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กรณีศึกษา 30 มณฑลในประเทศจีน

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ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

The Effects of Macroprudential Policy on Housing Market:

Evidence from 30 Provinces in China

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จุฬาลงกรณ์มหาวิทยาลัย
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ตลาดอสังหาริมทรัพย์มีบทบาทสำคัญต่อการเติบโตทางเศรษฐกิจของประเทศจีน แต่
อย่างไรก็ตาม ราคาที่อยู่อาศัยและยอดการปล่อยกู้ของธนาคารที่ขยายตัวอย่างรวดเร็วจะส่งผล
กระทบต่อเสถียรภาพและความปลอดภัยของระบบการเงินของประเทศ ดังนั้นเพื่อป้องกันและ
ควบคุมความเสี่ยงที่จะเกิดขึ้นจากตลาดอสังหาริมทรัพย์ นโยบายด้านการดูแลเสถียรภาพระบบ
การเงินจึงได้ถูกนำมาใช้เป็นเครื่องมือในการกำกับดูแลระบบเศรษฐกิจทั่วโลกรวมถึงประเทศจีน
การศึกษานี้มีวัตถุประสงค์หลักคือ ประเมินว่าเครื่องมือของนโยบายด้านการดูแลเสถียรภาพระบบ
การเงินมีประสิทธิภาพในการจัดการราคาที่อยู่อาศัยของทั้งตลาดอสังหาริมทรัพย์ใหม่และตลาด
อสังหาริมทรัพย์มือสองใน 30 มณฑลของประเทศจีนได้หรือไม่ และเปรียบเทียบว่าเครื่องมือตัว
ไหนมีผลมากน้อยเพียงใด โดยใช้เครื่องมือ Fixed-effect Panel Model ในขณะเดียวกัน จะ
ตรวจสอบหาผลกระทบที่แตกต่างระหว่างเครื่องมือแต่ละตัวกับตลาดอสังหาริมทรัพย์ใหม่และ
ตลาดอสังหาริมทรัพย์มือสอง โดยใช้เครื่องมือ Pooled Panel Model นอกจากนี้ จะเปรียบเทียบ
ผลกระทบที่แตกต่างกันของ Reserve Requirement Ratio (RRR) ต่อการจัดการราคาที่อยู่อาศัย
(แบ่งเป็นสามประเภท ตามพื้นที่ห้อง)ในตลาดอสังหาริมทรัพย์ใหม่และมือสอง

ในการประมาณค่าด้วยวิธี Panel Regressions ผลการศึกษาพบว่าเครื่องมือที่ใช้ของ
นโยบายด้านการดูแลเสถียรภาพระบบการเงินส่วนใหญ่มีนัยสำคัญและมีความสัมพันธ์กับราคาที่
อยู่อาศัย สอดคล้องกันตามที่คาดการณ์ไว้ โดยเฉพาะระหว่างปี 2006 ถึง 2014 เครื่องมือ
Reserve Requirement Ratio (RRR) และ Loan-to-value Ratio (LTV) เป็นเครื่องมือที่มีผลกระทบ
กับราคาที่อยู่อาศัย แต่เครื่องมือ Reserve Requirement Ratio (RRR) จะส่งผลกระทบได้ดีกว่า
นอกจากนี้ เครื่องมือที่ใช้ในแบบจำลองส่วนใหญ่จะมีผลที่ต่างกันระหว่างตลาดอสังหาริมทรัพย์
ใหม่และมือสอง ส่วนระหว่างปี 2011ถึง 2014 เมื่อศึกษาเจาะจงกับผลกระทบของ Reserve
Requirement Ratio (RRR) แล้ว พบว่า Reserve Requirement Ratio (RRR) สามารถช่วยจัดการ
ราคาที่อยู่อาศัยที่มีขนาดใหญ่ได้มากกว่าขนาดกลางและขนาดเล็กในทั้งสองตลาด

สาขาวิชา เศรษฐศาสตร์	ลายมือชื่อนิสิต	....
ปีการศึกษา 2558	ลายมือชื่อ อ.ที่ปรึกษาหลัก	....

LINA WANG: The Effects of Macroprudential Policy on Housing Market: Evidence from 30 Provinces in China. ADVISOR: PONGSAK LUANGARAM, Ph.D., 85 pp.

The housing market plays a significant role in Chinese economic growth. However, a house price inflation and the high credit growth could affect the stability and the safety of the financial system. In order to manage the potential risks from the housing market, macroprudential policy has been popularly used in recent years as both a regulatory and supervisory instruments, including China. The main objective of this thesis is to evaluate the effects of macroprudential policies on house price stability management of both newly constructed housing market and second-hand housing market in 30 provinces of China and to find out which instrument is more effective by using the fixed-effect panel model. By the way, to point out the different effectiveness between the different individual macroprudential policy instruments on newly constructed houses price (overall) and second-hand houses price (overall) by using the pooled panel model. Also, to compare the different effectiveness of the reserve requirement ratio (RRR) on three different housing space types of newly constructed houses and second-hand houses.

Using panel regression, it is found that most of macroprudential instruments are significant and have the expected relationship with house prices. In particular, during 2006 to 2014, the reserve requirement ratio (RRR) and some of loan-to-value ratios (LTV) are effective instruments, but reserve requirement ratio (RRR) is more effective. And most of instruments have different effectiveness between newly constructed housing market and second-hand housing market. In addition, during 2011 to 2014, it is found that the reserve requirement ratio (RRR) can manage the house price very well with the large size more than the middle size and small size in both two markets.

Field of Study: Economics	Student's Signature
Academic Year: 2015	Advisor's Signature

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CHAPTER 1

INTRODUCTION

1.1 Background and Significance of the problem

The housing market is an essential sector related to a large share of investments, loans and the wealth of the national economy (M. Zhu, 2014). Since 1978, under Deng Xiaoping's lead, the People's Republic of China embraced the first real estate reform. Until now 30 years past, housing markets played a significant role in Chinese economic growth; especially housing-related consumption, investment and tax revenue.

Since the loans and fixed-asset investments for developers, mortgages of households and house prices increased continually in recent years. The data showed that China's investment-to-GDP ratio achieved 45 percent in 2011, among which real estate investment reached up to 15.1 percent of GDP in 2013 and more than 1 in 3 of total investment, in comparison to only 4.9 percent 13 years ago. As regards real estate loans, it rose to nearly 30 percent of GDP and more than 20 percent of total loans. Increased investments and loans drove the developers to build more houses in the city, which increased the housing supply. But due to the consumers believe and expect that limited urban land, growing urbanization and the aspiration of working and staying in the city, housing demand will never decrease. Even if there is large amount of investment in construction of new houses, prices never diminished. Until 2013, housing prices have increased by almost 4 times their values of 10 years prior in some large cities, such as Shanghai, Beijing, Shenzhen, and has doubled values on average for whole country. At the same time, house mortgage loans went up nearly six-fold in last 10 years. When focus on more detailed market, it can be found that the price of both newly constructed house and second-hand house are uptrend in recent 10 year and the price of second-hand house increases faster and higher than newly constructed house in average. In consequence, it becomes a concern that these housing market features might become the financial risks, which could break the financial stability of nation economy.

When looking back at the last century until now, housing market has been the source of crises (Deng, Zheng, & Ling, 2005). House prices, boom or bust, form a crucial potential risk in the financial sector, which will have serious consequences for the stability and the safety of the financial system. The experience showed that if a house price booms, it requires central bank keep enough or much more reserve requirement, and other financial institutions (such as banks) to adjust the adequate capital and liquidity to satisfy the conditions of providing more loans and mortgages. However, if a house price goes bust, those institutions face a great loss from the loss value of the house and big numbers of non-performing loans. Therefore, house price values become a potential housing market risk and might lead to instability of the financial system. It can be the best explanation of why the "housing markets have certain characteristics that intrinsically link them to financial stability" (Galati & Moessner, 2012), as well as the national economy.

As for China, because of fast economic development in recent years, today, the phenomenon that there was no fair competition and free trading, the defect of financial institutions' regulations, the deficiency of regulation implementation, and different level of corruption, the irrational trend-following investments and other various shock in the present market economy made the financial systemic risk increase sharply. Also, the Chinese government was hard to make and produce timely and efficient management and control the house price in many cities. Furthermore, since 2006, the problem of high price, high non-performing loans ratio, high housing vacancy rate and other complexities had come under the media's focus. Most working-class people and families had to spent all their saving and picked the burden of mortgage for decades, which had made them a "property slave". However, as for the high-income people taken advantage of resources, which stocked a great number of housing preparing to sell or speculate in the future, forming the "ghost cities".

Not only China, but various countries all over the world had faced booming asset prices. In order to regulate and supervise these housing risk of the financial system, macroprudential policy is widely used in most of counties. It is shown that the

macroprudential policy are effective in lower the housing price inflation and credit growth (Lim et al., 2011).

After the word "macroprudential" first appearance in 1979, Bis (1986) formally presented this concept in a formally document, "macroprudential" is defined as "the safety and soundness of the broad financial system and payments mechanism". And Brockmeijer, Moretti, Osinski, and Blancher (2011) defined that, "Macroprudential policy is a complement to micro prudential policy and it interacts with other types of public policy that have an impact on systemic financial stability". Particularly, macroprudential policy can defuse systematic risk at time demission and cross section demission by using different policy instruments to keep financial system stable (Basel Committee On Banking, 2011; Borio, 2009; England, 2011; Wang & Sun, 2013).

With frequent financial crisis', the importance of macroprudential regulations have been emphasized by many countries. Macroprudential regulation even has an objective that sometimes is assigned to avoid asset price bubbles directly (Landau, 2009). And the research of IMF (2009) found out that the low interest rate and high housing price have no relationship, which means the monetary policy could not help curb the housing price boom and prevent the housing price bust including the crisis. But the macroprudential can be used to help deal with the housing market problem. Therefore, the macroprudential instruments are used more in managing housing market all over the world.

However, there are several instruments of macroprudential policy can be choose to managing housing market, the instrument combinations of different countries may be different. Based the difference of national conditions, these instruments are not necessary to be used all together. According to disparate objectives, national government or policy maker need to select the appropriate instrument combinations. For example, Loan-to-value ratio is the major housing related measures and reserve requirement is major credit measures in Asia region, but not the other regions over the world.

As for China, the People's Bank of China and the China Banking Regulatory Commission adopted macroprudential polices to sustain the housing market risk and the housing price booms in main cities from 2009 on. And different instruments have been used until now.

1.2 Objectives

Real estate is the main lifeline of China's economy. The housing market performance affects the macroeconomic trends and reflects the healthy development of financial institutions, as well as the people's living standards and quality of life. If the real estate market goes overheated, which leads to rapid growth in loans and housing prices in the short term, the market prices will severely deviate from the fundamental value, and hence have an influence of financial stability and may lead to the economic crisis. Once the housing price burst, the economic crisis comes along with the market prices falling, as well as the financial institutions will face the risk of assets price depreciation or even collapse, economic downturn and social panic. Therefore, Chinese governments, central bank and related financial regulatory authorities keep improving and jointly use such policies as monetary policies, fiscal policies, micro-prudential policies and macroprudential policies, only to better control the potential risks in real estate and maintain financial stability.

The main objective of this thesis is to evaluate the effects of macroprudential policies on house price stability management of both newly constructed houses market and second-hand houses market in 30 provinces of China and to find out which instrument is more effective by using the fixed-effect panel model.

By the way, to point out the different effectiveness between the different individual macroprudential policy instruments on newly constructed houses price (overall) and second-hand houses price (overall) in 30 provinces of China by using the pooled panel model. Also, to compare the different effectiveness of the reserve requirement ratio

(RRR) on three different housing space types of newly constructed houses and second-hand houses in 30 provinces of China, respectively.

1.3 Research Hypothesis

H1: The reserve requirement ratio (RRR), the capital adequacy ratio (CAR) and liquidity ratio (LR) have negative relationship with house prices. And the loan-to-value ratio (LTV) is positive association with house prices. As for the control variables, the lag of house prices, the provincial GDP, the provincial CPI and the provincial fixed-asset investment have positive relationship with house prices.

H2: When comparing the macroprudential policy effectiveness on different house markets, according to the percentage share of real market, there is different effectiveness between newly constructed house market and second-hand house market and expecting that macroprudential policy will be more effective on managing stability of newly constructed house market.

H3: When comparing the macroprudential policy effectiveness on different house types, according to the percentage share of real market, there is different effectiveness between small-, middle- and large-size house of both newly constructed and second-hand house market and expecting that macroprudential policy will be more effective on managing stability of small-size house of newly constructed house market and middle-size of second-hand house market.

1.4 Methodology

The main regressions will be the fixed-effects panel model with panel data to estimate the effects of macroprudential policy instruments on newly constructed housing market and second-hand market.

The quarterly data will be used in the model from 2006 to 2014. The dependent variables are the provincial newly constructed commercial residential housing price index (overall) and the provincial second-hand housing price index (overall). The

macroprudential instruments used as the policy variables in the model are the reserve requirement ratio (RRR) for large banks and the reserve requirement ratio (RRR) for small banks, the loan-to-value ratio (LTV) for the first house with housing space totaling less than 90 square meters, the loan-to-value ratio (LTV) for the first house with housing space totaling more than 90 square meters, the loan-to-value ratio (LTV) for the second house, the capital adequacy ratio (CAR), the liquidity ratio (LR). As for the macroeconomic control variables, following the literature, they are the provincial GDP index, the provincial CPI, the provincial fixed-asset investment index and the time trend variable.

Besides, there are also two pooled panel model to evaluate whether the impacts of macroprudential policy instruments are different between two markets and three housing types, by adding the dummy variables.

The sample of two markets comparison is the same as panel data used in the fixed-effect model. And the sample of three housing types is quarterly data from 2011 to 2014, which is the short sample. The dependent variables are the provincial newly constructed commercial residential housing price index (classified with three housing space types) and the provincial second-hand housing price index (classified with three housing space types) and the macroprudential instrument used as the policy variable is only the reserve requirement ratio (RRR).

There are totaling four steps of estimates as follows:

The first step is testing the panel cointegration with Kao test.

The second is running the model one with panel fixed-effects regressions.

The third is running the model two with pooled panel regressions.

The fourth is running the model three with pooled panel regressions.

1.5 Significance of Research

1) The results can present the relationship between different policy instruments and different types of house prices after the regression estimates. And the effectiveness of each macroprudential policy instrument on managing both newly constructed housing market and the second-hand housing market in 30 provinces of China from the implementation till 2014 can be summarized based on the significance.

2) The results can show the different impacts of macroprudential policy instruments on different housing market and different housing types by comparing.

3) The findings of the research could serve for the relevant financial researchers and organizations as the quantitative analysis reference of the effects of macroprudential policies on the house prices management.

3) Lastly, the research could provide the analysis framework and model as reference to those researchers who are eager to further study the effectiveness of macroprudential policies in China.

1.6 Limitations

1) Due to the vast land of China, it is difficult to collect and update the up-to-date data from all regions. Some of variables in the model have missing values for two or three periods.

2) In China, the implementation of the macroprudential policies has just started and all of processing were learning by doing. Most Chinses researches were still stay on theoretical analysis. However, there were many cases of foreign country, which could be draw lessons from them.

CHAPTER 2
CHINESE HOUSING MARKET

2.1 Detail of Chinese Housing Market Reform

Since 1978, under Deng Xiaoping's lead, China embraced "The Economic Reform", which is the first open economic trading principle that The People's Republic of China adopted since its foundation. From this pivotal decision, China has shaken off its label of "Sick Man of East Asia", and officially developed its "Socialism with Chinese Characteristics" market economy, hence stepped into the period of high-speed economic development. Now after 30 years, China has a successfully rural economic reforms as well as urban economic reforms, achieved its transition from a planned economy to a market economy. Now, a socialist market economy with Chinese characteristics is formed.

From many reforms, real estate is undoubtedly China's biggest success. At the beginning of its foundation, there was not a real estate market in China, no private property ownership, selling or renting was not allowed. The government distributed the country's housing resources. This rule led to lack of housing availability, and could not meet the demand. However, from September 1978, for the first time, Deng Xiaoping allowed private housing development. In June 1980, the government published a notice, to allow "private property development, private property trading and private ownership", this rule signified the start of China's real estate reform. January 1988, The State Council announced, the real estate is to start nationwide, to achieve a commercial status, and also to encourage residents making purchases. Unfortunately, two years later after that, China experienced a continual inflation, which forced the form to terminate. Until 1996 the Chinese government re-established the crucial position of the property market in the economic growth. After that, Chinese government released notice every year to control housing market and real estate reform till now.

2.2 Characteristics of Chinese Housing Market

1) Investments

After the reform and opening-up, China enjoyed a rapid development, yet the steady growth of GDP heavily relied on exports and investments, also the cheap labor and primary goods. In 2011, for instance, China's export-to-GDP ratio was 26.1% and investment amounted to 48.2% (Wang and Sun 2013), which got the highest proportion among G-20 economies (Figure 1).

Figure 1. The Investment-to-GDP Ratio in G-20 Economies (In percent, 2011)
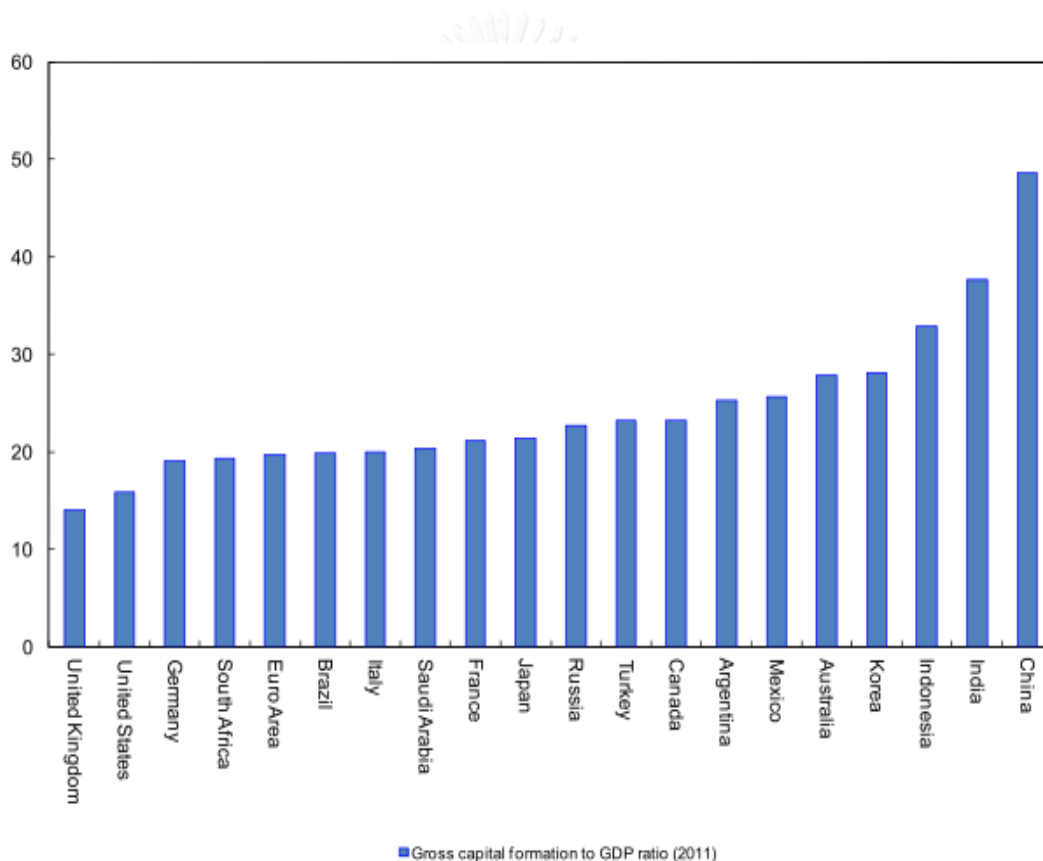
Source: International Financial Statistics, Wang and Sun (2013).

In the real estate sector, investments take a high proportion as well. From the year of 2000 to 2013, the investment-to-GDP ratio had a year-by-year increase in both real estate investment and residential real estate investment. It reached up to 15.1% in real estate investment in 2013, in comparison to only 4.9% 13 years ago. As for the

residential real estate investment, the ratio rose up from 3.3% in 2000 to 10.3% in 2013, three times more than 10 years ago (Figure 2).

Figure 2. Real Estate Investment-to-GDP in China (In percent)
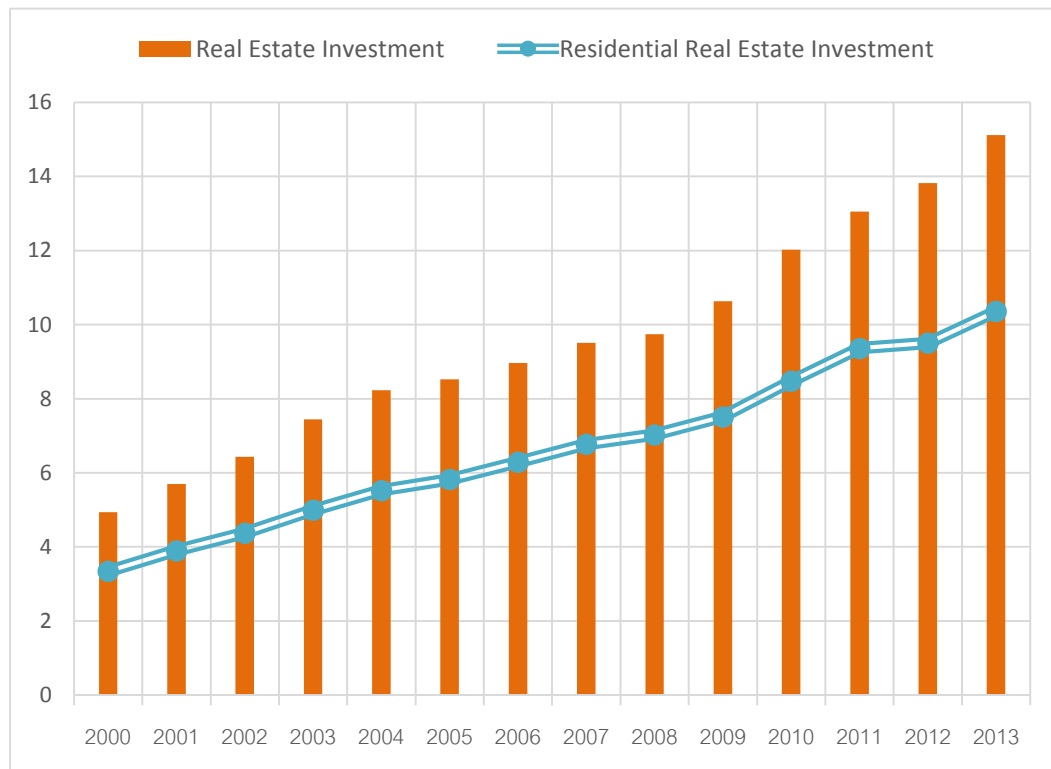
Source: National Bureau of Statistics.

   2) Loans

Real estate is a pillar industry of China. Real estate loan are equally important in promoting the housing consumption and investment as well as reflecting the financial stability. In the first quarter of 2014, real estate loan was nearly 30% of GDP, meanwhile more than 20% of the total loans (Figure 3). Since the real estate loan in China owns a huge proportion and it maintains the healthy and stable development of the financial system, the failure of appropriate managing will cause serious consequences.

Figure 3. Real Estate Loan Growth (In percentage points, year-on-year)
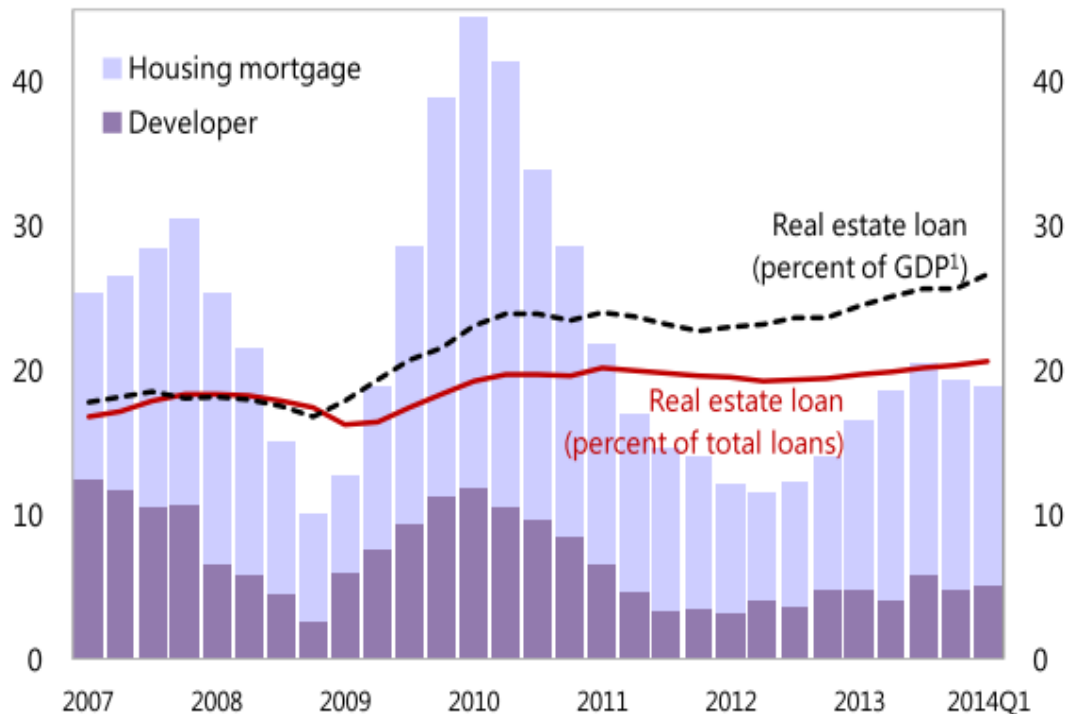
Source: Source: CEIC Data Company Ltd.; Haver Analytics; Housing Administration Bureau; and IMF (2014).

In real estate loans, it is worth mentioning that the housing mortgage loans, keeping an uptrend since 2005. The individual residential housing mortgage loans doubled in the past five years (Figure 4). For developers, the investment in property development is much more than that investment in land and social security houses development, and the loans of property development increased more than two times in only four years. However, the loans for land and social security houses remain relatively stable with slowly growth. It signified that, in recent years, developers constantly increased the investments and developments to meet the housing market demand, which led to a sharp increase in loans accordingly (Figure 5).

Figure 4. Loan of Real Estate Housing Mortgage

Unit: RMB tn

Real Estate Housing Mortgage

Real Estate Housing Mortgage: Individual: Residential
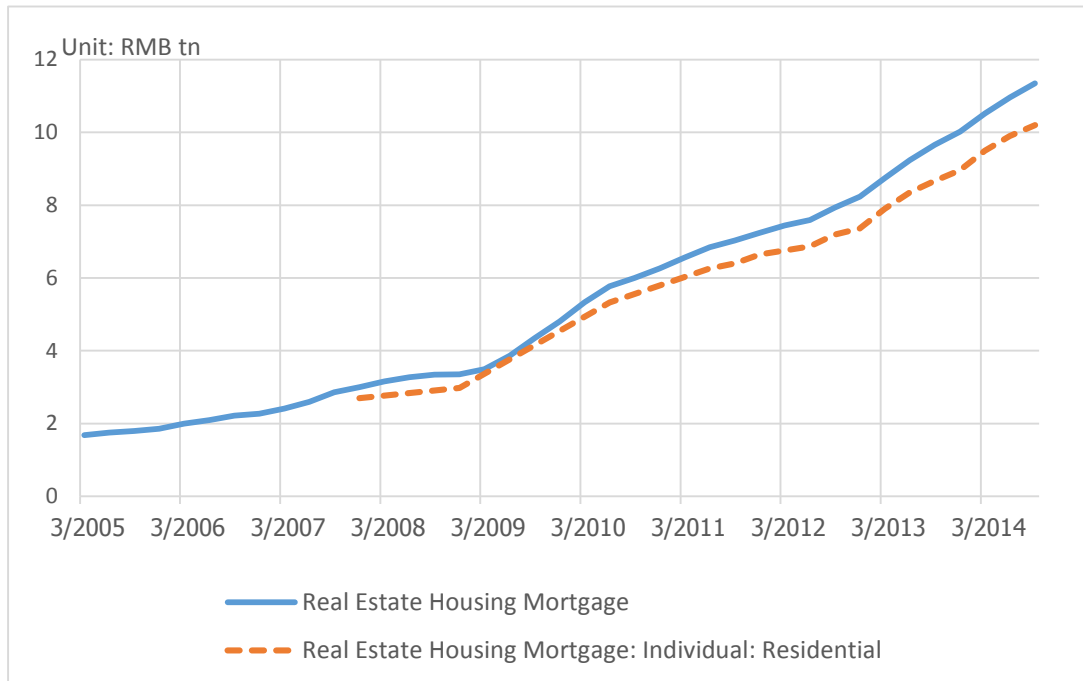
Source: CEIC.

Figure 5. Loan of Real Estate Development

Unit RMB tn

Land — Property — Social Security House
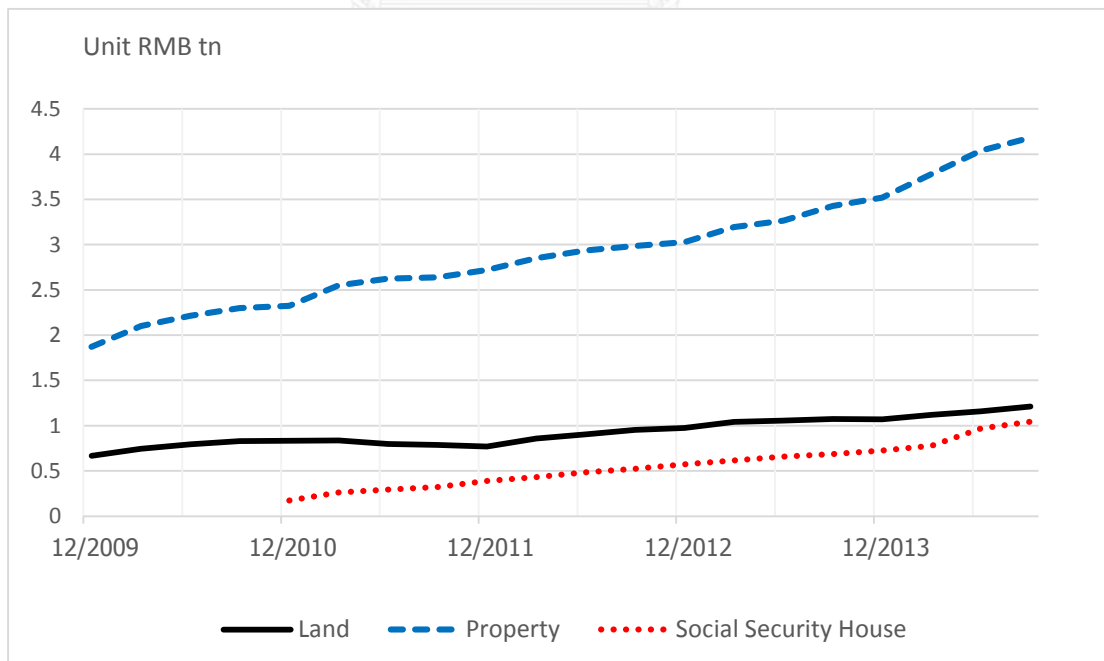
Source: CEIC.

3) Taxes

The rise of housing costs may make the housing prices go up. And land tax is a non-negligible part of the housing cost. For a majority of provinces, the land-related tax is an important part of the government revenue. Land-related tax revenue had a median level at 20% in total tax revenue for the local governments in 2012. In such provinces or cities as Jiangsu and Tianjin, the ratio went up to even 50-60%, while that in provinces or cities of Beijing, Chongqing, Tibet kept relatively low, merely 10% (Figure 6). Thus, if the government fails to lower taxes, housing costs could not be reduced. Thus, it might make the prices remain high.

Figure 6. Land-related Tax Revenue in Local Governments (In percent of provincial tax revenue before central government transfers in 2012)
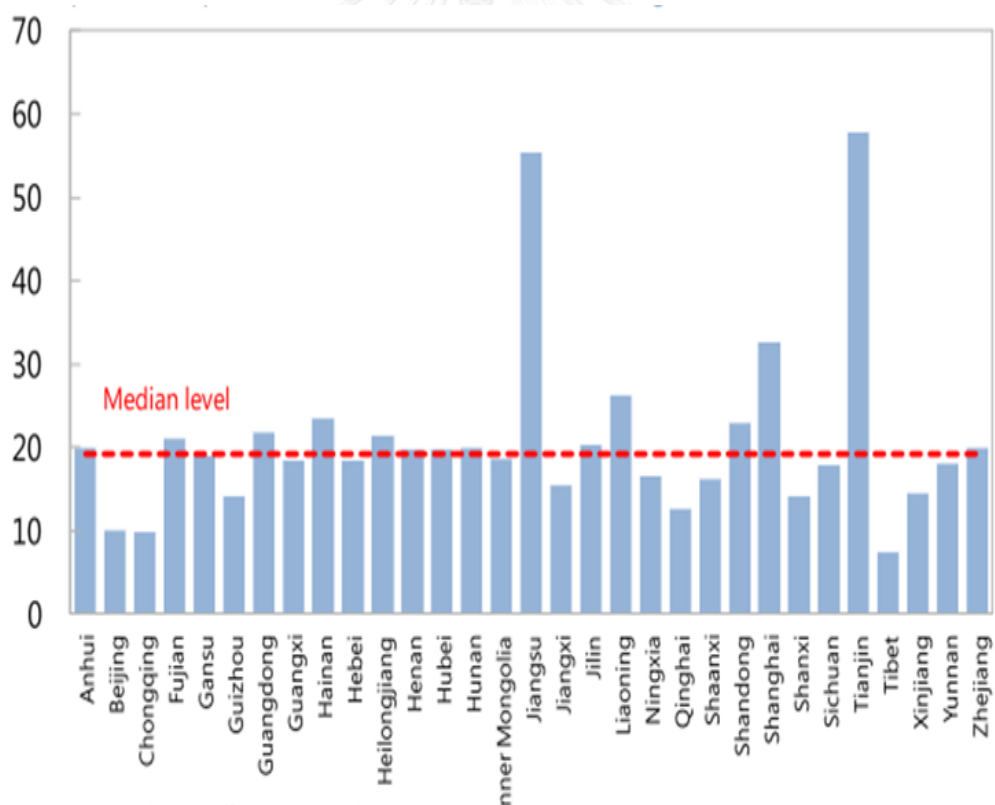
Source: CEIC; and IMF (2014) staff estimates and calculations.

4) Regional differences over the vast country

China covers a land area of thirty-six thousand square kilometers, with a large population of 1.3 billion people distributing in more than 30 provinces, direct-controlled municipalities and special administrative regions. Each province has a different city composition. Geographical factors, natural factors and historical factors all lead to the differences in population, economy and culture in different regions. Such as GDP, in 2013, among the 32 major provinces and cities, in such provinces as Guangdong and Jiangsu, it reached up to six thousands billion RMB, but Sichuan and Shanghai only gained half, between two thousands and three thousands billion RMB. The regions of Xinjiang and Tibet whose GDP was lower than one thousand billion RMB, almost one sixth of that in Guangdong (Figure 7).

Figure 7. Differences in Gross Domestic Product at Province Level (RMB bn, 2013/12, annual average)
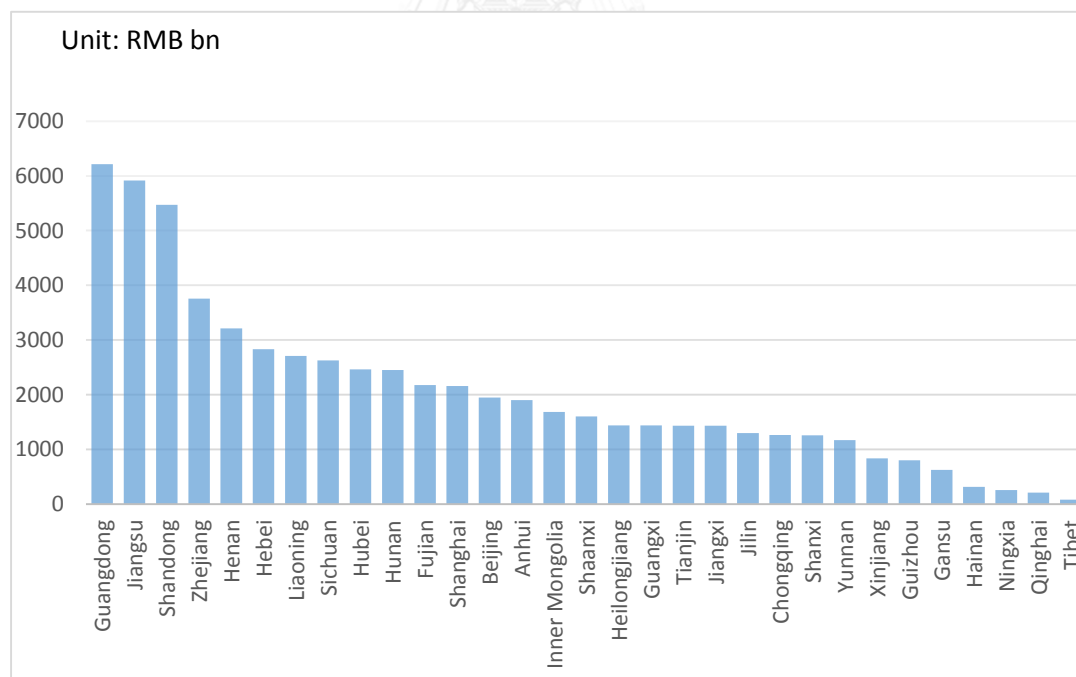
Sources: CEIC.

5) House Prices

Since the State Council officially launched the housing reform in 1998, the Chinese residence-based real estate market has started to boom. The speedy expansion of housing construction and housing consumption, as the essential and key elements, have played a crucial role in stimulating economic growth and improving people's living standard. However, it should also be taken notice of the current unbalanced development of China's real estate market combining with the regional differences. It would bring problem of the imbalance between housing supply and demand in some areas, mainly shown as the excessively fast growth of real estate prices and investments. Figure 8 demonstrates the average selling price of commercial residential houses in the 35 large and medium cities nationwide from 1999 to 2013, by unit of thousand RMB (Yuan) per square meter. These cities are divided into three regions and two tiers in accordance with the city development and geographical distribution areas, called the first-tier cities of east region, the second-tier cities of east region and the second-tier cities of west region. As is presented, first-tier cities, such as Beijing and Shenzhen, enjoyed a higher level than any other cities, and the house prices there increased rapidly in periods between 2006-2007, 2008-2010 and 2012-2013. In contrast, the other two lines of second-tier cities were relatively close to the national level (the dotted line). The growth in central and west region was more stable than the east. After 2006, the house prices of first-tier cities increased almost 2.6 times, while the other second-tier cities grew only by 2.25 times and 2.2 times, respectively.

6) Newly constructed housing market and second-hand housing market

While the house price is the important indicator of national economy, it worth to analyze the housing market more detailed. In general, there are two types of housing market in the real economy, which is newly constructed housing market and second-hand housing market. And demand of consumers can be divided into three types,

Figure 8.Commercial Residential Building Selling Price of 35 Cities Average
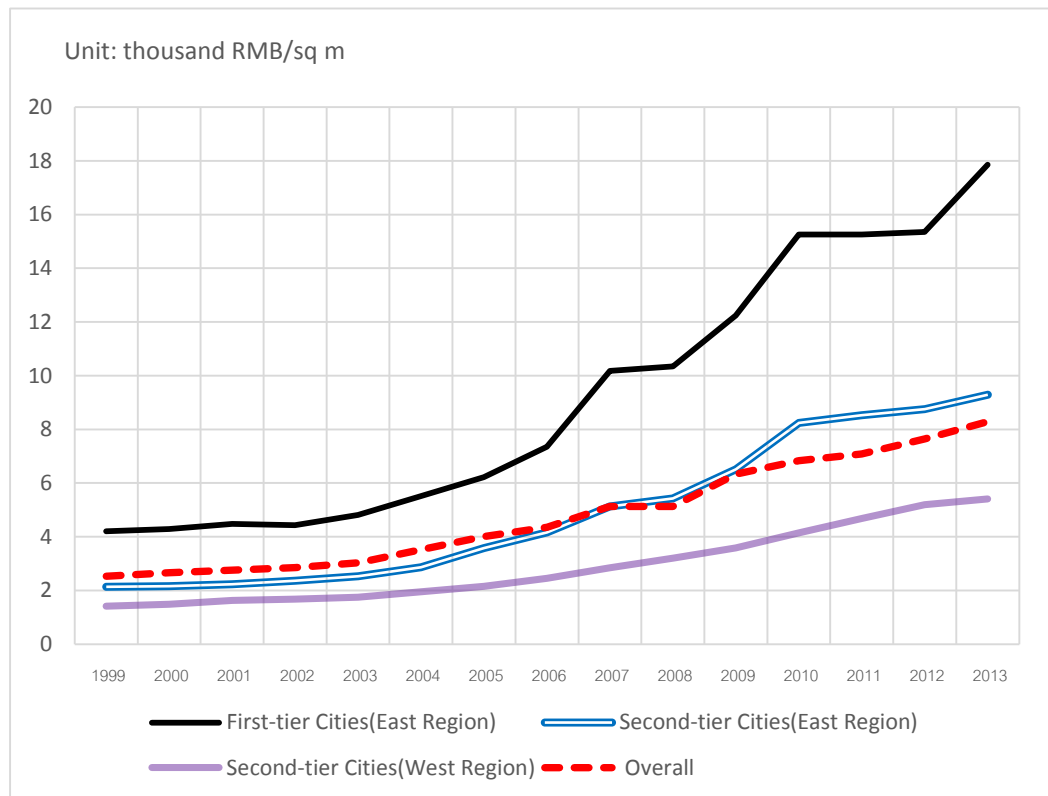
Source: CEIC.

purchasing newly constructed houses, purchasing second-hand houses and renting second-hand houses.

However, different cities or provinces get different demand of these two type houses due to the distinct level of economy development and purchasing power. And since the development of country, the more urbanization and the more amount of working-class people willing to have his own residence, the demand of house is increase continually, with the supply of land and house is limited when comparing with numbers of people, the price is increase. It can be shown in both Figure 8 above and Figure 9-10 below. The difference is Figure 8 shows the total house price which includes all housing markets. But the Figure 9 and Figure 10 shows the price of both newly constructed house and second-hand house, respectively, and the four cities chosen here represent the differ of regions. When comparing two markets, different cities represent the different level. It

can be found that the first-tier cities, such as Beijing and Shenzhen, house price index rose from around 1000 to 4000 points in newly constructed housing market and grew from about 1000 to more than 6000 points in second-hand housing market. In contrast, the second-tier cities, such as Hangzhou, house price index rose about 2000 points in newly constructed housing market and grew about 4000 points in second-hand housing market. And the third-tier cities, such as Chengdu, house price index rose only 1000 points and 2000 points in newly constructed housing market and second-hand housing market, respectively.

As the whole, Figure 9 and Figure 10 show that the price of both newly constructed house and second-hand house are uptrend in recent 10 year. And the data shows that the price of second-hand house increases faster and higher than newly constructed house in average. The reason of this phenomenon might be that most of consumers are looking for the houses with convenient location, which are near by the subway stations, offices or shopping centers, but most of them are constructed for years. Second, consumers don't need to worry about the building quality problem after used for years. Third, since the limitation of good and central locations, most of the newly constructed houses are located far away from the central of city or sometimes located in the different provinces, which make the cost of trip go up. At the same time, several new projects use the promotion to attract consumer, which makes the price much lower.

Therefore, due to the difference between these two markets, it will be better to evaluate the effects of macroprudential policy on two markets at the same time, separately, rather than investigate the whole market in average.

Figure 9. The Price Trend of Newly Constructed Housing Market Index

— Beijing — Shenzhen — Hangzhou — Chengdu
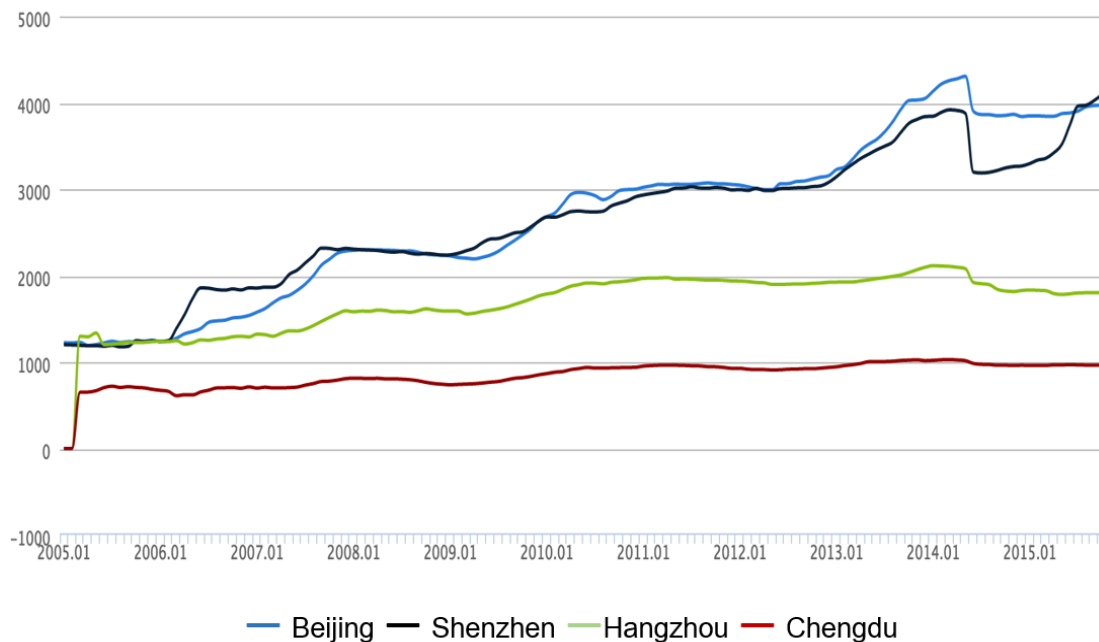
Source: China Real Estate Index System.

Figure 10. The Price Trend of Second-hand Housing Market Index

— Beijing — Shenzhen — Hangzhou — Chengdu
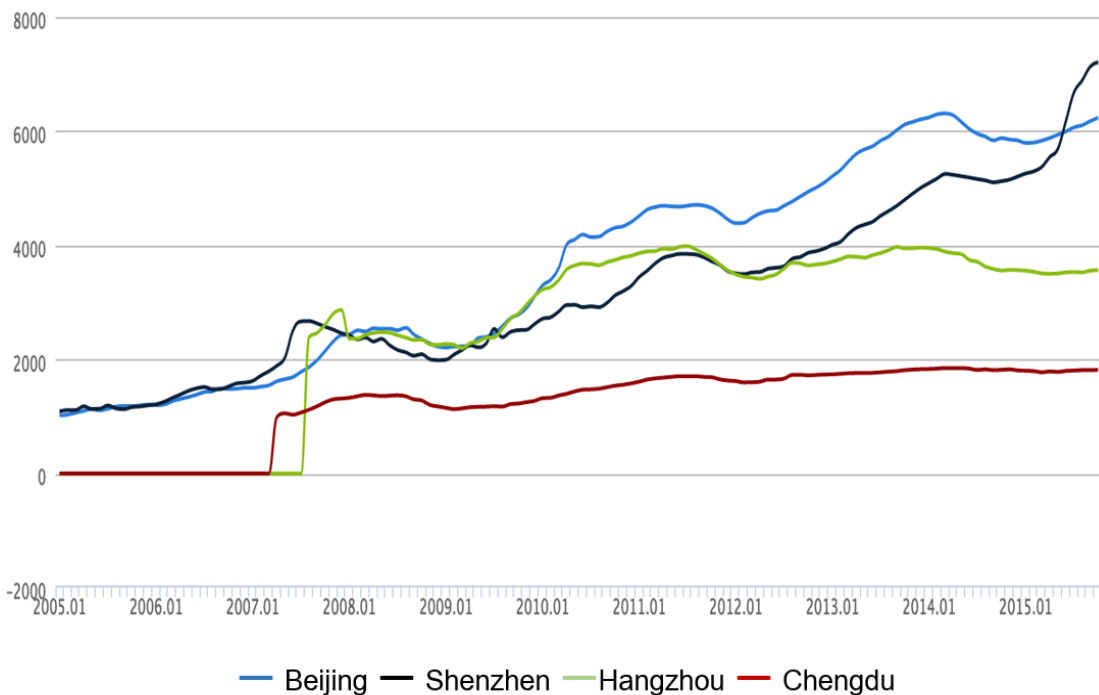
Source: China Real Estate Index System.

CHAPTER 3

MACROPRUDENTIAL POLICY

3.1 The Concept of Macroprudential Policy

The word "macroprudential" appeared first time in the minutes of a meeting of the Cooke Committee 1979. Later on 1986, BIS formally presented this concept in a formally document, defining that "macroprudential regulation can help remain safety and stability of financial system and payment mechanism". With financial crisis frequent outbreaks, the importance of macroprudential is being emphasized by countries. However, there is still no exact definition of macroprudential. But its objective is very clear and definite that "Macroprudential policy is a complement to microprudential policy and it interacts with other types of public policy that have an impact on systemic financial stability" (Brockmeijer et al., 2011) and have directly impacts on systemic financial stability. Borio (2009) explained that the distinctions between macroprudential and mincroprudential policy are their objective (Table 1). The macroprudential policy can defuse systematic risk at time demission and cross section demission by using different policy instruments to keep financial system stable (Basel Committee On Banking, 2011; England, 2011; Lim et al., 2011; Wang & Sun, 2013). The microprudential policy can limit the risk of individual institutions and avoid the implication to consumers.

Table 1. Macro- and microprudential perspectives compared

	Macroprudential	Microprudential
Proximate Objective	Limit financial system-wide distress	Limit distress of individual institutions
Ultimate Objective	Avoid macroeconomic costs linked to financial instability	Consumer (investor/depositor) protection
Characterization of Risk	"endogenous" (dependent on collective behavior)	"exogenous" (independent of individual agents' behavior)
Correlations and common exposures across institutions	Important	Irrelevant

Calibration of Prudential Controls	In terms of system-wide risk; top-down	In terms of risks of individual institutions; bottom-up

Source: Borio (2009), Galati and Moessner (2012).

The main tools of macroprudential policy can be classified roughly by various objectives. The first classification aims at time demission and cross section demission, at the same time, the other one is according to aims of policy, that capital-related, credit-related, liquidity-related instruments and structural (Table 2).

Table 2. Macroprudential instruments

	Tools to address threats from excessive credit expansion	Tools to address structural vulnerabilities and key amplification mechanisms of systemic risk
Capital-related	Time-varying/countercyclical capital requirements or risk weights	Additional loss absorbency related to systemic importance
	Time-varying/dynamic provisions	Levy on non-core funding
Credit-related	Ceilings on credit or credit growth	Limits on counterparty concentration risk
	Time-varying caps on loan-to-value (LTV) or debt service-to-income (DTI) ratios	
	Dynamic haircut-setting and margining	
Liquidity-related	Minimum reserve requirements	Caps on foreign currency lending
	Time-varying minimum margin requirements	Limits on net open currency positions or mismatches
		Limits on maturity mismatches
Structural		Resolution requirements for SIFIs
		Disclosure policy for markets and institutions targeting systemic risk

Sources: IMF, FSB, and BIS (2011), Lim et al. (2011), Weistroffer (2012), DB Research.

The detail conceptual basis for most of the macroprudential instruments in Table 2 is shown in Table 3 (Lim et al., 2011). They are caps on the LTV and the DTI, caps on foreign currency lending, ceilings on credit or credit growth, limits on net open currency positions/currency mismatch, limits on maturity mismatch, reserve requirements, countercyclical capital requirement, time-varying/ Dynamic provisioning and restrictions on profit distribution.

Table 3. The conceptual basis for macroprudential instruments

Instruments	Conceptual Basis
Caps on the LTV .	The LTV imposes a down payment constraint on households' capacity to borrow. In theory, the constraint limits the procyclicality of collateralized lending since housing prices and households' capacity to borrow based on the collateralized value of the house interact in a procyclical manner. Set at an appropriate level, the LTV addresses systemic risk whether or not it is frequently adjusted. However, the adjustment of the LTV makes it a more potent counter-cyclical policy instrument.
Caps on the DTI	The DTI represents prudential regulation aimed at ensuring banks' asset quality when used alone. When used in conjunction with the LTV, however, the DTI can help further dampen the cyclicality of collateralized lending by adding another constraint on households' capacity to borrow. Like in the LTV, adjustments in the DTI can be made in a counter-cyclical manner to address the time dimension of systemic risk.
Caps on foreign currency lending	Loans in foreign currency expose the un-hedged borrower to foreign exchange risks which, in turn, subject the lender to credit risks. The risks can become systemic if the common exposure is large. Caps (or higher risk weights, deposit requirements, etc.) on foreign currency lending may be used to address this foreign-exchange-induced systemic risk.
Ceilings on credit or credit growth	A ceiling may be imposed on either total bank lending or credit to a specific sector. The ceiling on aggregate credit or credit growth may be used to dampen the credit/asset price cycle—the time dimension of systemic risk. The ceiling on credit to a specific sector, such as real estate, may be used to contain a specific type of asset price inflation or limit common exposure to a specific risk—the cross-sectional dimension of systemic risk.

Limits on net open currency positions/currency mismatch	Such prudential regulation tools limit banks' common exposure to foreign currency risks. In addition, the limits may be used to address an externality—sharp exchange rate fluctuations caused by a convergence of purchases/sales of foreign exchange by banks. This externality increases the credit risk of un-hedged borrowers with heavy foreign currency debt.
Limits on maturity mismatch	These prudential regulation tools may be used to address systemic risk since the choice of asset/liability maturity creates an externality—fire sales of assets. In a crisis, the inability of a financial institution to meet its short-term obligations due to maturity mismatches may force it to liquidate assets, thus imposing a fire sale cost on the rest of the financial system. The funding shortages of a few institutions could also result in a systemic liquidity crisis due to the contagion effect.
Reserve requirements	This monetary policy tool may be used to address systemic risk in two senses. First, the reserve requirement has a direct impact on credit growth, so it may be used to dampen the credit/asset price cycle—the time dimension of systemic risk; second, the required reserves provide a liquidity cushion that may be used to alleviate a systemic liquidity crunch when the situation warrants.
Countercyclical capital requirement	The requirement can take the form of a ratio or risk weights raised during an upturn as a restraint on credit expansion and reduced during a downturn to provide a cushion so that banks do not reduce assets to meet the capital requirement. A permanent capital buffer, which is built up during an upturn and deleted during a downturn, serves the same purpose. Both can address the cyclicality in risk weights under Basel II based on external ratings that are procyclical.
Time-varying/ Dynamic provisioning	Traditional dynamic provisioning is calibrated on historical bank-specific losses, but it can also be used to dampen the cyclicality in the financial system. The provisioning requirement can be raised during an upturn to build a buffer and limit credit expansion and lowered during a downturn to support bank lending. It may be adjusted either according to a fixed formula or at the discretion of the policymaker to affect banks' lending behavior in a counter-cyclical manner.

Restrictions on profit distribution	These prudential regulation requirements are intended to ensure the capital adequacy of banks. Since undistributed profits are added to bank capital, the restrictions tend to have a counter-cyclical effect on bank lending if used in a downturn. The capital conservation buffer of Basel III has a similar role.

Source: Lim et al. (2011).

3.2 The Use of Macroprudential Policy Instruments in Asia

In the century of financial crisis frequent burst, real estate sector will lead national economy, and will be the necessity goods of people as well. Then it seems to be very serious to control and manage real estate market.

However, because of the difference of national conditions, these instruments are not necessary to be used together. According to disparate objectives, national government or policy maker need to select instrument combinations suitable. Housing-related measures, credit measures and reserve requirement, for example, are very different between Asia, Latin America, Middle East and Africa, CEE/CIS, Advanced Europe and North America (Figure 11). Among all of regions, the greatest number of macroprudential instruments are used in Asia, especially housing-related measures, since that Asia has more developing countries or emerging markets than other continents. It matches with Lim et al. (2011), who pointed out that use of the macroprudential instruments was more widely and frequent in most of the emerging countries rather than the developed countries. In general, for Asian region, loan-to-value ratio (LTV) is the major housing related measures and reserve requirement ratio (RRR) is major credit measures and reserve requirements (Lim et al., 2011; Zhang & Zoli, 2014). Asian countries, such as China, Hong Kong, Korea, Malaysia, Singapore and Thailand, use loan-to-value ratio (LTV) as key instrument. As for reserve requirement ratio (RRR), commonly, it is used as the key tool of monetary policy. However, when implemented the macroprudential policy system, the reserve requirement ratio (RRR) was also used as the main macroprudential instrument in some of countries as well, such as China, Korea and Malaysia.

Figure 11. Use of Macroprudential Policy Instruments Across Regions

Housing Related Measures
(Average number of tightening and loosening actions by country in each region)

- Asia
- Latin America
- Middle East and Africa
- CEE/CIS
- Advanced Europe and North America

Loan-to-value ratio | Debt-to-income ratio | Risk weights on mortgages | Other housing measures[1]

[1] Include provisions on housing loan requirements, housing/land related taxation, limits on adjustable rates component of mortgages.

Credit Measures and Reserve Requirements
(Average number of tightening and loosening actions by country in each region)

Consumer loans[1] measures | Credit limits | Reserve requirements on local currency deposits

[1] Include regulations and debt service limits on credit cards and personal loans.

Source: IMF, Zhang and Zoli (2014).

3.3 The Use of Macroprudential Policy Instruments in China

The monetary policy committee of China's central bank issued the monetary policy report of the third quarter 2009, presenting that "Macroprudential regulatory and supervisory framework will be classified into the macro-control policy" for the first time. The regular meeting of committee, held subsequently at the fourth quarter of 2009, explicit stated that macroprudential regulation should be established to prevent and reduce potential financial risks effectively. Under these conditions, macroprudential regulation had been formally incorporated into the central bank's agenda. Following statements, China's Twelfth Five-Year Plan [1] clearly stated that the major goal in the period between 2011 and 2015 would be to build counter-cyclical macroprudential financial

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[1] The five-year plans of China are a group of social and economic development plans. The Twelfth Five-Year Plan was debated at the 17th Central Committee of the Communist Party of China on October 2010.

management framework. At present, China is trying to establish a complementary mechanism with macroprudential and micro-prudential supervision. The government authorized the Central Bank and China Banking Regulatory Commission to improve the relevant management tools with the existing monetary policy, fiscal policy and tax policy, to undertake the co-management and coordination of the country's financial system together.

The macroprudential policy instruments, used and authorized by Chinese government, are shown in the Table 4.

Table 4. China's Macroprudential Policy Instruments

Instruments	Authorities
Time-dimension risks	
Dynamic adjustment of the differentiated reserve requirement ratio	People's Bank of China
Dynamic LTV requirement for first homes and second homes	People's Bank of China; China Banking Regulatory Commission
Dynamic provisioning requirement	China Banking Regulatory Commission
Countercyclical capital buffer	People's Bank of China; China Banking Regulatory Commission
Cross-sectional dimension	
Capital surcharge for SIFIs	People's Bank of China; China Banking Regulatory Commission
Capital conservation buffer	China Banking Regulatory Commission
Leverage ratio requirement	China Banking Regulatory Commission
Liquidity surcharge	China Banking Regulatory Commission
Enhancing supervision for SIFIs	China Banking Regulatory Commission
Early warning system	People's Bank of China; China Banking Regulatory Commission

Source: China Monetary Policy Report (2011 Q4), Liao (2012).

In the housing market, the two main instruments China in macroprudential policy are reserve requirement ratio (RRR) and loan-to-value ratio (LTV), which also serve as the two most commonly used indicators in housing related measures and credit related measures in Asia.

As usual, the reserve requirement ratio (RRR) is used as the main instrument of monetary policy. However, it also used as macroprudential policy to keep macroeconomic stabilization in recent years. Federico, Vegh, and Vuletin (2014) analyzed that whether reserve requirement policy substitutes or complements monetary policy. It was found that more than 50 percent of developing countries used reserve requirment as a macroeconomic instrument. But reserve requirement substituted monetary policy as a countercyclical tool in most developing countries. By analogy with Ma, Xiandong, and Xi (2013) found that "China's reserve requirement system has also become more complex and been used to address a range of other policy objectives, not least being macroeconomic management, financial stability and credit policy".

Following the literature review on research of IMF, Wang and Sun (2013) summarized the definitions of the "dynamic adjustment of the differentiated reserve requirement" in Table 5, which was developed by the People's Bank of China (PBOC) from reserve requirement ratio (RRR). Wang and Sun (2013) explained that:

"*Differentiated reserve requirement: Taking the RRR as a traditional instrument of monetary policy, the PBC launched the "differentiated reserve requirement" in 2004 to inhibit the expansion of loans by financial institutions with a low CAR and the deterioration of asset quality. The purpose was to reduce credit within the financial system by decreasing the amount of loans and increasing the reserves of those banks with a CAR of less than 4 percent.*

Dynamic adjustments to the differentiated reserve requirement: In 2011, the PBC dynamically adjusted the differentiated reserve requirement on a continuous

and case- by-case basis to enhance macroprudential regulation in response to the credit risk."

Figure 12 indicates the Reserve Requirement Ratio change in China in the last decade. According to the data available in the National Bureau of Statistics, the starting value of reserve requirement ratio (RRR) used to be 7, recorded in the report of September 21th 2003, and the value increased by twenty times for a total of 105 basis points in both large and small banks until September 25th 2008. But after 2008, the Central Bank made a different requirement for the points adjusted in large banks and small banks, and furthermore started a reduction on the reserve requirement ratio (RRR) for the first time, which maintained until 2010. And the adjustments in 2010 and 2011 were particularly frequent and volatile, yet very few in the period between 2012 and 2014.

Table 5 shows the Loan-to-value Ratio condition in China. In order to better control house prices, the Central Bank of China used the different loan-to-value ratio (LTV) for first home and second home, respectively, and made an adjustment separately in 2006-2014.

In addition to the two most important indicators mentioned above, the data of Capital Adequacy Ratio (CAR), Liquidity Ratio will be applied to the regression analysis as well, functioning as equally important macroprudential tools.

Figure 12. Reserve Requirements Ratio (RRR) in China
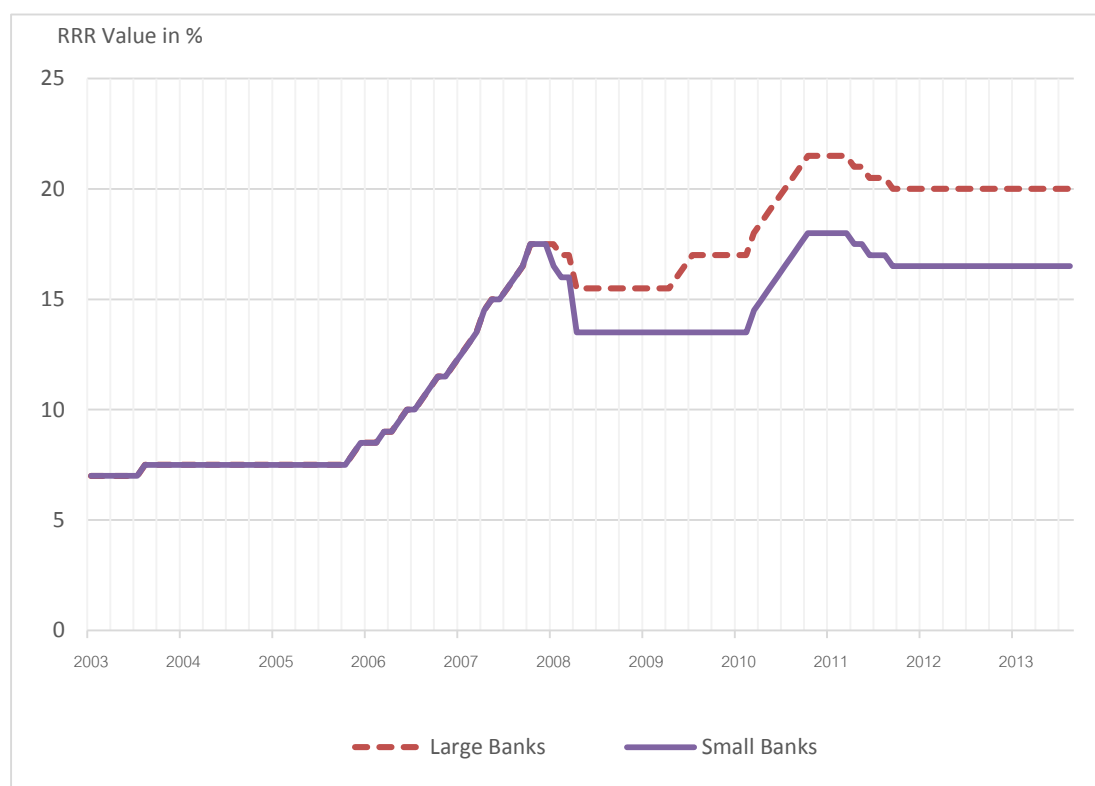
Source: PBOC.

Table 5. Loan-to-value ratio (LTV) in Real Estate Sector of China

Year		First Home		Second Home
		<90 square meters	>90 square meters	
2006		80	70	60
2007		80	70	60
2008		80	80	60
2009		80	80	60
2010	Before 9/30	80	70	50
	After 9/30	70	70	50
2011		70	70	40
2012		70	70	40
2013		70	70	40
2014		70	70	40

Source: China Monetary Policy Report (2011 Q4), Liao (2012) and Chinese government notices.

CHAPTER 4

LITERATURE REVIEW

4.1 House price boom

An asset price boom is a positive deviation of an aggregate asset price indicator, such as equity, private and commercial real estate prices with the different weights in the national economy, which would deviate from its benchmark trend at least 10 percent (Detken & Smets, 2004).

The features of an asset price boom are that both equity and real estate prices rise strongly and fast during the period of boom and then crash after that. Real GDP growth is quickly and constant during the boom, but is followed by a lower growth. Following the definition of Alessi and Detken (2009), a "costly" asset-price boom is usually followed by a three-year period that the real GDP growth will lower than potential growth at least 3 percent. The cause of this result is that during the boom period, real GDP growth is mainly driven by housing-related investment and loans with looser monetary policy.

However, not all the asset price booms would lead to a crash and not all busts would bring a financial crisis (Detken & Smets, 2004). It still will be very dangerous that if government do nothing but watch it boom. Therefore, it appears macroprudential regulations that can address systematic risk in both time dimension and cross section dimension. According to Landau (2009), macroprudential regulations even have an objective that sometimes macroprudential policies are assigned to avoid asset price bubbles. It seems that macroprudential instruments are used more in managing housing market than stock market.

4.2 Relevant research

After macroprudential policies formally proposed and widely used in various Western countries, the effects of implementation and the role of the

macroprudential policies attracted international researchers' attention, who made many researches and papers to analyze these relationship.

Most of them are empirical studies that try to identify the effectiveness of macroprudential policies in reducing systemic risk and the relevant macroeconomic variables (i.e., housing prices growth, loan growth, and real credit growth). Overall, a number of this empirical literature investigates the impact of major individual macroprudential instruments in different regions at the same period. Lim et al. (2011) use the fixed-effect dynamic panel regression with GMM estimator and data covering 49 countries during 2000-2010. The analysis shows that many instruments are effective in reducing systemic risk. Vandenbussche, Vogel, and Detragiache (2012) investigate whether the key macroprudential policy instruments have usefulness on reducing housing price inflation in 16 countries of CESEE from late 1990's to end-2010 by using error correction model with fixed effects estimator. The finding of this paper suggests that some tools do have a strong impact, such as CAR and Non-standard liquidity measures.

Furthermore, Asian economies appear to use macroprudential policy extensively much more than the other regions, especially housing-related measures are most effective in sustaining the housing price growth and housing market risk. Zhang and Zoli (2014) review the use of key macroprudential policy and capital flow measures in Asia and investigate how these measures affect the relevant macroeconomic variable(i.e., real credit growth, real housing prices growth, and capital inflows). The data used in fixed-effect dynamic panel regressions covers 46 countries all over the world from 2000Q1 to 2013Q1. GMM can help estimate the whole sample and the sample of only 13 Asian economies. The results show that macroprudential policy tools and capital flow measures can help curb housing price inflation, equity flows and credit growth, particularly the LTV ratio and housing tax which are the housing-related measures. He and Krishnamurthy (2015) review the evidence from Hong Kong that conduct LTV as a main macroprudential policy and attempts to find out whether the policies have effect on housing market risk. In the empirical work, this paper uses VAR model to evaluate the short- run impact. The

results suggest that LTV ratio have significantly impact in constraining household leverage, but do not have effectiveness on sustaining housing price. Furthermore, the effect on loan growth is also dependent on the situation. But the transaction tax seems to be effective in restraining housing price. HKMA (2010) the Hong Kong Monetary Authority also use the fixed-effects model to evaluate the effectiveness of LTV policy by using unbalanced quarterly panel data for 13 economies from Q1 1991 to Q2 2010. The model estimates using the generalized least squares (GLS) instead of OLS. The paper suggests that LTV policy is effective in reducing systemic risk regarding the housing market cycles.

However, the researches on macroprudential policies in China are still very limited, especially, the empirical analysis and the use conditions.

As for empirical literatures of China, Wang and Sun (2013) examine the effectiveness of macroprudential policies in controlling the loan growth and housing prices by panel fixed-effect models, using a sample of 171 banks and 31 provinces during 2000-2011. The results show that the RRR and housing-related policies are useful. But the policies adopted now cannot guarantee curb the current systemic risk. The suggestion given by this paper is making targeted macroprudential policies according to different regions and levels. Liang, Zhao, Tian, and Luo (2014) discuss the dynamic changes in macroeconomic variables under the dynamic loan-to-value ratio instrument by using a dynamic stochastic general equilibrium framework. The conclusions suggest that macroprudential policy has no effects on the target of monetary policy, and it can help sustain the economic stability that combining macroprudential policy and monetary policy.

Then, there are a few theoretical analysis researches on macroprudential policies in China. But most of them emphasize the introduction in origin, characters and development of macroprudential policy in foreign countries (X. Zhu, 2009). Further, these researches focus on the carefully using of macroprudential policy based on China's economic in recent years. Ba, Wang, and Du (2010) suggest that macroprudential supervision in China should pay more attention to the non-performing loan and housing

market bubble problems. Wang and Sun (2013) review the use of macroprudential policies in China, which point out that there are both time dimension risk and cross-sectional risk in financial system. The paper also summarizes the history and step of using macroprudential policies in China.

In fact, the study of housing market in China, instead, there are many papers research the housing bubble appearing in China. Two approaches can be broadly used. One investigates the existence of bubble by using indicators, such as price-to-income ratio, housing vacancy rate, growth rate of housing price, growth rate of GDP etc. (Lv, 2010). Hou (2010) examines whether there exist housing price bubble in Beijing and Shanghai, the two largest cities in China, by using different quantitative indicators. The paper compares the market price with its rational expectation price by using a simple present value model during 2000-2007. The control chart is used as another indicator by setting upper and lower control line of PCGDP during 1992-2008 for Beijing and 1996-2008 for Shanghai. Besides, price to income ratio and price to rent ratio are including. The results show that Beijing appears to have a housing bubble between 2005 and 2008 and has obvious housing market cycle. However, Shanghai perhaps has a housing bubble from 2003 to 2004. The second focuses on modeling the fundamental price to compare gap between real market price and fundamental price with a under and upper control line (Gao, Wang, & Li, 2012; Noguchi, 1989). Ahuja, Cheung, Han, Porter, and Zhang (2010) use a dynamic OLS model to estimate the long-run fundamental price, which bases on the demand- and supply-side factors. The data is a quarterly panel data during 2000Q1–2009Q4 at city level for 35 cities. The result shows that although house prices had sharp increased during 2009, for the whole China, house prices are not overvalued. However, there are significantly overvaluations in some large cities. Furthermore, the paper finds that policies unveiled in April 2010 by Chinese government have some impact on sustain the price growth.

CHAPTER 5

METHODOLOGY

5.1 Definition of panel data

A panel data is also known as longitudinal data, which has both a cross-sectional and a time series dimension. Panel data are composed of the observations on the same N entities at two or more time periods T.

$$x_{i,t}, \; i = 1, ..., N, \; t = 1, ...,T.$$

Where the subscript, i, refers to the entity, which has N observations and the subscript, t, represents to the date, which accounted from 1 to T.

5.2 Tests of panel data before regression estimations

Based on the characters of panel, the data used in the model should be tested by panel cointegration test before the regressions estimations.

Kao test is one of the main panel residual-based cointegration test approaches to examine that whether there is the long-run cointegration relationship, which was developed to avoid the spurious regression problem. Whether the data used is stationary or not, if it can be proved that the panel have long-run cointegration relationship, it can be used in the regression. The null hypothesis of Kao test is there is no cointegration in the long-term relationship.

5.3 Panel data analysis model

In general, there are three main model for panel data analysis, they are:

1) Pooled OLS Model

2) The Fixed-effect Model

3) The Random-effect Model

As the models applying to panel data, the fixed-effect and the random-effect model are most common used and basic estimation methods. However, there is still another model for panel data regression, pooled OLS model, which is not widely used as the fixed-effect and the random-effect model. Because the pooled OLS model considers all of the entities as a whole observation, no matter cross-sectional dimension or time series dimension.

The fixed-effect model assumes that each entity gets its own intercept to distinguish each individual. That means the slope coefficients are the same for this entity all over the time series. The fixed-effect model is also known as fixed-effect least squares dummy variable (LSDV). The reason is that a number of dummy variables will be added to every entity.

The random-effect model assume that the each entity effects are captured by the intercept and a random component. This random component is not associated with the regressor on the right-hand side and part of the error term. A random-effect model is estimated by generalized least squares (GLS) when the variance is known and would be estimated by the feasible generalized least squares (FGLS) when the variance is unknown.

In a word, a fixed-effect model assumes that intercepts across groups or time periods are different between N entities, instead a random-effect model explores the differences in error variances.

In statistics, the way to choose whether fixed-effect model or random-effect model is called Hausman Test. The Hausman test compares between the fixed-effect and random-effect, which is under the null hypothesis that the individual effects are uncorrelated with the other regressors in the model (Hausman, 1978). If the results of testing rejects the H0, it means that correlated, representing that a random-effect model produces biased estimators, which violates one of the Gauss-Markov assumptions, so the

fixed-effect model is preferred to use in the estimation. Hausman's essential result is that the covariance of an efficient estimator with its difference from an inefficient estimator is zero (Greene, 2011).

However, when solving the economic problem by using statistics approaches, it more depends on the objective of the research. For instance, while the panel data obviously contains the differences in cross-sections, using random-effect model means the effects would be the same for all cross-sections, an implication that is too restrictive in practice. Instead, the fixed-effect could be a better choice.

5.4 Methodology

This research needed to identify whether the major macroprudential policy instruments are effective in managing newly constructed and second-hand house prices in 30 provinces of China. Following the literature review, in order to investigate how these instruments affect the relevant macroeconomic variables and reduced systemic risk, Lim et al. (2011) and Zhang and Zoli (2014) used fixed-effect dynamic panel regression. Zhang and Zoli (2014) find that macroprudential policy tools can help curb housing price inflation, particularly the LTV ratio and housing tax, which are the housing-related measures. Wang and Sun (2013) used panel fixed-effect models, finding that the RRR and housing-related policies are useful.

1) The model

Model One:

In this part, the main purpose is to evaluate the effects of macroprudential policies on house price management of both newly constructed houses price (overall) and second-hand houses price (overall) in 30 provinces of China by using the model below.

Following the literature reviews, the panel fixed-effect model will be used, which can be defined as:

$$lnNHP_{i,t} = \alpha_i + \beta_0 + \beta_1 MPI_{i,t} + \beta_2 lnNHP_{i,t-1} + \beta_3 lnGDP_{i,t} + \beta_4 lnINF_{i,t}$$
$$+ \beta_5 lnINV_{i,t} + \lambda Time + \varepsilon_{i,t}$$

$$lnSHP_{i,t} = \alpha_i + \beta_0 + \beta_1 MPI_{i,t} + \beta_2 lnSHP_{i,t-1} + \beta_3 lnGDP_{i,t} + \beta_4 lnINF_{i,t}$$
$$+ \beta_5 lnINV_{i,t} + \lambda Time + \varepsilon_{i,t}$$

For each province *i,* at time *t*:

$lnNHP_{i,t}$ is the log of sale price indexes of newly constructed houses (overall).

$lnSHP_{i,t}$ is the log of sale price indexes of second-hand houses (overall).

$MPI_{i,t}$ is a matrix of macroprudential policy variables, which contains the time-series value of the macroprudential instruments, as follows:

RRRL: the reserve requirement ratio (RRR) for large banks.

RRRS: the reserve requirement ratio (RRR) for small banks.

LTV11: the loan-to-value ratio (LTV) for the first house with housing space totaling less than 90 square meters.

LTV12: the loan-to-value ratio (LTV) for the first house with housing space totaling more than 90 square meters.

LTV2: the loan-to-value ratio (LTV) for the second house.

CAR: the capital adequacy ratio (CAR).

LR: the liquidity ratio (LR).

$lnNHP_{i,t-1}$ is the lag of the logged newly constructed house price indexes.

$lnSHP_{i,t-1}$ is the lag of the logged second-hand house price indexes.

$lnGDP_{i,t}$ is the macroeconomic control variables, which is the log of provincial GDP.

$lnINF_{i,t}$ is the macroeconomic control variables, which is the log of provincial CPI.

$lnINV_{i,t}$ is the macroeconomic control variables, which is the log of provincial fixed-asset investment indexes.

$Time$ is the time trend variable.

The steps of regression estimations are shown in Table 6 below.

Table 6. The steps of regressions in model one.

Steps	Dependent Var.	Macroprudential Policy Var.	Describe
Part one	NHP	Individually: RRRL,RRRS, LTV11, LTV12, LTV2, CAR, LR	To evaluate whether the each instrument in the model is effective on managing newly constructed housing market or not by using the newly constructed house price (overall) as a dependent variable and putting the different individual policy instrument for each time.
		Combine all of instruments	To estimate which instrument is more effective among all the instruments by using the newly constructed house price (overall) as a dependent variable and putting all policy instruments in the regression.
Part two	SHP	Individually:	To evaluate whether the each instrument in the model is effective on

		RRRL, RRRS, LTV11, LTV12, LTV2, CAR, LR	managing second-hand housing market or not by using the second-hand house price (overall) as a dependent variable and putting the different individual policy instrument for each time.
		Combine all of instruments	To estimate which instrument is more effective among all the instruments by using the second-hand house price (overall) as a dependent variable and putting the all policy instruments in the regression.

Model Two:

In this part, the main purpose is to point out the differences between the effectiveness of different individual macroprudential policy instruments on newly constructed houses price (overall) and second-hand houses price (overall) in 30 provinces of China by using the model below.

The pooled panel model with the dummy variable of second-hand house will be used, which can be defined as the equation below:

$$lnHP_{i,t} = \alpha + \beta_0 + \beta_1 MPI_{i,t} + \beta_2 MPI_{i,t} * dSecond\_hand + \beta_3 lnGDP_{i,t} \\ + \beta_4 lnINF_{i,t} + \beta_5 lnINV_{i,t} + \lambda Time + \varepsilon_{i,t}$$

For each province *i*, at time *t*:

$lnHP_{i,t}$ is the log of sale price indexes of all kinds of houses (overall), which includes the NHP (overall) and SHP (overall).

$MPI_{i,t}$	is a matrix of macroprudential policy variables, which contains the time-series value of the macroprudential instruments, as follows:

RRRL: the reserve requirement ratio (RRR) for large banks.

LTV11: the loan-to-value ratio (LTV) for the first house with housing space totaling less than 90 square meters.

LTV12: the loan-to-value ratio (LTV) for the first house with housing space totaling more than 90 square meters.

LTV2: the loan-to-value ratio (LTV) for the second house.

CAR: the capital adequacy ratio (CAR).

LR: the liquidity ratio (LR).

$MPI_{i,t} * dSecond\_hand$	is the interaction term between macroprudential policy instruments and dummy variable of second-hand house, which the value of dummy equals to 1 for the second-hand houses.
$lnGDP_{i,t}$	is the macroeconomic control variables, which is the log of provincial GDP.
$lnINF_{i,t}$	is the macroeconomic control variables, which is the log of provincial CPI.
$lnINV_{i,t}$	is the macroeconomic control variables, which is the log of provincial fixed-asset investment indexes.
$Time$	is the time trend variable.

The steps of regression estimations are shown in Table 7 below.

Table 7. The steps of regressions in model two.

Steps	Dependent Var.	Macroprudential Policy Var.	Describe
Part one	HP	Individually: RRRL, LTV11, LTV12, LTV2, CAR, LR	Estimating the regression with the all house price index (overall) as a dependent variable and putting the different individual policy instrument and the relevant interaction term for each time.

Model Three:

In this part, the main purpose is to compare the differences between the effectiveness of the reserve requirement ratio (RRR) on three different house types of newly constructed housing market and second-hand housing market in 30 provinces of China, respectively.

The pooled panel model with the dummy variable of different house type will be used, which can be defined as the equation below:

$$lnNHP123_{i,t} = \alpha + \beta_0 + \beta_1 RRR_{i,t} + \beta_2 RRR_{i,t} * dNHP2 + \beta_3 RRR_{i,t} * dNHP3 + \beta_4 lnGDP_{i,t} + \beta_5 lnINF_{i,t} + \beta_6 lnINV_{i,t} + \lambda Time + \varepsilon_{i,t}$$

$$lnSHP123_{i,t} = \alpha + \beta_0 + \beta_1 RRR_{i,t} + \beta_2 RRR_{i,t} * dSHP2 + \beta_3 RRR_{i,t} * dSHP3 + \beta_4 lnGDP_{i,t} + \beta_5 lnINF_{i,t} + \beta_6 lnINV_{i,t} + \lambda Time + \varepsilon_{i,t}$$

For each province *i,* at time *t*:

$lnNHP123_{i,t}$ is the log of sale price indexes of all three different types of newly constructed houses, which includes the small-size

newly constructed house (housing space less than 90 square meters), middle-size newly constructed house (housing space between 90 to 144 square meters) and large-size newly constructed house (housing space more than 144 square meters).

$lnSHP123_{i,t}$ is the log of sale price indexes of all three different types of second-hand houses, which includes the small-size second-hand house (housing space less than 90 square meters), middle-size second-hand house (housing space between 90 to 144 square meters) and large-size second-hand house (housing space more than 144 square meters).

$RRR_{i,t}$ Is the macroprudential policy variables, which contains the time-series value of the reserve requirement ratio (RRR).

$RRR_{i,t} * dNHP2$ is the interaction term between RRR and dummy variable of the newly constructed middle-size house, which the housing space is between 90 to 144 square meters.

$RRR_{i,t} * dNHP3$ is the interaction term between RRR and dummy variable of the newly constructed large-size house, which the housing space is more than 144 square meters.

$RRR_{i,t} * dSHP2$ is the interaction term between RRR and dummy variable of the second-hand middle-size house, which the housing space is between 90 to 144 square meters.

$RRR_{i,t} * dSHP3$ is the interaction term between RRR and dummy variable of the second-hand large-size house, which the housing space is more than 144 square meters.

$lnGDP_{i,t}$ is the macroeconomic control variables, which is the log of provincial GDP.

$lnINF_{i,t}$ is the macroeconomic control variables, which is the log of provincial CPI.

$lnINV_{i,t}$ is the macroeconomic control variables, which is the log of provincial fixed-asset investment indexes.

$Time$ is the time trend variable.

The steps of regression estimations are shown in Table 8 below.

Table 8. The steps of regressions in model three.

Steps	Dependent Var.	Macroprudential Policy Var.	Describe
Part one	NHP123	RRR	Estimating the regression with the newly constructed house price index as a dependent variable and the policy instrument is RRR with the interaction term of middle- and large-size newly constructed house.
Part two	SHP123	RRR	Estimating the regression with the second-hand house price index as a dependent variable and the policy instrument is RRR with the interaction term of middle- and large-size second-hand house.

2) The hypothesis

H1: The reserve requirement ratio (RRR), the capital adequacy ratio (CAR) and liquidity ratio (LR) have negative relationship with house prices. When the reserve requirement ratio (RRR), the capital adequacy ratio (CAR) and liquidity ratio (LR) increase, the house prices will decrease. And the loan-to-value ratio (LTV) is positive association with house prices. When the loan-to-value ratio (LTV) increases, the house prices will increase. As for the control variables, the lag of house prices, the provincial GDP, the provincial CPI and the provincial fixed-asset investment have positive relationship with house prices. When the house prices in last period, GDP, CPI and fixed-asset investment increase, the house prices in this period will increase.

H2: When comparing the macroprudential policy effectiveness on different house markets, according to the percentage share of real market, there is different effectiveness between newly constructed house market and second-hand house market and expecting that macroprudential policy will be more effective on managing stability of newly constructed house market.

H3: When comparing the macroprudential policy effectiveness on different house types, according to the percentage share of real market, there is different effectiveness between small-, middle- and large-size house of both newly constructed and second-hand house market and expecting that macroprudential policy will be more effective on managing stability of small-size house of newly constructed house market and middle-size of second-hand house market.

3) Variables and Data

The resource of data obtained in this research came from the National Bureau of Statistics of China, PBOC and CEIC. For objective one, the data is quarterly from January 2006, to December 2014. As for objective two, the data is quarterly from January 2011, to December 2014.

According to the literature, variables used in the model can be classified in three parts. They are dependent variable, macroeconomic control variables and macroprudential policy variables. The details is shown in the Table 9-11 below.

Table 9. List of Dependent Variables

Municipal Sale Price Indices of 30 provinces in China (Preceding year=100)

Dependent Variables	Description	Start	End	Detail
NHP	Newly Housing Price (overall)	2006	2014	Quarterly
NHP1	Newly Housing Price (housing space <90 square meters)	2011	2014	Provincial
NHP2	Newly Housing Price (housing space 90~144 square meters)			
NHP3	Newly Housing Price (housing space >144 square meters)			
SHP	Second-hand Housing Price (overall)	2006	2014	Quarterly
SHP1	Second-hand Housing Price (housing space <90 square meters)	2011	2014	Provincial
SHP2	Second-hand Housing Price (housing space 90~144 square meters)			
SHP3	Second-hand Housing Price (housing space >144 square meters)			

Sources: National Bureau of Statistics

Table 10. List of Macroeconomic Control Variables

Control Variables	Description	Details		Source
GDP	Provincial GDP Index	Provincial	Quarterly	CEIC
INF	CPI Index	Provincial	Quarterly	National Bureau of Statistics
INV	Fixed-asset Investment Index	Provincial	Quarterly	

Table 11. List of Macroprudential Policy Variables

Policy Variables	Description	Detail	Start	End
RRRL	Required reserve ratio (RRR) for large banks	Quarterly	2006	2014
RRRS	Required reserve ratio (RRR) for small banks			
LTV11	Loan-to-value ratio (LTV) for the first house with housing space totaling less than 90 square meters.	Quarterly	2006	2014
LTV12	Loan-to-value ratio (LTV) for the first house with housing space totaling more than 90 square meters.			
LTV2	Loan-to-value ratio (LTV) for the second house.			
CAR	Capital Adequacy Ratio(CAR)	Quarterly	2009	2011
LR	Liquidity Ratio	Quarterly	2009	2011

Sources: PBOC

CHAPTER 6
EMPIRICAL RESULTS

In this chapter, the empirical results will be summarized. The main objective of this thesis is to evaluate the effects of macroprudential policies on house price stability management of both newly constructed houses market and second-hand houses market in 30 provinces of China by using the fixed-effect panel model. By the way, to point out the different effectiveness between the different individual macroprudential policy instruments on newly constructed houses price (overall) and second-hand houses price (overall) in 30 provinces of China by using the pooled panel model. Also, to compare the different effectiveness of the reserve requirement ratio (RRR) on three kinds of housing space type of newly constructed houses and second-hand houses in 30 provinces of China, respectively.

The results are organized into four main parts as follows:

6.1 The results of testing panel cointegration with Kao test.

6.2 The results of model one, which are the main focus of this thesis.

6.3 The results of model two, which are the comparison between newly constructed and second-hand house market.

6.4 The results of model three, which are the comparison with different house types of both newly constructed and second-hand house market.

6.5 Discussion in comparison with earlier literature.

6.1 The Results of Testing Panel Cointegration with Kao Test

6.1.1 The results of the model one (long sample)

For the model one, the long sample and the fixed panel model will be used. In order to know whether the data used in the model has long-term cointegration relationship, the Kao test should be tested before running the regressions. The results of Kao test of the model are shown in the Table 12.

Table 12. Results of Panel Cointegration with Kao test

Model		ADF		Residual	HAC
		t-Statistic	Prob.	Variance	Variance
NHP	All instruments	-9.690065	0.0000	0.000580	0.000739
	RRRS	-11.81590	0.0000	0.000658	0.000920
	LTV11	-11.20643	0.0000	0.000664	0.000725
	LTV12	-11.00884	0.0000	0.000666	0.000666
	LTV2	-11.16858	0.0000	0.000677	0.000677
	CAR	-10.43754	0.0000	0.000668	0.000673
	LR	-12.43984	0.0000	0.000806	0.001167
SHP	All instruments	-7.860934	0.0000	0.000403	0.000458
	RRRL	-7.590024	0.0000	0.001023	0.001111
	LTV11	-7.119781	0.0000	0.001023	0.001044
	LTV12	-6.921090	0.0000	0.001029	0.001029
	LTV2	-7.078472	0.0000	0.001029	0.001029
	CAR	-8.267839	0.0000	0.000437	0.000440
	LR	-9.081545	0.0000	0.000519	0.000675

Source: Author's estimation.

With the ADF t-statistic value and probability value at 0.0000 of all models with the original data in the results, it is significant at 1% level and strongly rejects the null hypothesis. In the other word, all models in this part have the cointegration relationship in the long run.

6.2 The Results of Model One (Panel Fixed-Effects Model) Regressions

After getting the significant results from the panel cointegration test, it can be confirmed that there will not be any spurious problem in the next panel regressions.

In this part, the results of the main objective of this thesis will be shown in detail by using the panel fixed-effects model regressions. Since the main objective of this thesis is to evaluate whether macroprudential policy enacted by government can have an impact on both newly constructed house price (overall) and second-hand house price (overall) in helping manage house price growth of 30 provinces in China, this subsection is composed of two parts.

The first part is investigating the effects of the individual and all macroprudential policy instruments on the newly constructed house (overall). The second part is to investigate the effects of the individual and all macroprudential policy instrument on the second-hand house (overall).

1) The results for the impact of macroprudential policy instruments on the newly constructed house price growth (overall) of 30 provinces.

As is shown in Table 13, the results show that most macroprudential policy instruments are significant in managing the newly constructed house price growth (overall). In particular, the reserve requirement ratio (RRR), the loan-to-value ratio (LTV) of the first house (housing space less than 90 square meters), the loan-to-value ratio (LTV) of second house, the capital adequacy ratio (CAR) and the liquidity ratio (LR). However, when compare that which instrument is more effective, the results shows that the reserve requirement ratio (RRR), the capital adequacy ratio (CAR) and the liquidity ratio (LR) are more effective than the loan-to-value ratio (LTV) of the first house (housing space less than 90 square meters). The result's detail of each model is composed of two parts as follows:

1.1) Part One: To investigate that which macroprudential policy instruments take effect to the newly constructed house price by putting the individual instrument in the model.[2]

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[2] Based on the methodology of IMF working paper, Wang and Sun (2013).

1.1.1) Reserve requirement ratio (RRR)

The results are shown in the regressions column one in Table 13. The regression column one aims at estimating whether the reserve requirement ratio (RRR) of small bank takes effect on newly constructed house (overall), that the value of r-square is 0.8533.

Reserve requirement ratio (RRR) of small bank have a significantly negative relationship with newly constructed house price growth (overall) at 1% level, the similar as the reserve requirement ratio (RRR) of large banks. While the value of small bank's reserve requirement ratio (RRR) increases 1 percent, the newly constructed house price decrease 0.4842 percent. The reason comes from that when rising the reserve requirement ratio (RRR), it represents that banks and financial institutions have to keep more capital as the reserve following the requirement of central bank. If keeping more capital, the banks and financial institutions will decrease the loans. As the consequence, consumer will get less mortgage loan and may don't have enough money to buy house, then the house price drops.

As for the macroeconomics control variables, the provincial GDP index is only significant at 10% level, which means the change of GDP increases 1 percent, the newly constructed house price will increase 0.3097 percent.

And the provincial CPI is strongly significant at 1% level. When the value of inflation increases 1 percent, the newly constructed house price will increase 0.3826 percent. When the inflation of each province or nation increasing, almost types of consumption goods price of consumers go up, including the house price.

The provincial fixed-assets investment is significant at 10% level either. When the developers increase the investment in fixed assets, it might be the signal that the supply the house in that period is not enough when comparing the demand of consumers. At the same time, most of consumers believe that the fixed-assets price will not depreciation. If the new projects were done, consumers believe that the price in the

next few years will be higher than now. Thus, some of consumers choose to buy the house right now, instead buying in two or three years. This kind of behavior probably makes the present demand increasing and house prices go up. However, according to the results, the fixed-asset investment has negative relationship with newly constructed house price, which is the opposite with the hypothesis. The reason might come from the excess supply in that period, that supply of newly constructed house is more than the demand of market. Thus, when the supply keeps going up, price is going down. The results shows that when the fixed-asset investment of developers increases 1 percent, the newly constructed house price will decrease 0.1249 percent.

As for the lag of newly constructed house price and the time trend, they are both strongly significant at 1% level.

1.1.2) Loan-to-value ratio (LTV)

The results are shown in the regressions column two to four in Table 13. The regression column two aims at estimating whether the loan-to-value ratio (LTV) of the first house, which has housing space totaling less than 90 square meters, takes effect on the newly constructed house (overall), with the value 0.8520 as the r-square. The regression column three aims at estimating whether the loan-to-value ratio (LTV) of the first house, which has housing space totaling more than 90 square meters, takes effect on the newly constructed house (overall), that the value of r-square is 0.8517. The regression column four aims at estimating whether the loan-to-value ratio (LTV) of the second house takes effect on the newly constructed house (overall), that the value of r-square is 0.8488.

There are three kinds of loan-to-value ratio to meet different request in lending mortgage loan, which are LTV for the first house with housing space less than 90 square meters, the first house with housing space more than 90 square meters and the second house. Theoretically, all kinds of loan-to-value ratio should be positive value. When raising the loan-to-value ratio (LTV), banks can release more loans for housing mortgage.

Consumers can apply for more percentage mortgage loans and pays the down payment less than before. It makes the demand increase at the same time and house prices increase.

From the results, it shows that the loan-to-value ratio (LTV) of the first house with housing space less than 90 square meters and loan-to-value ratio (LTV) of second house are positive association with newly constructed house price growth (overall) and significant at 1% level and 5% level, respectively. It is clear that when the loan-to-value ratio (LTV) of the first house with housing space less than 90 square meters decreases 1 percent, the newly constructed house price decreases 0.2711 percent as well. And when the loan-to-value ratio (LTV) of the second house decreases 1 percent, the newly constructed house price decreases 0.1152 percent. However, the loan-to-value ratio (LTV) of first house with housing space more than 90 square meters is not significant, which represents that it has no relationship or could not explain in managing the stability of newly constructed house price.

As for the control variables, the provincial GDP index in both three regressions are significant at 5% level, 10% level and 5% level, respectively. When the GDP increases 1 percent, the newly constructed house price will increase 0.3585 percent, 0.3380 percent and 0.4145 percent, respectively.

The provincial CPI in both three regressions are strongly significant at 1% level. When the inflation increases 1 percent, the change of newly constructed house price will increase 0.3895 percent, 0.2641 percent and 0.3345 percent, respectively.

The provincial fixed-assets investment in both three regressions are significant at 1% level with negative value. When the fixed-asset investment of developers increase 1 percent, the newly constructed house price will decrease 0.2472 percent, 0.2552 percent and 0.2520 percent, respectively. It represents that during the period in the sample, the supply of developers is more than demand of people. When supply keep increase, price keep decrease.

The lag of house price of these three models are significant at 1% level. And the coefficients of these three models shows that when the newly constructed house price increases 1 percent in the last period (t-1), the newly constructed house price in this period (t) will increase 0.7523 percent, 0.7952 percent and 0.7721 percent, respectively. And time trend of loan-to-value ratio (LTV) of first house with housing space less than 90 square meters and second house are significant.

1.1.3) Capital adequacy ratio (CAR)

The results are shown in the regressions column five in Table 13. The model, estimating whether the capital adequacy ratio (CAR) takes effect on the newly constructed house (overall) with panel fixed-effects regression, can be found that r-squares is 0.8437.

Capital adequacy ratio (CAR) has strongly negative relationship with newly constructed house price growth (overall). As the measure of bank's risk to protect the efficiency of financial system, when raising the value of capital adequacy ratio (CAR), banks need keep more capital or decrease the risk weighted assets to keep the stability of bank. As for mortgagors, who is willing to buy a house, they might lend loans from banks less than before. Then demand of house will decrease and price decrease. However, the capital adequacy ratio (CAR) is not adjusted frequently as the reserve requirement ratio (RRR) and the international standard level of this ratio is around 8%.

The results show that when the capital adequacy ratio (CAR) increases 1 percent, the newly constructed house price will decrease 3.6222 percent.

As for the control variables, the provincial GDP index is significant at 5% level, which represents the GDP increases 1 percent, the newly constructed house price will increase 0.5285 percent. The provincial CPI is significant at 10% level. When the inflation increases 1 percent, the newly constructed house price will increase 0.3393 points. The provincial fixed-asset investment is significant at 1% level, which represents

the fixed-asset investment of developer increases 1 percent, the newly constructed house price will decrease 0.1850 percent.

The lag of house price is significant at 1% level. And the coefficients shows that when the newly constructed house price increases 1 percent in the last period (t-1), the newly constructed house price in this period (t) will increase 0.6700 percent. And the time trend is significant, time trend has impact on house price.

1.1.4) Liquidity ratio (LR)

The results are shown in the regression column six in Table 13. The model, estimating whether the liquidity ratio (LR) takes effect on the newly constructed house (overall) with panel fixed-effects regression, can be found that r-squares is 0.8608.

Liquidity ratio (LR) is strongly negative association with the newly constructed house price growth (overall). When capital have much more liquidity, it represents that the economy runs well. The decreasing house price could be possible. Following the theory, when the price is higher than the price at equilibrium, the higher price will moving back to the equilibrium price in the long term.

The results show that when the liquidity ratio (LR) increases 1 percent, the newly constructed house price will decrease 0.7837 percent.

As for the control variables, the provincial GDP and the provincial fixed-asset investment are significant at 5% level. When the GDP and fixed-asset investment increase 1 percent, the newly constructed house price will increase 0.4731 percent. But when the fixed-asset investment increase 1 percent, the newly constructed house price will decrease 0.1973 percent. The provincial CPI is not significant.

The lag of house price is significant at 1% level. And the coefficients shows that when the newly constructed house price increases 1 percent in the last period (t-1), the newly constructed house price in this period (t) will increase 0.8107 percent. And time trend is strongly significant.

1.2) Part Two: To investigate that which macroprudential policy instrument is more effective than the others in managing the newly constructed house price by putting all instrument in the model.

The results are shown in the regressions last column in Table 13. The regression last column aims at comparing all of the instruments and finding the more effective instrument on newly constructed house (overall) by combining all of instruments used in the model into one regression. The value of r-square is 0.8577.

As it shown, when combining all instruments in on regression, both reserve requirement ratio (RRR), capital adequacy ratio (CAR) and liquidity ratio (LR) have a significantly negative relationship with newly constructed house price growth (overall) at 1% level. When the value of large bank's reserve requirement ratio (RRR) increases 1 percent, the newly constructed house price decrease 0.5615 percent. When the value of capital adequacy ratio (CAR) increases 1 percent, the newly constructed house price decrease 1.2140 percent. When the value of liquidity ratio (LR) increases 1 percent, the newly constructed house price decrease 0.6356 percent. At the same time, loan-to-value ratio (LTV) of first house (housing space less than 90 square meters) only significant at 10% level having positive relationship with newly constructed house price growth (overall). When the value of loan-to-value ratio (LTV) of first house (housing space less than 90 square meters) decreases 1 percent, the newly constructed house price decrease 0.1266 percent. However, the loan-to-value ratio (LTV) of first house (housing space more than 90 square meters) and loan-to-value ratio (LTV) of second house are not significant at all, when combing the whole instruments into one regression.

When focus on housing- related macroprudential instruments, the reserve requirement ratio (RRR) and loan-to-value ratio (LTV), it can be found that reserve requirement ratio (RRR) is strongly significant but loan-to-value ratio (LTV) is only significant in the first house (housing space less than 90 square meters) at lower significance. And when reserve requirement ratio (RRR) change 1 percent, it can help reducing newly constructed house price 0.5615 percent, which is more than the loan-to-

value ratio (LTV) of first house with small size at 0.1266 percent. Therefore, the reserve requirement ratio (RRR) is more effective than loan-to-value ratio (LTV) in managing newly constructed house price.

As for macroeconomic control variables, the provincial GDP is significant at 1% level, when the provincial GDP increases 1 percent, the newly constructed house price increase 0.4688 percent. While the provincial CPI and provincial fixed-asset investment are not significant, which means the change of provincial CPI and provincial fixed-asset investment could not explain the change of newly constructed house price. As for the lag of newly constructed house price, it is strongly significant at 1% level with positive relationship. When the house price of newly constructed house increased in the last period for 1 percent, it makes the house price of newly constructed house increase 0.6547 percent. As for time trend variable, the results shows that the changes of time trend have strongly significant positive relationship with newly constructed house price growth.

2) The results for the impact of macroprudential policy instruments on the second-hand house price growth (overall) of 30 provinces.

As shown in Table 14, the results show that most macroprudential policy instruments are significant in managing second-hand house price growth (overall) as well. In particular, the reserve requirement ratio (RRR), the loan-to-value ratio (LTV) of the first house (housing space less than 90 square meters) and second house, the capital adequacy ratio (CAR) and the liquidity ratio (LR). However, when compare that which instrument is more effective, the results shows that the reserve requirement ratio (RRR), the capital adequacy ratio (CAR) and the liquidity ratio (LR) are more effective and the loan-to-value ratios (LTV) are not effective when combining with other instruments. The result's detail of each model is composed of two parts as follows:

2.1) Part One: To investigate that which macroprudential policy instruments take effect to the second-hand house price by putting the individual instrument in the model.[3]

2.1.1) Reserve requirement ratio (RRR)

The results are shown in the regressions column one in Table 14. It can be found that r-square of regression column one is 0.5794. The regression column one aims to aims at estimating whether the reserve requirement ratio (RRR) of small bank takes effect on second-hand house (overall).

Reserve requirement ratio (RRR) of small bank have a significantly negative relationship with second-hand house price growth (overall) at 1% level. When the small bank's reserve requirement ratio (RRR) increases 1 percent, the second-hand house price decrease 0.4577 percent. It shows that the small bank's reserve requirement ratio (RRR) of small banks have impact on both newly constructed house (overall) and second-hand house (overall).

As for the control variables, the provincial GDP index is significant at 5% level. When the GDP increase 1 percent, the second-hand house price will increase 0.2614 percent. And the provincial CPI is strongly significant at 1% level. When the inflation increases 1 percent, the second-hand house price will increase 0.4367 percent. However, the fixed-assets investment is not significant.

The lags of house prices is significant at 1% level. When the second-hand house price increases 1 percent in the last period (t-1), the second-hand house price in this period (t) will increase 0.5382 percent. And the time trend variable is strongly significant with positive value.

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[3] Based on the methodology of IMF working paper, Wang and Sun (2013).

2.1.2) Loan-to-value ratio (LTV)

The results are shown in the regressions column two to four in Table 14, it can be found that r-squares of regression column two to four are 0.5821, 0.5557 and 0.5655, respectively. The regression column two aims at estimating whether the loan-to-value ratio (LTV) of the first house, which has housing space totaling less than 90 square meters, takes effect on the second-hand house (overall). The regression column three aims at estimating whether the loan-to-value ratio (LTV) of the first house, which has housing space totaling more than 90 square meters, takes effect on the second-hand house (overall). And the regression column four aims at estimating whether the loan-to-value ratio (LTV) of the second house takes effect on the second hand house (overall).

From the results, it shows that only the loan-to-value ratio (LTV) of the first house with housing space less than 90 square meters is positive relationship with the second-hand house price growth (overall) and significant at 1% level. It is clear that when the loan-to-value ratio (LTV) of the first house with housing space less than 90 square meters decreases 1 percent, the second-hand house price decreases 0.2954 percent. And the loan-to-value ratio (LTV) of second house is significant at 5% level. When the loan-to-value ratio (LTV) of second house decreases 1 percent, the second-hand house price decreases 0.1536 percent. But the loan-to-value ratio (LTV) of the first house (housing space less than 90 square meters) is not significant in explaining the dependent variable. Obviously, it shows that the loan-to-value ratio (LTV) of first house with small size and loan-to-value ratio (LTV) with second house have impact on both newly constructed house (overall) and second-hand house (overall).

As for the control variables, the provincial GDP is significant at 5% level in both three regressions. When the GDP increase 1 percent, the second-hand house price will increase 0.3107 percent, 0.3123 percent and 0.3836 percent, respectively. And the provincial CPI in all three models are significant at 1% level. When the inflation increases 1 percent, the second-hand house price will increase 0.4597 percent, 0.3530 percent and 0.4155 percent, respectively. Then, the fixed-asset investment in both three regressions

are significant with negative value. When the fixed-asset investment in three regressions increase 1 percent, the second-hand house price decrease 0.1648 percent, 0.1858 percent and 0.1639 percent, respectively.

The lag of house price of these three models are significant at 1% level. And when the second-hand house price increases 1 percent in the last period (t-1), the second-hand house price in this period (t) will increase 0.5154 percent, 0.5574 percent and 0.5277 percent, respectively. And the time trend variables are both significant at 5% level.

2.1.3) Capital adequacy ratio (CAR)

The results are shown in the regressions column five in Table 14. It estimates whether the capital adequacy ratio (CAR) on the second-hand house (overall) with panel fixed-effects regression, and can be found that r-squares is 0.7401.

Capital adequacy ratio (CAR) has strongly negative relationship with second-hand house price growth (overall). When the capital adequacy ratio (CAR) increases 1 percent, the second-hand house price will decrease 2.6112 percent. And it shows that the capital adequacy ratio (CAR) has impact on both newly constructed house (overall) and second-hand house (overall).

As for the control variables, the provincial GDP is significant at 1% level, which means the GDP increases 1 percent, the second-hand house price will increase 0.4548 percent. The provincial fixed-asset investment is significant at 5% level. When the investment increases 1 percent, the second-hand house price will decrease 0.1507 percent. The provincial CPI is not significant.

The lag of house price is significant at 1% level. And the coefficients shows that when the second-hand house price increases 1 percent in the last period (t-1), the second hand house price in this period (t) will increase 0.6586 percent. And the time trend variable is strongly significant.

2.1.4) Liquidity ratio (LR)

The results are shown in the regression column six in Table 14. The model, estimating whether the liquidity ratio (LR) takes effect on the second-hand house (overall) with panel fixed-effects regression. The r-squares is 0.7164.

Liquidity ratio (LR) is strongly negative relationship with dependent variable and when the liquidity ratio (LR) increases 1 percent, the second-hand house price will decrease 0.5201 percent. It shows that the liquidity ratio (LR) has impact on both newly constructed house (overall) and second-hand house (overall).

As for the control variables, the provincial GDP index is significant at 5% level. The provincial fixed-asset investment is strongly significant at 1% level. When the GDP increases 1 percent, the second-hand house price will increase 0.4069 percent. When the fixed-asset investment increases 1 percent, the second-hand house price will decrease 0.1858 percent. The provincial CPI is not significant.

The lag of house price is significant at 1% level. And when the second-hand house price increases 1 percent in the last period (t-1), the second-hand house price in this period (t) will increase 0.7780 percent. Time trend is strongly significant.

2.2) Part Two: To investigate that which macroprudential policy instrument is more effective than the others in managing the second-hand house price by putting all instrument in the model.

The results are shown in the regressions last column in Table 14. The regression last column aims at comparing all of the instruments and finding the more effective instrument on second-hand house (overall) by combining all of instruments used in the model into one regression. The value of r-square is 0.7494.

As it shown, when combining all of instruments, both capital adequacy ratio (CAR) and liquidity ratio (LR) have a significantly negative relationship with second-hand house price growth (overall) at 1% level. When the value of capital adequacy ratio

(CAR) increases 1 percent, the second-hand house price decrease 1.0888 percent. When the value of liquidity ratio (LR) increases 1 percent, the newly constructed house price decrease 0.3271 percent. And the reserve requirement ratio (RRR) of large bank is significant at 5% level, when the value of large bank's reserve requirement ratio (RRR) increases 1 percent, the second-hand house price decrease 0.6058 percent. However, all of the loan-to-value ratio (LTV) are not significant at all, it is different with the newly constructed case that at least the loan-to-value ratio (LTV) of first house (housing space less than 90 square meters) is significant at 10% level and have impact on the newly constructed house price.

When focus on housing- related macroprudential instruments, the reserve requirement ratio (RRR) and loan-to-value ratio (LTV), it can be found that reserve requirement ratio (RRR) is strongly significant but loan-to-value ratios (LTV) are not significant. Therefore, the reserve requirement ratio (RRR) is more effective in managing newly constructed house price.

As for macroeconomic control variables, the provincial GDP is significant at 5% level, when the provincial GDP increases 1 percent, the second-hand house price increase 0.4514 percent. While the provincial CPI and provincial fixed-asset investment are not significant, which means the change of provincial CPI and provincial fixed-asset investment could not explain the change of second-hand house price. As for the lag of second-hand house price, it is strongly significant at 1% level with positive relationship. When the house price of second-hand house increased in the last period for 1 percent, it makes the house price of second-hand house increase 0.6552 percent. As for time trend variable, the results shows that the changes of time trend have strongly significant positive relationship with second-hand house price growth.

3) Discussion between Part One and Part Two (Run Individual and Run All Instruments) of both newly constructed house price and second-hand house price.

The reason why running the regressions by putting individual instrument and all instruments is that, the aim of running the individual instruments is to evaluate whether the instruments used by government have effect on managing house price and the effectiveness is positive or negative, since macroprudential policy appears in recent years and it is not absolute explanation that which instrument is effective, furthermore these instruments enacted in the same period and have the same purpose that maintain the financial stability. And the aim of running all instruments is to find which instrument is more effective when combining all instruments at the same time.

And the results of part one and part two shows some difference in the loan-to-value ratio (LTV) that, in part one the results shows the loan-to-value ratio (LTV) of first house with small size and loan-to-value ratio (LTV) of second house are the effective instruments in both newly constructed house market (overall) and second-hand house market (overall). However, when combining all the instruments, only loan-to-value ratio (LTV) of first house with small size takes effect and only significant at 10% in the newly constructed house market (overall). As for the second-hand house market (overall), the loan-to-value ratios (LTV) are not significant at all. In contrast, the reserve requirement ratio (RRR), the capital adequacy ratio (CAR) and the liquidity ratio (LR) are effective instruments and are more effective in managing house price than the loan-to-value ratios (LTV) in both two markets.

The difference between the loan-to-value ratios (LTV) might be caused by two reasons. First, the loan-to-value ratios (LTV) are not significant and not effective instruments at all, what shown in the individual regressions are caused by the high correlationship between loan-to-value ratios (LTV) with the reserve requirement ratio (RRR) and the capital adequacy ratio (CAR), so when combining all instruments together, the effectiveness of loan-to-value ratios (LTV) are missing or weaken. Second, the loan-to-value ratios (LTV) can be defined as still effective, although they are not significant when

combining all instruments, the coefficients are still positive value following the hypothesis, and the features of data might be source of problem as well. That means that loan-to-value ratios (LTV) are still effective but with very weak relationship with house prices.

In general, based on the data and sample until now, it could not be conclude the exactly reason, since the series are not too long and the change of loan-to-value ratios (LTV) is not frequent.

Table 13. The results of the macroprudential policy instruments in managing newly constructed house price (overall) in 30 provinces of China

Regression	1	2	3	4	5	6	7
Dependent Variables: Newly Constructed House Price (t)							
Control Variables							
New House Price	0.7537	0.7523	0.7952	0.7721	0.6700	0.8107	0.6547
(t-1)	(0,0420)***	(0.0415)***	(0.0405)***	(0.0430)***	(0.0199)***	(0.0306)***	(0.0221)***
GDP	0.3097	0.3585	0.3380	0.4145	0.5285	0.4731	0.4688
	(0.1528)*	(0.1502)**	(0.1666)*	(0.1738)**	(0.2419)**	(0.2269)**	(0.2751)*
Inflation	0.3826	0.3895	0.2641	0.3345	0.3393	-0.1617	0.0828
	(0.0855)***	(0.0610)***	(0.0727)***	(0.0663)***	(0.1959)*	(0.1795)	(0.1236)
Investment	-0.1249	-0.2474	-0.2552	-0.2520	-0.1850	-0.1973	0.0197
	(0.0669)*	(0.0528)***	(0.0546)***	(0.0584)***	(0.0641)***	(0.0767)**	(0.0685)
Policy Variables							
Reserve Requirement Ratio (RRR)							
Large Bank							-0.5615
							(0.1624)***
Small Bank	-0.4842						
	(0.0841)***						
Loan-to-value Ratio (LTV)							
First House(<90 m^2)		0.2711					0.1266
		(0.0726)***					(0.0632)*
First House(>90 m^2)			-0.0355				0.0128
			(0.0285)				(0.0767)
Second House				0.1152			0.0279
				(0.0471)**			(0.0567)
Capital Adequacy Ratio (CAR)					-3.6222		-1.2140
					(0.1609)***		(0.2217)***
Liquidity Ratio (LR)						-0.7837	-0.6356
						(0.0599)***	(0.1006)***
t	0.0012	0.0013	-0.0000	0.0011	0.0023	0.0016	0.0054
	(0.0003)***	(0.0005)***	(0.0002)	(0.0006)*	(0.0004)***	(0.0003)***	(0.0008)***
Constant	-1.4640	-1.4271	-0.6578	-1.3582	-1.2946	-0.6140	-0.7908
	(0.5923)**	(0.6958)**	(0.6388)	(0.7585)*	(0.6266)**	(0.5515)	(1.3995)
Number of obs.	990	990	990	990	720	750	660
R-square (overall)	0.8533	0.8520	0.8517	0.8488	0.8437	0.8608	0.8577

Note: The table present panel fixed-effects regressions.

***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively.

Table 14. The results of the macroprudential policy instruments in managing second-hand house prices (overall) in 30 provinces of China

Regression	1	2	3	4	5	6	7
Dependent Variables: Second-hand House Price (t)							
Control Variables							
Second-hand House Price (t-1)	0.5382 (0.1371)***	0.5154 (0.1443)***	0.5574 (0.1466)***	0.5277 (0.1476)***	0.6586 (0.0296)***	0.7780 (0.0390)***	0.6552 (0.0358)***
GDP	0.2614 (0.1250)**	0.3107 (0.1335)**	0.3123 (0.1506)**	0.3836 (0.1608)**	0.4548 (0.1558)***	0.4069 (0.1496)**	0.4514 (0.1761)**
Inflation	0.4367 (0.0797)***	0.4597 (0.0785)***	0.3530 (0.0775)***	0.4155 (0.0774)***	0.2009 (0.1504)	-0.0991 (0.1389)	0.0967 (0.1193)
Investment	-0.0585 (0.0993)	-0.1648 (0.0756)**	-0.1858 (0.0765)**	-0.1639 (0.0810)*	-0.1507 (0.0622)**	-0.1858 (0.0630)***	0.0016 (0.0663)
Policy Variables							
Reserve Requirement Ratio (RRR)							
Large Bank							-0.6058 (0.2589)**
Small Bank	-0.4577 (0.1094)***						
Loan-to-value Ratio (LTV)							
First House(<90 m^2)		0.2954 (0.0974)***					0.0244 (0.0385)
First House(>90 m^2)			0.0032 (0.0322)				0.0757 (0.0647)
Second House				0.1536 (0.0597)**			-0.0145 (0.0817)
Capital Adequacy Ratio (CAR)					-2.6112 (0.1832)***		-1.0888 (0.2261)***
Liquidity ratio (LR)						-0.5201 (0.0603)***	-0.3271 (0.0682)***
t	0.0008 (0.0003)***	0.0010 (0.0004)**	-0.0003 (0.0001)**	0.0012 (0.0006)**	0.0016 (0.0003)***	0.0011 (0.0002)***	0.0036 (0.0007)***
Constant	-0.7924 (0.3622)**	-0.8260 (0.4314)*	-0.1918 (0.3466)	-0.8828 (0.4795)*	-0.5189 (0.3906)	0.6302 (0.3724)	-0.7458 (0.8858)
Number of obs.	990	990	990	990	720	750	660
R-square (overall)	0.5794	0.5821	0.5557	0.5655	0.7401	0.7164	0.7494

Note: The table present panel fixed-effects regressions.

   ***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively.

6.3 The Results of Model Two Regressions

This part shows the results of comparison between newly constructed and second-hand house market, that whether the effectiveness of the different individual macroprudential policy instruments are different on newly constructed houses price (overall) and second-hand houses price (overall) in 30 provinces of China by using the pooled panel model.

The regressions column one shows the impact of large bank's reserve requirement ratio (RRR) on newly constructed house market and second-hand house market. It can be found that large bank's reserve requirement ratio (RRR) is significant at 5% level. And the interaction terms that include dummy variables of second-hand house, it shows that the impact of large bank's reserve requirement ratio (RRR) on second-hand house market is significant at 5% level. Representing that the impact of large bank's reserve requirement ratio (RRR) on newly constructed house is different with the impact on second-hand house. When the large bank's reserve requirement ratio (RRR) increase 1 percent, the newly constructed house price will decrease 0.8238 percent, however, the second-hand house price will decrease 0.8579 percent.

The regressions column two shows the impact of loan-to-value ratio (LTV) for first house with small size on newly constructed house market and second-hand house market. The loan-to-value ratio (LTV) for first house with small size is significant at 1% level. And the interaction terms that include dummy variables of second-hand house is significant at 10% level but the negative relationship. Representing that the impact of loan-to-value ratio (LTV) for first house with small size on newly constructed house is different with the impact on second-hand house. While the loan-to-value ratio (LTV) for first house with small size decrease 1 percent, the newly constructed house price will decrease 0.5838 percent, however, the second-hand house price will only decrease 0.5775 percent.

The regressions column three shows the impact of loan-to-value ratio (LTV) for first house with large size on newly constructed house market and second-hand house market. It shows that the loan-to-value ratio (LTV) for first house with large size is not significant with newly constructed house market. However, it is significant with second-hand house market at 10% level with negative relationship, that the loan-to-value ratio (LTV) of first house with large size will increase the second-hand house price, which is not obey the hypothesis. Therefore, the loan-to-value ratio (LTV) for first house with large size could not reduce the second-hand house price and could not explain newly constructed house market.

The regressions column four shows the impact of loan-to-value ratio (LTV) for second house on newly constructed house market and second-hand house market. The loan-to-value ratio (LTV) for second house is significant at 1% level. But the interaction terms that include dummy variables of second-hand house is not significant. Representing that the impact of loan-to-value ratio (LTV) for second house on newly constructed house is the same with the second-hand house. And if the loan-to-value ratio (LTV) for second house decrease 1 percent, both newly constructed and second-hand house price will decrease 0.2827 percent.

The regressions column five and six shows the impact of capital adequacy ratio (CAR) and liquidity ratio (LR) on newly constructed house market and second-hand house market. These two instruments are significant at 1% level. And the interaction terms that include dummy variables of second-hand house are significant at 5%. It can be defined as the impact of capital adequacy ratio (CAR) and liquidity ratio (LR) on newly constructed house are different with the second-hand house. If the capital adequacy ratio (CAR) and liquidity ratio (LR) increase 1 percent, the newly constructed house price will decrease 6.4208 percent and 6.4712 percent, respectively, and the second-hand house price will only decrease 0.8795 percent and 0.8924percent, respectively.

The results can be summarized as that all of the macroprudential policy instrument used in the model are significant, except the loan-to-value ratio (LTV) of first

house with large size in newly constructed house market. And all the significant policy instruments have different impacts on newly constructed housing market and second-hand housing market, except the loan-to-value ratio (LTV) of second house.

Table 15. The results of comparison between two markets.

Regression	1	2	3	4	5	6
Dependent Variables: House Price (t)						
Control Variables						
GDP	0.2050 (0.0725)***	0.1905 (0.0659)***	0.1981 (0.0743)***	0.2891 (0.0731)***	0.2549 (0.0761)***	0.2144 (0.0820)***
Inflation	0.6517 (0.0820)***	0.7755 (0.0781)***	0.5874 (0.0823)***	0.6965 (0.0806)***	0.8293 (0.1501)***	0.2396 (0.1531)
Investment	0.3129 (0.0547)***	0.0647 (0.0488)	0.0771 (0.0506)	0.0774 (0.0500)	0.1164 (0.0857)	0.1675 (0.0819)**
Policy Variables						
RRR of Large bank	-0.8238 (0.0848)**					
RRR Large * Second-hand House	-0.0341 (0.0142)**					
LTV for First House(<90 m^2)		0.5838 (0.0594)***				
LTV First (<90 m^2) * Second-hand House		-0.0063 (0.0033)*				
LTV for First House(>90 m^2)			-0.0125 (0.0311)			
LTV First (>90 m^2) * Second-hand House			-0.0065 (0.0035)*			
LTV for Second House				0.2827 (0.0357)***		
LTV Second * Second-hand House				-0.0077 (0.0049)		
CAR					-6.4208 (0.3215)***	
CAR * Second-hand House					-0.0504 (0.0219)**	
LR						-0.8795 (0.0885)***
LR * Second-hand House						-0.0129 (0.0066)**
t	0.0033 (0.0004)***	0.0023 (0.0003)***	-0.0002 (0.0002)	0.0023 (0.0004)***	0.0038 (0.0003)***	0.0013 (0.0003)***
Constant	-0.7158 (0.4205)*	-0.6315 (0.4238)	0.6415 (0.4135)	-0.4913 (0.4333)	-0.2563 (0.5191)	2.0977 (0.5621)***
Number of obs.	2040	2040	2040	2040	1440	1500
R-square (overall)	0.1393	0.1530	0.1530	0.1272	0.2898	0.1331

Note: The table present pooled panel regressions.

***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively.

6.4 The Results of Model Three Regressions

In China, the reserve requirement ratio (RRR) is a very important monetary policy and it has also been used as the main macroprudential policy as well. From the statistics, it was adjusted by the central bank of China (PBOC) very frequently than the other policies. From previous results, it can obviously be found that reserve requirement ratio (RRR) is the relatively effective macroprudential policy instrument. Therefore, it is also needed to know that whether the reserve requirement ratio (RRR) as the main policy instrument have different effectiveness on managing newly constructed houses price (classified with three different housing type) and second-hand houses price (classified with three different housing type) in 30 provinces of China. These three housing types are divided by housing space, which are housing space totaling less than 90 square meters, between 90 to 144 square meters, and more than 144 square meters.

At this subsection, the main purpose is to compare the different effectiveness of the reserve requirement ratio (RRR) on three kinds of housing space type of newly constructed houses and second-hand houses in 30 provinces of China, respectively. However, it is worth to point out that in sample the value of reserve requirement ratio (RRR) large bank and small bank have the same values. Because the quarterly data used in this part is from 2011-2014, which is shorter than the data used in the previous section. So the reserve requirement ratio (RRR) used in this part will not be separated as two parts anymore.

The results of model three, which are the comparison between different house types of newly constructed and second-hand house market, shows in the Table 16.

The regressions column one shows the impact of reserve requirement ratio (RRR) on newly constructed house market. According to the results, it can be found that reserve requirement ratio (RRR) is significant at 1% level and have negative relationship with the whole newly constructed house price in this sample. However, when focus on the interaction terms that include dummy variables of different housing type, it shows that the

impact of reserve requirement ratio (RRR) on newly constructed house with middle size is not significant, that represents the impact of reserve requirement ratio (RRR) on newly constructed house with middle size is not different with the impact of reserve requirement ratio (RRR) on newly constructed house with small size. But the results shows that the interaction term of reserve requirement ratio (RRR) and newly constructed house with large size is significant at 5% level. Representing that the impact of reserve requirement ratio (RRR) on newly constructed house with large size is different with the impact of reserve requirement ratio (RRR) on newly constructed house with small size. According to the value of coefficient, when the reserve requirement ratio (RRR) increase 1 percent, the newly constructed house price with both small size and middle size will decrease 2.9553 percent, however, the newly constructed house price large size will decrease 2.9943 percent.

The regressions column two shows the impact of reserve requirement ratio (RRR) on second-hand house market. According to the results, it can be found that reserve requirement ratio (RRR) is significant at 1% level and have negative relationship with the whole second-hand house price in this sample. However, when focus on the interaction terms that include dummy variables of different housing type, it shows that the impact of reserve requirement ratio (RRR) on second-hand house with middle size is not significant, that represents the impact of reserve requirement ratio (RRR) on second-hand house with middle size is not different with the second-hand house with small size. But the results shows that the interaction term of reserve requirement ratio (RRR) and second-hand house with large size is significant at 1% level. Representing that the impact of reserve requirement ratio (RRR) on second-hand house with large size is different with the small size. According to the value of coefficient, when the reserve requirement ratio (RRR) increase 1 percent, the second-hand house price with both small size and middle size will decrease 2.1047 percent, however, the second-hand house price large size will decrease 2.1398 percent.

In general, in this section, the reserve requirement ratio (RRR) is efficiency in managing the price stability of all three housing types of both newly constructed house and second-hand house. Besides, the impacts of reserve requirement ratio (RRR) are the same in the small size house and middle size house, but it can decrease the price of the large size much more in both two markets.

Table 16. The results of comparing impact of reserve requirement ratio (RRR) in both newly constructed and second-hand house market with different house types.

Regression	1	2
Dependent Variables	Newly Constructed House Price	Second-hand House Price
Control Variables		
GDP	0.1885	0.1162
	(0.0592)***	(0.0483)**
Inflation	1.7749	1.1196
	(0.1198)***	(0.0938)***
Investment	0.8941	0.7145
	(0.1306)***	(0.0473)***
Policy Variables		
RRR for Large Bank	-2.9553	-2.1047
	(0.3775)***	(0.1819)***
RRR * New House (Middle Size)	-0.0153	
	(0.0167)	
RRR * New House (Large Size)	-0.0390	
	(0.0166)**	
RRR * Second-hand House (Middle Size)		-0.0137
		(0.0092)
RRR * Second-hand House (Large Size)		-0.0351
		(0.0090)***
t	0.0114	0.0072
	(0.0007)***	(0.0003)***
Constant	-8.1049	-4.0467
	(0.6779)***	(0.4091)***
Number of obs.	1260	1260
R-square (overall)	0.2884	0.3786

Note: The table present panel fixed-effects regressions.

　　　　***, **, * indicate statistical significance at 1%, 5%, and 10%, respectively.

6.5 Discussion in comparison with earlier literature

During 2006 to 2014, the results show that most individual macroprudential policy instruments are significant in managing the newly constructed house price and the second-hand house price (overall), the same with Darbar and Wu (2015) and Catte, Cova, Pagano, and Visco (2010).

In particular, when focus on the reserve requirement ratio (RRR) and the loan-to-value ratio (LTV), it can be found that the reserve requirement ratios (RRR) are more effective than the loan-to-value ratios (LTV) in curbing and sustaining both newly constructed house price and the second-hand house price. The same as the earlier literature, such as, Wang and Sun (2013) found that reserve requirement ratio (RRR) and house-related policy have effects in controlling house prices in the full sample. Zhang and Zoli (2014) found the housing measures are strongly significant in Asian countries sample and the advanced Asia (including Hong Kong SAR, Singapore and Korea). Lim et al. (2011) found that loan-to-value ratio (LTV) is significant in reducing the credit growth rate in the full sample, but reserve requirement ratio (RRR) is significant in reducing the credit growth rate during credit booms. Kuttner and Shim (2013) found the maximum DSTI can reduce credit growth than the maximum loan-to-value ratio (LTV). HKMA (2010), which is Hong Kong Monetary Authority, proved the loan-to-value ratio (LTV) is useful in reducing house price increase, especially the impact on luxury house. Igan and Kang (2011) and Se (2013) also found the loan-to-value ratio (LTV) is effective in managing housing market bubbles.

However, there are some of literature get the different results. Wang and Sun (2013) found that capital adequacy ratio (CAR) and liquidity ratio (LR) have no effect on house price. Zhang and Zoli (2014) found that when estimate with full sample (including CEE/CIS countries), the housing measures (LTV and tax measures) are not significant. Likewise, in this thesis part of results show that the loan-to-value ratio (LTV) of first house with housing space more than 90 square meters and the loan-to-value ratio (LTV) of second house are not significant as well. Furthermore, Crowe, Ariccia, Igan, and Rabanal

(2011) found the loan-to-value ratio (LTV) is more effective in decelerating credit growth than house price.

Whether the effective cases or the ineffective cases, all of literature have not explored the China's housing market with more detailed data in dependent variables and policy variables. The results of this thesis also show that reserve requirement ratio (RRR) and loan-to-value ratio (LTV) are effective instruments, and reserve requirement ratio (RRR) of large bank can help curb both newly constructed and second-hand house price (overall) better than all loan-to-value ratios (LTV). And when comparing the effectiveness of two markets, it shows that the effectiveness of large bank's reserve requirement ratio (RRR), the capital adequacy ratio (CAR) and the liquidity ratio (LR) on second-hand housing market are much better than the newly constructed housing market. However, the more effectiveness of loan-to-value ratio (LTV) of first house with housing space less than 90 square meters on newly constructed housing market than the second-hand housing market. And the effectiveness of loan-to-value ratio (LTV) of second house on newly constructed housing market and the second-hand housing market is the same. The loan-to-value ratio (LTV) of first house with housing space more than 90 square meters is not significant on both two markets.

Furthermore, during 2011 to 2014, when focus on comparing the effectiveness of reserve requirement ratio (RRR) on the house price of three different housing space types, it is shown that both newly constructed housing market and second-hand housing market, the reserve requirement ratio (RRR) can manage the house price very well with the large size more than the middle size and small size, which is different with Vandenbussche et al. (2012), who found the reserve requirement ratio (RRR) has no impact on house price inflation of 16 countries of CESEE.

It would be good to combine both average or overall sample and the detailed sample to make the results more comprehensive.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 General Conclusion

The housing market is an important component of country's economy, including investment and wealth, and it directly links to the financial stability. As well as for China, Chinese government paid great attention on the healthy development of housing market in recent decade to avoid the financial consequence. Thus, it's important to know whether the macroprudential policies enacted by government are useful or effective. This thesis concentrates on how significant it will be and what is the relationship between the different individual macroprudential policy and different type of house prices.

During 2006 to 2014, most instruments of macroprudential policy are significant and have the expected relationship with house prices (overall).

The reserve requirement ratio (RRR) and the loan-to-value ratio (LTV) as the important housing-related instruments can help control and contain increase of house prices (overall) of newly constructed houses and the second-hand houses. Based on the results of regression estimations, the reserve requirement ratio (RRR) of large banks, the loan-to-value ratio (LTV) for the first house with totaling house space less than 90 square meters, the loan-to-value ratio (LTV) of second house, as well as the capital adequacy ratio (CAR) and liquidity ratio (LR) are the most significant policy variables, which means these kinds of policies are effective. When the large bank's reserve requirement ratio (RRR) increases, it will reduce the house price (overall) of both two markets. But it can be more effective in the second-hand housing market than the newly constructed housing market. And when the loan-to-value ratio (LTV) of the first house with housing space less than 90 square meters decreases, the house price (overall) of both two markets would decreases as well. However, it would be more effective in the newly constructed housing market than the second-hand housing market. As for the loan-to-value ratio (LTV) for second house, it has the same effectiveness in managing stability of house price in both

two markets. By the way, when the capital adequacy ratio (CAR) and the liquidity ratio (LR) increases, the newly constructed house prices (overall) and the second-hand house prices (overall) will decrease, and the impacts of these two ratios on the second-hand house prices (overall) are much more effective than newly constructed house price (overall).

However, the loan-to-value ratio (LTV) for the first house with totaling house space more than 90 square meters has no impact or unclear impact to neither the newly constructed house prices (overall) nor the second-hand house prices (overall).

Following the literature reviews and experience of foreign countries especially the Asian countries, the reserve requirement ratio (RRR) is one of the key macroprudential policy instruments. There is the same situation in China as well, Chinese government used the reserve requirement ratio (RRR) as the main monetary policy all the time. But when implemented the macroprudential policy system, the reserve requirement ratio (RRR) was also used as the main macroprudential policy as well.

During 2011 to 2014, focusing on the effectiveness of the reserve requirement ratio (RRR) on three different housing type of newly constructed housing market and second-hand housing market in 30 provinces of China, the reserve requirement ratio (RRR) can manage the house price very well with the large size more than the middle size and small size in both two markets.

In summary, exist literatures have not explored the China's housing market with detailed data in house prices and policy instruments as this thesis. The effectiveness of two main housing-related macroprudential policy instruments could be concluded as follow. The reserve requirement ratio (RRR) are effective in managing the stability of house price (overall) in second-hand housing market than the newly constructed housing market, and it can reduce the house price of large size housing type much more than the middle size and the small size in all two markets. The effectiveness of the loan-to-value ratio (LTV) of first house with small size is much more in the newly constructed housing

market than the second-hand housing market, however, the loan-to-value ratio (LTV) of second house has the same effect on both two markets, and the loan-to-value ratio (LTV) of first house with large size is not effective neither newly constructed nor second-hand housing market.

7.2 Suggestions

The key instruments should be keeping used as usual. Although the reserve requirement ratio (RRR) was adjusted by the central bank very frequent, which was increasing by more than 30 times in recent 10 years, the results show that it works in long-term. Instead, there was few adjustment in the loan-to-value ratio (LTV), such as during 2006 to 2009 the ratio values of first house with totaling house space less than 90 square meters and the second house were stable, as well as the ratio values between 2011 and 2014. It might be the reason that the reserve requirement ratio (RRR) seems to have better performance than the loan-to-value ratio. The loan-to-value ratio, the instrument can effect on housing market directly, might should be used more active than now, in particular, the ratio of first house with large size.

And sometimes the function instruments are interact with each other, it's hard to estimate the impact of all macroprudential policy instruments at the same time, but using the individual instrument for each estimate. Besides the control variables used in the model, there might are many other factors making the policy useful in managing house price. Therefore, it can be tried by choosing the fit instrument combinations by drawing lessons from the experience of foreign countries.

Furthermore, it would be better that policy can be made relating the difference of province and implement for each region.

7.3 Recommendations for the future research

1) Due to the vast land of China, it is difficult to collect and update the up-to-date data from all regions. Some of variables in the model have missing values for two or three periods. If data collector or researcher can get more detail data, such as data in

city level with longer time series, it would make the model much better and the results will help other people to understand China more comprehensive.

2) In China, the implementation of the macroprudential policies has just started and all of processing were learning by doing. Most Chinses researches were still stay on theoretical analysis. Meanwhile, yet very limited quantitative analysis and empirical analysis in China. Hope there are more quantitative analysis and empirical analysis in case of China by learning the experience from many cases of foreign country.

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APPENDIX

APPENDIX 1. LIST OF 30 PROVINCES

Beijing	Tianjin	Shijiazhuang	Tangshan	Qinhuangdao
Taiyuan	Huhehaote	Baotou	Shenyang	Dalian
Dandong	Jinzhou	Changchun	Jilin	Ha'erbin
Mudanjiang	Shanghai	Nanjing	Wuxi	Xuzhou
Yangzhou	Hangzhou	Ningbo	Wenzhou	Jinhua
Hefei	Bengbu	Anqing	Fuzhou	Xiamen
Quanzhou	Nanchang	Jiujiang	Ganzhou	Jinan
Qingdao	Yantai	Jining	Zhengzhou	Luoyang
Pingdingshan	Wuhan	Yichang	Xiangfan	Changsha
Yueyang	Changde	Guangzhou	Shaoguan	Shenzheng
Zhanjiang	Huizhou	Nanning	Guilin	Beihai
Haikou	Sanya	Chongqing	Chengdu	Luzhou
Nanchong	Guiyang	Zunyi	Kunming	Dali
Xi'an	Lanzhou	Xining	Yinchuan	Wulumuqi

APPENDIX 2. THE ADJUSTMENT OF RESERVE REQUIREMENTS RATIO IN CHINA

Date	Large Banks	Small Banks	Date	Large Banks	Small Banks
21-Sep-03	7	7	25-Sep-08	0	-1
25-Apr-04	+0.5	+0.5	15-Oct-08	-0.5	-0.5
5-Jul-06	+0.5	+0.5	5-Dec-08	-1	-2
15-Aug-06	+0.5	+0.5	25-Dec-08	-0.5	-0.5
15-Nov-06	+0.5	+0.5	18-Jan-10	+0.5	0
15-Jan-07	+0.5	+0.5	25-Feb-10	+0.5	0
25-Feb-07	+0.5	+0.5	10-May-10	+0.5	0
16-Apr-07	+0.5	+0.5	16-Nov-10	+0.5	+0.5
15-May-07	+0.5	+0.5	29-Nov-10	+0.5	+0.5
5-Jun-07	+0.5	+0.5	20-Dec-10	+0.5	+0.5
15-Aug-07	+0.5	+0.5	20-Jan-11	+0.5	+0.5

25-Sep-07	+0.5	+0.5	24-Feb-11	+0.5	+0.5
25-Oct-07	+0.5	+0.5	25-Mar-11	+0.5	+0.5
26-Nov-07	+0.5	+0.5	21-Apr-11	+0.5	+0.5
25-Dec-07	+1	+1	18-May-11	+0.5	+0.5
25-Jan-08	+0.5	+0.5	20-Jun-11	+0.5	+0.5
25-Mar-08	+0.5	+0.5	5-Dec-11	-0.5	-0.5
25-Apr-08	+0.5	+0.5	24-Feb-12	-0.5	-0.5
20-May-08	+0.5	+0.5	18-May-12	-0.5	-0.5
15-Jun-08	+0.5	+0.5	25-Apr-14	0	0
25-Jun-08	+0.5	+0.5			

Source:PBOC (http://www.pbc.gov.cn:8080/publish/zhengcehuobisi/610/index_2.html)

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