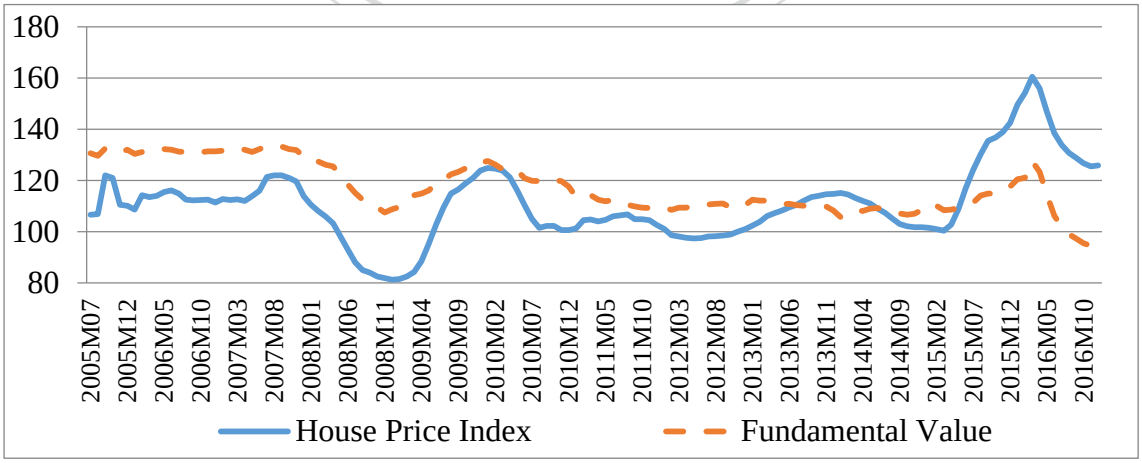


Figure 4-6 House Price Index and Fundamental Value in Guangzhou

4.4 Results of Shenzhen

State Space model in Shenzhen includes five variables, that is, COST, CPI, FRC, M1 and RMB_USD. The SVt means the house bubbles including positive bubbles and negative bubbles. Shenzhen house price index is the dependent variables and COST, CPI, FRC, M1 and RMB_USD are the independent variables. COST, M1 and RMB_USD have the positive significant relationship to Shenzhen house price index at 1% level. CPI has the positive significant relationship to Shenzhen house price index at 5% level. FRC has no significant relationship with Shenzhen house price index. The findings indicate that construction cost, consumer price index, M1 and RMB to USD are related to the Shenzhen house bubble. However, foreign reserve change percentage has no significant related with Shenzhen house price index.

The Shenzhen State Space model, results and graphs show as below:

$$HP\_SZ_t = \alpha_0 + \beta_1 Cost_t + \beta_2 Cpi_t + \beta_3 Frc_t + \beta_4 M1_t + \beta_5 Rmb\_Usd_t + SV_t + \varepsilon_i$$

$$SV_t = \delta_1 SV_{t-1} + \gamma_i$$

$$Var(\gamma_t) = \exp(\omega_t)$$

Table 4-4 Consequence of Shenzhen State Space Model

	α_0	β_1	β_2	β_3
Coefficient	-2.1534	0.1579	0.6186	-0.0366
z-Statistic	-29.2221 ***	26.9658 ***	2.4037 **	-0.8112
	β_4	β_5	δ_1	ω_t
Coefficient	0.3662	3.1291	0.9837	0.4210
z-Statistic	7.8512 ***	22.4550 ***	2.0E+121 ***	201.1324 ***

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

As the Figure 4-9 shows, Shenzhen house bubbles are between 10 to -10. To start with, there are both positive bubbles and negative bubbles in the different periods. The negative bubbles from 2005 Q3 to 2012 Q3 indicates that the house price deviate from the fundamental value. Furthermore, the fundamental values are higher than house price for a long period. The Shenzhen bubbles are constantly negative and result in the higher fundamental values than house price while the housing bubbles are recently positive. The positive bubbles from 2015 Q3 to 2016 Q4 indicate that the house price is higher than the fundamental value. Due to the early development of Shenzhen, the land supply may be relatively lacking and resulting in high prices. Even though Shenzhen and Guangzhou have a geographical relationship, their housing price trends are not similar.

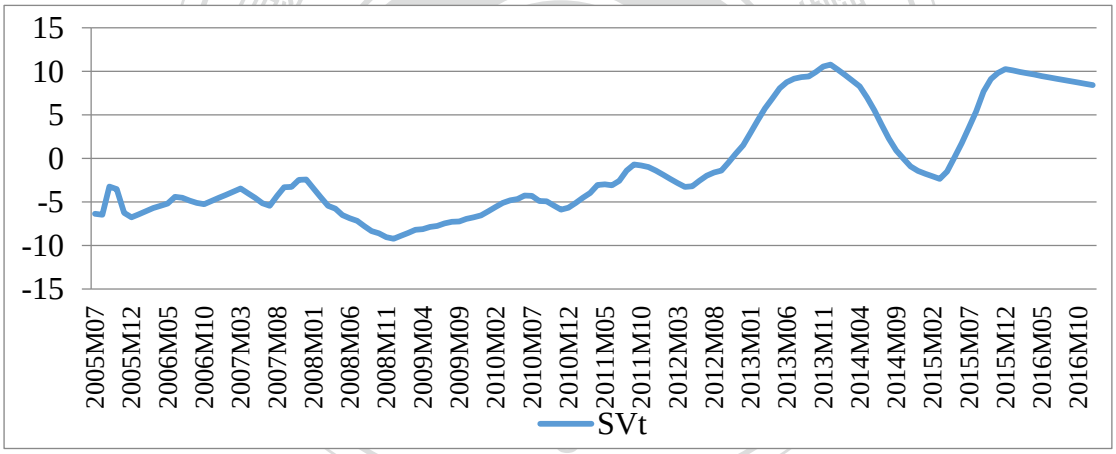


Figure 4-7 SV_t in Shenzhen House Prices

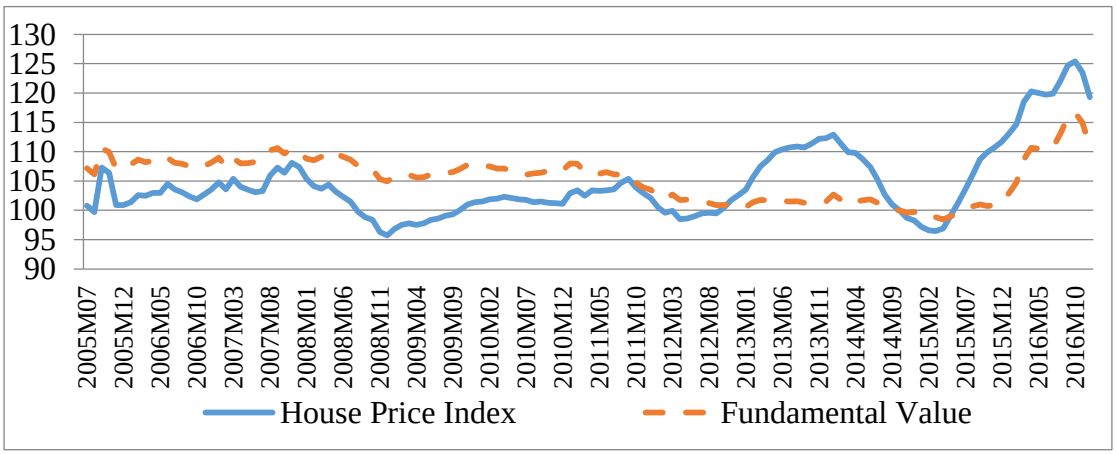


Figure 4-8 House Price Index and Fundamental Value in Shenzhen

4.5 Results of Chongqing

State Space model in Chongqing includes five variables, that is, CPI, M2, PMI, INT and COST. The SVt means the house bubbles including positive bubbles and negative bubbles. Chongqing house price index is the dependent variables and CPI, M2, PMI, INT and COST are the independent variables. CPI and M2 have the positive significant relationship to Chongqing house price index at 1% level. PMI has the positive significant relationship to Chongqing house price index at 5% level. INT has negative significant relationship to Chongqing house price index at 1% level. However, COST has no significant relationship with Chongqing house price index. The findings indicate that consumer price index, M2, purchase management index and overnight interbank call-loan rate are related to the Chongqing house bubbles. However, construction cost has no significant related with Chongqing house price index.

The Chongqing State Space model, results and graphs show as below:

$$HP\_CH_t = \alpha_0 + \beta_1 Cpi_t + \beta_2 M2_t + \beta_3 Pmi_t + \beta_4 Int_t + \beta_5 Cost_t + SV_t + \varepsilon_i$$

$$SV_t = \delta_1 SV_{t-1} + \gamma_i$$

$$Var(\gamma_t) = \exp(\omega_t)$$

Table 4-5 Consequence of Chongqing State Space Model

	α_0	β_1	β_2	β_3
Coefficient	42.2954	0.6889	0.1771	0.1034
z-Statistic	1427.7650 ***	2.8475 ***	14.8990 ***	2.0041 **
	β_4	β_5	δ_1	ω_t
Coefficient	-0.1609	-0.1723	0.9432	-0.0246
z-Statistic	-7.2043 ***	-0.5328	10.4808 ***	-0.0204

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

As the Figure 4-7 shows, Chongqing house bubbles are between 6 to -6. First, there are both positive bubbles and negative bubbles in the different periods. The negative bubbles from 2014 Q3 to 2016 Q4 indicates that the house price deviate from the fundamental value. The fundamental values are higher than house price for a long period. Next, Chongqing housing bubbles are frequently negative and result in the higher fundamental values than house price. For example, the positive bubbles from 2013 Q3 to 2014 Q2 indicate that the house price is higher than the fundamental value. In comparison, Chongqing has less positive bubbles than other regions. One of the reasons may be due to higher housing demand in Chongqing. If there is a higher demand for housing rather than investment behavior, it may reduce for the housing bubbles.

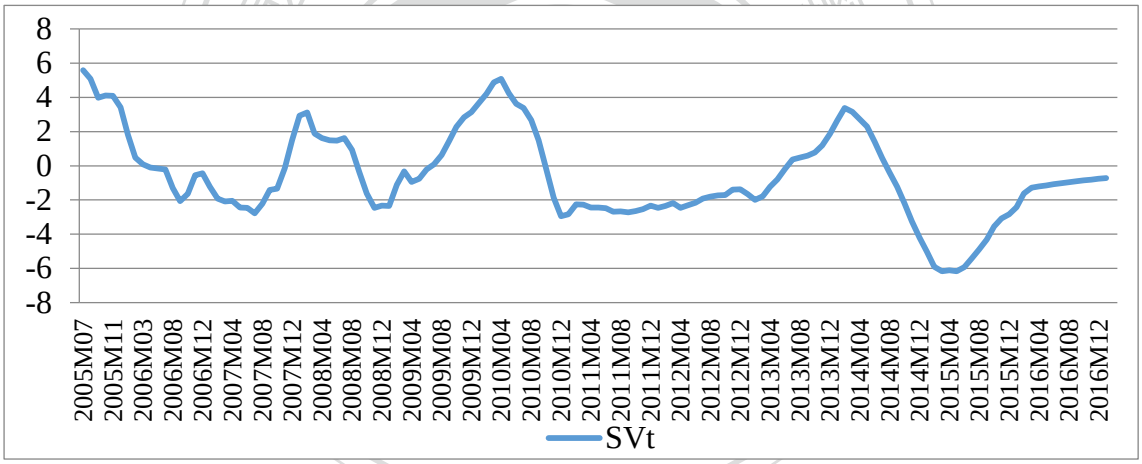


Figure 4-9 SV_t in Chongqing House Prices

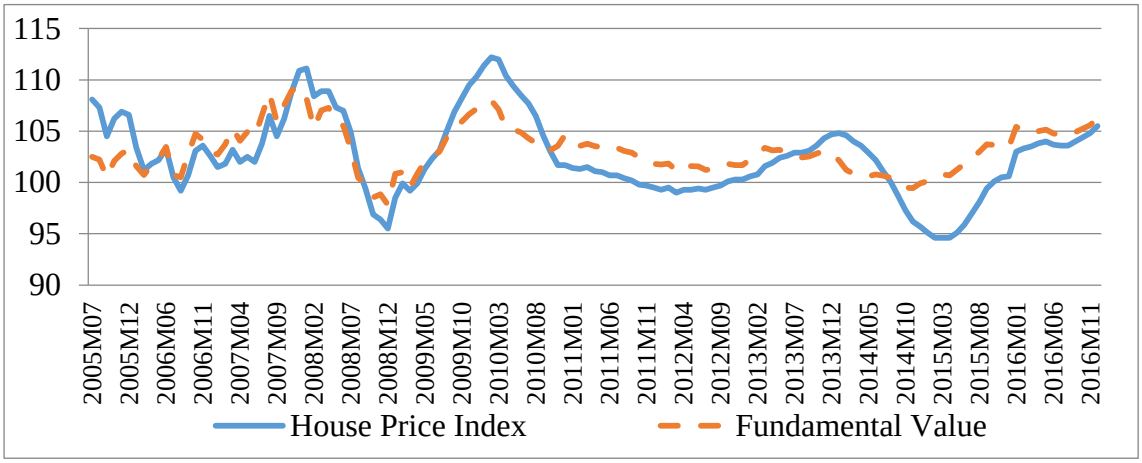


Figure 4-10 House Price Index and Fundamental Value in Chongqing

4.6 Results of Wuhan

State Space model in Wuhan includes five variables, that is, CPI, FRC, M1, M2 and RMB_USD. The SVt means the house bubbles including positive bubbles and negative bubbles. Wuhan house price index is the dependent variables and CPI, FRC, M1, M2 and RMB_USD are the independent variables. CPI and M2 have the positive significant relationship to Wuhan house price index at 1% level. M1 has the positive significant relationship to Wuhan house price index at 5% level. Apart from the results, FRC and RMB_USD have no significant relationship with Wuhan house price index. The findings indicate that consumer price index, M1 and M2 are related to the Wuhan house bubble. However, foreign reserve change percentage and RMB to USD have no significant related with Wuhan house price index.

The Wuhan State Space model, results and graphs show as below:

$$HP\_WH_t = \alpha_0 + \beta_1 Cpi_t + \beta_2 Frc_t + \beta_3 M1_t + \beta_4 M2_t + \beta_5 Rmb\_Usd_t + SV_t + \varepsilon_i$$

$$SV_t = \delta_1 SV_{t-1} + \gamma_i$$

$$Var(\gamma_t) = \exp(\omega_t)$$

Table 4-6 Consequence of Wuhan State Space Model

	α_0	β_1	β_2	β_3
Coefficient	34.2149	0.5211	-0.0287	0.4609
z-Statistic	1962.6740 ***	2.7920 ***	-0.2512	2.4541 **
	β_4	β_5	δ_1	ω_t
Coefficient	2.7280	-0.0004	0.9875	0.8768
z-Statistic	25.2674 ***	-0.0003	10.0246 ***	0.0765

Note: *, ** and***indicate significance at the 10%, 5% and 1% level respectively.

As the Figure 4-11 shows, Wuhan house bubbles are between 15 to -20. To begin with, there are both positive bubbles and negative bubbles in the different periods. In addition, the negative bubbles from 2005 Q3 to 2012 Q4 indicates that the house price deviate from the fundamental value. That is, the fundamental values are higher than house price for a long period. The Wuhan bubbles are mostly negative and result in the higher fundamental values than house price while the housing bubbles are becoming recently positive. The positive bubbles from 2015 Q2 to 2016 Q4 indicate that the house price is higher than the fundamental value. Since Wuhan is a related late developing of the regions, therefore, the real estate investment and residential demand are more prosperous than others.

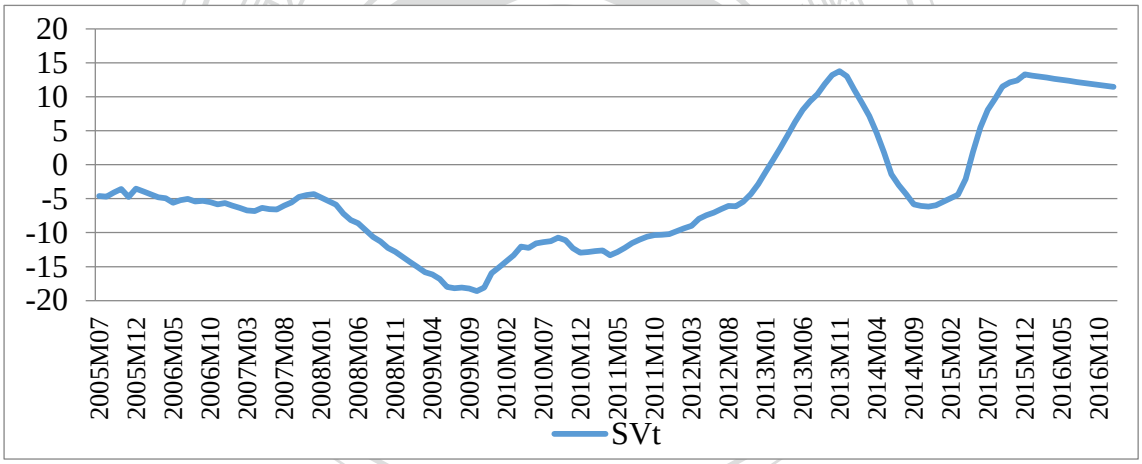


Figure 4-11 SV_t in Wuhan House Prices

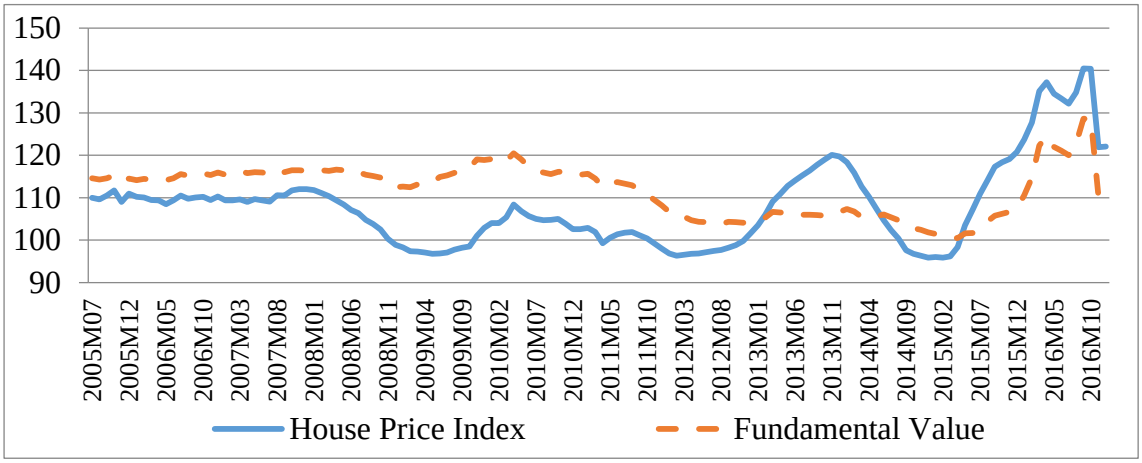


Figure 4-12 House Price Index and Fundamental Value in Wuhan

As the Figure 4-13 shows, there are several similarities in the six regions. First, consumer confident index has a significant relationship of the housing bubble in all regions. Second, money supply also has the significant relationship of the housing bubble in Shanghai, Beijing, Chongqing, Shenzhen and Wuhan. The RMB exchange to US dollars has the significant relationship of the housing bubbles in Beijing, Guangzhou, and Shenzhen means that exchange rate market an influence on the housing market. The construction cost only significant relationship to the housing bubbles in Guangzhou and Shenzhen. The interest rate only has the significant relationship to the housing bubbles in Shanghai and Chongqing. Comparing these six regions, the housing bubbles are largest in Beijing and Chongqing has the most unstable house price. After the restriction order of house in 2010, most cities have a negative housing bubble. Guangzhou, Shenzhen and Wuhan had negative housing bubbles from 2010 Q1 to 2012 Q3. The six regions all had negative housing bubbles from 2011 Q1 to 2011Q2. The situation infers that the restriction order of house has some effects of housing price.

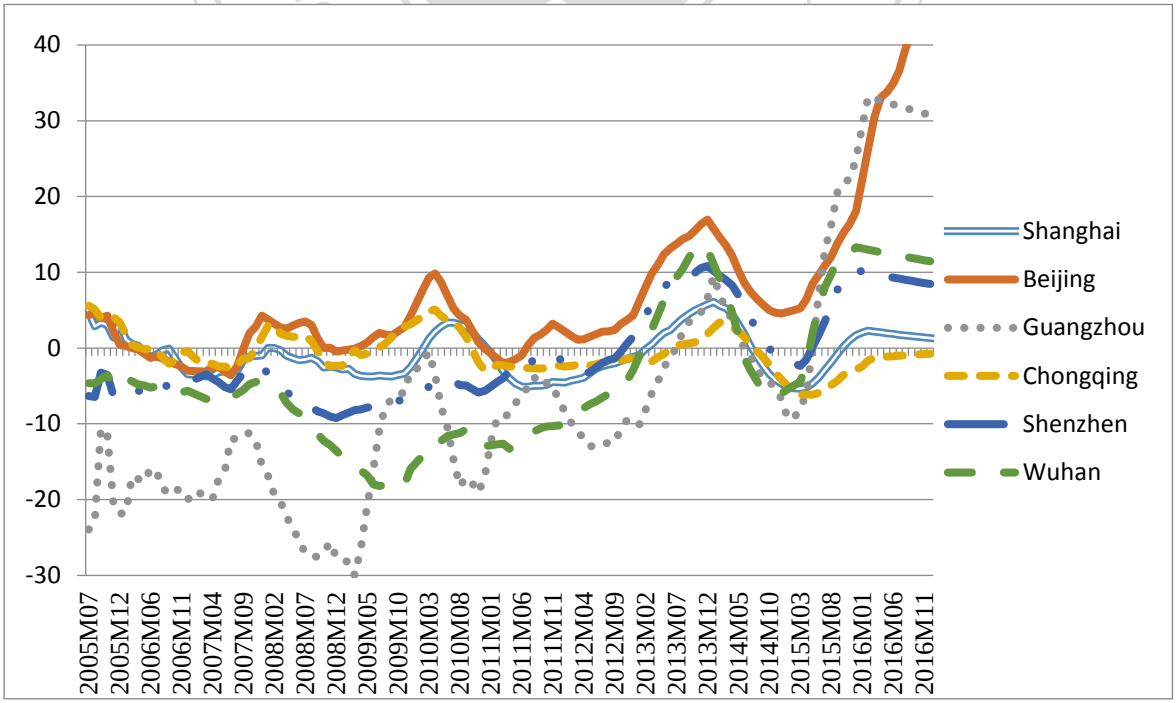


Figure 4-13 Results of SV_t in Six Regions

Chapter 5

Conclusions and Suggestions

5.1 Conclusions

According to previous literatures, it can be found that real estate prices are susceptible to factors such as government policy, international economic indicators, money supply and buildings construction. Therefore, through the past literatures, this study selects several variables as independent variables including monetary aspects, foreign exchange sections, construction factors, and economic situation. Besides, Shanghai, Beijing, Chongqing, Guangzhou, Shenzhen and Wuhan house price index are selected in this research as dependent variables using State Space model to estimate how the housing bubbles in these six regions.

Based on three tests including correlation analysis, unit root test and Granger Causality test, there are some interesting findings. With the Granger Causality Test, consumer confidence Granger causes some housing price, like Beijing, Chongqing, and Guangzhou. This means that housing price in these two regions has the relationship with consumer confidence index. M2 Granger causes the housing price in Shanghai and Chongqing. Interest rate Granger causes the housing price in Chongqing. Construction cost has a Granger effect on Shanghai and Guangzhou. Only RMB exchange to US dollar Granger causes the housing price in Guangzhou. Consumer confidence index can be viewed as the leading index of housing price.

Even though the macroeconomic variables have an impact on housing price bubbles, there are still some other reasons that affect the rise house bubbles such as government policies on buying or investing a house. Comparing these six regions, general speaking, the trend in all regions is almost the same with the exception of

some periods. As the previous chapters were explained, both forward and downward trends of housing price bubbles are the same. The previous chapters also discussed how different variables will influence housing price bubbles.

As a result, the housing bubbles increased from 2013 especially in Beijing and reduced in the end of the same year. Starting from 2014, the housing price bubbles began to decrease and then recovered in 2015. However, there is an increasing trend from 2015 till the end of 2016. In recent month, the housing bubbles increase dramatically in Beijing and Guangzhou. These two regions have higher housing bubbles that indicate there is an abnormal rise of housing prices. In contrast, other regions including Shanghai, Chongqing, Shenzhen and Wuhan have less housing bubbles. However, once the housing price continues to increase like Beijing and Guangzhou, these regions will have housing bubbles one day. Investors can consist to observe whether these two regions will decline or continue to rise in housing prices in the future. In summary, Beijing and Guangzhou have higher housing price bubbles and need to strengthen control to avoid more housing bubbles. Moreover, the other four regions also have an increase in housing price bubbles trend and they also need to pay more attention.

5.2 Suggestions

Based on the empirical results, there are various investment suggestions and comments on Shanghai, Beijing, Chongqing, Guangzhou, Shenzhen and Wuhan house price. Beijing and Guangzhou housing price bubbles have higher risk than other regions and investors should be more careful to invest in a house. Additionally, Beijing and Guangzhou have higher house price per square meter. The housing price bubbles in Shanghai and Chongqing are lower than others and housing price bubbles are around zero. On the other hand, Chongqing's house price per square meter does not increase dramatically while Shanghai increases in recent month. In my opinion, investors could consider investing or buying Shanghai and Chongqing's houses due to the lower housing price bubbles. Even though Shanghai's average house price per square meter is higher and there may have less housing price in such rural areas. To sum up, since there are some government policies that affect the housing price, so investors need to pay attention to major housing policies and money supply policies.

In the previous literatures and news, there are diverse comments that China has housing bubbles and that the bubbles would break. In addition, the easing monetary policies stimulate the housing price which means that lower interest rate will attract for investors to buy a house. Supposed that the government reduces the easing money policies then it will not worsen the situation of the housing bubbles. Furthermore, the higher mortgage loan rate to purchase a house can avoid people to invest a house. While limitation policy can restraints excess consumption or investment in houses will also avoid higher housing price. On the other hand, the speed of land construction cannot fulfill to land demand of people. In summary, these housing problems maybe solve both by government limitation policies and interest rate to avoid excess investment and consumption.

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