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House Price Bubble in Urban China: Evidence from Eight Chinese Cities

A thesis submitted in partial fulfilment of the requirements for the Degree of Doctoral of Philosophy in Finance at Lincoln University by Wang Weizhuo

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China’s property prices started to pick up in 2001, where the nationwide property price index for residential building exhibited an increase of 23 percent from 2000 to 2004 (Peng et al., 2008). Cities such as Beijing and Shanghai have experienced annual land price growth rates of 20.2 percent and 23.7 per cent since 2008 (Deng et al., 2012). This rapid increase in house prices has led economists to believe that a “bubble” has formed in the Chinese housing market. If the house price bubble bursts, house prices will plummet before economic slowdown, at a faster rate than the overall economic growth, inflicting greater impacts on economic growth than any other industry (Liu, 2007). Due to the ongoing integration of China into the world markets, China’s real estate bubble burst will also slow down the global economy.

This study employs the simple price-to-income model, to more sophisticated econometric models such as Vector Auto Regression (VAR) and the Vector Error Correction Model (VECM) to investigate house price bubbles in eight Chinese real estate markets (Kunming, Xian, Urumqi, Guangzhou, Changchun, Beijing, Qingdao and Nanjing) for the period 1999 to 2013. The study also estimates the relationships between macroeconomic fundamental variables and house price indices in both the short-run and long-run. The study results suggest that China’s housing markets did not experience a bubble. The fluctuation in the house price indices of the eight Chinese cities can be explained better by the macroeconomic fundamental variables (inflation, income and mortgage rates) in the long-run than in the short-run. Furthermore, the results reveal that housing markets are efficient in Kunming, Xian, Urumqi, Changchun and Beijing, but inefficient in Guangzhou.

**Keywords:** house price bubbles, Price-to-income ratio, VAR, VECM, China
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Chapter 1
Overview of the Study

1.0 Introduction

Over the last two decades, China has experienced fast economic growth, accompanied by rapid expansion in the real estate market. The development of the Chinese property market started in the late 1980s with a series of gradual reforms on land-use and housing systems (Peng et al., 2008). The administrative housing allocation system was abolished in 1998 and this has increased the pace of urbanisation, along with strong income growth and the expansion of the mortgage loan business by commercial banks in the Chinese housing market (Peng et al., 2008).

Before 1980, China pursued a complete welfare-housing distribution system. Under this system, the government constructed welfare-housing and distributed the houses to residents according to the government’s housing plan (Yu, 2010). China did not develop a comprehensive real estate market until the State Council of China abolished the nationwide welfare-housing distribution system, and residents began to purchase houses in the real estate market (Yu, 2010). Housing has become the most important private property commodity for urban Chinese after the housing market reforms, when the idea of a tradable property market began to develop. Since 1990, urbanization in China has caused a substantial increase in house demand. For instance, the number of city dwellers in Beijing has increased from 10.8 million to 17.6 million, while the average members per household decreased from 3.2 people to 1.7 people. Newly registered marriages have risen by 54 percent since 2007 to 2010 raising the housing demand (Beijing Statistical Yearbook, 2011). For many Chinese, especially for young couples, renting an apartment is not very popular; one of the reasons being that renters lose their apartment if the owner wants back the apartment for other uses.

Real estate development investment has consistently expanded at a faster pace than economic growth since the introduction of private housing ownership in 1998. For the period 2000 to 2005, China’s nominal GDP almost doubled from 10 trillion Renminbi (RMB) to 19 trillion RMB. Over the same period, real estate development investment tripled from 0.5 trillion RMB to 1.6 trillion RMB (Seki, 2012). Similar trends continued during the five years after 2005. Nominal GDP doubled to 40.2 trillion RMB, while real estate development investment tripled to 4.8 trillion RMB (Seki, 2012). The increasing trend of the real estate market shows the continuous rise in the contribution of real estate development investment to nominal GDP in China (see Figure 1.1).
Property prices started to pick up in 2001, following declines in earlier years. The nationwide property price index for residential building increased by 23 percent between 2000 and 2004 (Peng et al., 2008). House prices have increased sharply in major cities and coastal provinces; in particular, the property price index of Shanghai increased by an average of about 13 percent per annum between 2001 and 2004 (Peng et al., 2008). Wu et al. (2010) study compared land prices to the value of finished-home sales (i.e. land plus the physical unit) for recent transactions. The authors reported that from 2003 to 2009, the ratio of land values to house values increased from between 30 percent and 40 percent. In early 2010, this ratio doubled to just over 60 percent on average (Wu et al., 2010). Deng et al. (2012) study on the quality of the land-price index for thirty five major cities in China reveals that the average annual land-price growth rate is above 20 percent in eleven cities from 2011 to 2012.; for example, Beijing and Shanghai, which experienced real annual growth rates of 20.2 percent and 23.7 percent, respectively. The land markets of Changsha, Chongqing, Lanzhou, Nanjing and Tianjin are almost indistinguishable from Beijing and Shanghai in terms of the land-price growth rate. In fact, the city of Hefei, the capital of Anhui province has the highest land-price growth rate with an annual average growth rate of 30.1 percent (Deng et al., 2012).

The property market boom in China is having a significant impact on the wider economy. In particular, real estate investment for residential building has grown strongly by an average rate of about 28 percent per annum for the period 2001 to 2004. The real estate industry raised GDP growth from 1.9 percent to 2.5 percent in the same period (Gu, 2005). The strong investment demand contributed to the sharp increase in producer and investment goods’ price inflation between 2002 and 2004. Chan’s (1999) study reported the housing component as the second largest contributor (after food prices) to the rise in the consumer price index. Sales of land and property development have become an
important source of income for local governments (Chan, 1999). Moreover, banks’ exposure to the property market has also increased. Liu and Huang (2004) estimate that in the early 2000s, about 60 percent of real estate investment in China was financed by bank loans, with mortgage and development loans accounting for 35 percent and 25 percent, respectively.

Many researchers have focused on the dramatic increases in house prices over the last decade which potentially will further inflate the house price bubble in China’s housing market. Shen et al. (2005) examined the house price bubble in the Beijing and Shanghai mortgage markets, and found strong evidence to support the existence of a house price bubble in the Shanghai housing market. Dreger and Zhang (2010) used time series data drawn from 35 major cities in China to investigate the size of China’s real estate bubble, and their results indicate that the house price bubble is particularly huge in the cities of the southeast coastal areas, and in special economic zones such as Shenzhen. Ning and Hoon’s (2012) study shows the real estate bubble in Beijing is bigger than that in Shanghai. Beijing exhibited serious housing bubbles in 2001, 2007, 2009 and 2010, compared to Shanghai’s bubbles in 2009 and 2010 (see Figure 1.2). In response to fears of a bubble, in the summer of 2011, Standard & Poor’s downgraded its outlook for China’s real estate development sector, to negative from stable (http://www.chinesecrash.com).

Figure 1.2 Level of Real Estate Bubble in Beijing and Shanghai (2001~2010)

Evidence of a housing bubble also includes significant numbers of vacant apartments in some Chinese cities, such as Sanya in the Hainan province, Ordos in the Gobi Desert, Kangbashi in Inner Mongolia, Zhengzhou New district in the Henan province, and Chenggong New District in the Yunnan province. In the Pearl River Delta, the New South China Mall is the world’s largest mall, twice the size of the Mall of American in Minneapolis. However, the New South China Mall is another example of a vacant project or a “ghost mall” (Alastair, 2012). Capole (2010) and Wenzel (2011) estimate that 64 million luxury units are vacant, and that “ghost cities” appear to exist in Yunnan province and Sanya city.
The vacant luxury units show that developers only build luxury apartments thereby strengthening their profits, at the expense of low and middle income housing (Rein, 2010).

Public housing programmes in China include low-rent units (lian zu fang), public rental units (gong gong zu lin fang), affordable housing units (jing ji shi yong fang) and price-controlled units (xian jia fang) (Deng et al., 2012). In 1995 affordable housing was 15 percent of all construction; in 2008 it was only 5 percent, which places the low income sector of Chinese citizens in a difficult housing position (Guo, 2010). Housing affordability or otherwise has become a pressing issue due to factors such as a growing population, speculation in the housing market and an inadequate supply of affordable housing. All these factors contribute to property booms.

In addition, high housing price-to-income ratio signals the existence of a housing price bubble in China. On January 19, 2010, the National Bureau of Statistics of China published the 2009 National Real Estate Market Situation, which revealed that the national, new house price average was 4695 RMB per square metre (Shen, 2012). Thus, an apartment of 100 square metres would cost about 470,000 RMB. According to the National Bureau of Statistics, the per capita disposable income of Chinese urban residents in 2009 was 17,175 RMB, resulting in an annual household income (average family of three) of 51,525 RMB for a household. Therefore, in 2009 the average housing price-to-income ratio was 9.1 for urban residents in China. By contrast, the comparable national data ratios are 2.9 for the U.S., 5.1 for the U.K., and 6.8 for Australia (Shen, 2012).

China is a developing country with a population of 1.3 billion and housing is a basic need for people’s livelihoods as well as for the public good. The development of the real estate industry is closely related to overall economic growth. If a housing bubble bursts due to economic or political factors, house prices will plummet before economic slowdown occurs, at a faster rate than the overall economic growth falls, thereby inflicting a greater impact on consumer confidence and economic growth than any other industry can (Liu, 2007). Helbling and Terrones (2003) and Goodhart and Hofmann (2008) point out that house price bubble bursts are associated with output losses that are twice as large as equity bubble bursts. Shocks caused by a housing bubble burst might transmit through a number of channels, including credit crunches and fewer construction activities (Dreger and Zhang, 2010). Due to the ongoing integration of China into world markets, China’s real estate market will also be affected by the global economy and shocks. Killion’s (2009) study reported that Asian economic growth is likely to suffer constraints, due to an unexpected slowdown in the U.S. economy and a potential spillover from the U.S. subprime mortgage crisis. For example, twenty-two U.S. banks failed in 2008, with banks rushing to conclude new deals as the Wall Street crisis deepened. On September 18th, 2008, the China Daily reported that at least three large Chinese commercial banks had disclosed their exposure to the worsening U.S. financial crisis, via bonds issued by the investment bank Lehman Brothers (Killion,
Following the collapse of the Lehman Brothers bank, China’s nominal GDP growth rate fell from its peak of 24 percent in the fourth quarter of 2007 to a mere 3.6 percent in the first quarter of 2009; China’s GDP deflator fell from 12.3 percent to a negative 3.7 percent in the same period (Nakamae, 2010).

Since 2011, there has been growing concern that the housing bubble is about to collapse. For example, Seki (2012) reports that the number of real estate transactions has fallen since September 2011, even though September and October are normally the busiest months for house sales in China. Seki also argues that if sales contracts shrink by 30 percent, then over half of Chinese housing developers, including some major companies (e.g. Van Ke and Poly Real Estate Group) would be unable to repay their debts (Seki, 2012). The issues discussed above mean that it is a challenge to investigate how the property market development has affected China’s overall economy.

1.1 China’s Property Market

The Chinese property market is directly linked to government revenue. The monetary Policy Analysis Group of the People’s Bank of China (2002) reports that the real estate sector accounts for 30 percent of China’s GDP growth rate. Lai et al. (2009) report that the real estate industry is highly relevant to many other industries, for example, the construction material industries, furnishings, real estate sales, and mortgage businesses. As reported by the People’s Bank of China, at the end of 2010 the outstanding balance of residential mortgage loans reached 6.16 trillion RMB, or about 6.1 percent of total bank loans. Thus, the bursting of a housing bubble could send the overall economy into recession or depression such as that which happened with the U.S. 2008 subprime loan crisis. The close relationship between the Chinese real estate growth rate and government revenue leads many analysts to predict that the government will not control property prices, as property price increases mean higher levels of public revenue. However, the property problems are not only economic problems, but are also social, class, generation, and urban-rural disparity problems, and the continued price growth may spark severe economic and social problems.

The surge in property prices and rising real estate investment has raised concerns about housing affordability for ordinary Chinese people (Jung-Myung, 2010). For instance, Veneziani and Chanos (2010) report that the average annual median income in China is US$3,500 and is only slightly higher in the urban sector. In some second tier Chinese cities such as Dalian, Chengdu and Changsha, a typical 100 square metre condo costs between US$120,000 and US$140,000. This means that for a dual income couple who make between US$7,000 to US$10,000 a year with a deposit of 20 percent, the monthly housing loan will cost between 60 percent and 100 percent of the couple’s total income before tax (Veneziani & Chanos, 2010). This mismatch of continuous increasing house prices, low average annual incomes and fewer affordable houses provided by the government, will cause
economic and social problems in China (Wu, Gyourko & Deng, 2012). In addition, accelerating house prices may indicate the presence of a housing price bubble (Dreger & Zhang, 2010).

The Chinese government needs to come up with solutions to prevent real estate prices from undermining economic and social stability in the country (Jung-Myung, 2010). This study examines the Chinese housing market, focusing on the price bubbles, in order to reduce the potential harm caused by boom and bust cycles of house prices, to China’s economy.

1.2 Concept of a Bubble

The term “bubble” is widely used but rarely clearly defined (Case & Shiller, 2003a). The term “bubble” was first used to describe well-known cases of speculative price movements such as the Tulip Bulb mania in Holland, the South Sea bubble in England, and the collapse of the Mississippi Company in France (Garber, 1990). From then on, the term “bubble” has been adopted to describe the dramatic process in which an economy sector prospers rapidly, and then declines rapidly (Kim, 2004).

The New Palgrave Dictionary of Economics (2008) defines a bubble as a sharp rise in the price of an asset or a range of assets in a continuous process, with the initial rise generating expectations of further rises and attracting new buyers. Sometimes a bubble is caused by speculators who are interested in profits from trading rather than expanding the sociable housing supply. Kindelberger (1987) defines a bubble as a sharp increase in an asset price in a continuous process. Increased asset price is caused by an investor’s expectation of a future increase in asset price (Stiglitz, 1990). This leads to the purchase of an asset in anticipation that the asset can be resold to other people for a higher price (Blanchard & Fischer, 1989). The people who buy the asset also hold the same beliefs about the asset price in future (Blanchard & Fischer, 1989).

Flood and Hodrick (1990) define a bubble as a deviation of the current market price of the asset (such as stocks or real estate) from the value implied by market fundamentals. Smith and Smith (2006) define a bubble as a situation in which the market price of the asset rises far above the present value of the anticipated cash flow from the asset. Camerer (1989) and Weil (1987) define bubbles as a change in the real economic environment. These changes that are caused by bubbles are described as a specific type of financial crisis (Knight, 2002).

Lind (2009) suggests each bubble episode has unique features since it is possible to construct a smaller number of “ideal types” of bubbles, where a specific mechanism dominates. The author defines three ideal types of bubbles:
1) A pure speculative bubble: where buyers believe the price of the asset today is too high and that the price eventually will fall, but believe in continuing price increases for some time, planning to sell with a profit before the price falls (Lind, 2009).

2) An irrational expectation bubble: where people in the market become over-optimistic and think the asset price will grow rapidly over a longer period of time. The growth is expected to be considerably higher than historical averages. Therefore, it seems rational to pay a high price today (Lind, 2009).

3) The irrational institutions bubble: where the main mechanism behind this bubble is the principal-agent problem, where buyers have incentives to pay higher prices than what is supported by historical patterns or strong evidence (Lind, 2009). The buyers of the houses/apartments do not expect to suffer losses when prices fall dramatically, while the person who lends the money also expects to be able to shift the losses to someone else, maybe the government. Subprime lending is the latest example of this type of bubble (Wheaton & Nechayev, 2008).

This current study adopts the irrational expectation bubble definition to investigate the housing bubbles in Chinese housing market. The massive saving rate (China’s gross national savings as a percentage of GDP surged over 50% in the 2000s), limited investment vehicles (the predominant investment vehicles are bank deposits and stock markets) and high average annual returns offered by the Chinese housing market (the lowest annual average return is 11% among the Chinese cities for the period 2003 to 2013) motivated the Chinese household to invest in the housing market (Fang et al., 2015). This study employs the long-term equilibrium house price to detect deviation of housing prices from macroeconomic fundamental variables.

1.3 Speculative and Historical Bubbles in the Housing Market

“That is what bubble is all about: buying for the future price increase, rather than simply for the pleasure of occupying the home.”


According to Stiglitz (1990) the asset price is high today only because investors believe that the selling price will be high tomorrow. When “fundamental” factors do not seem to justify such an increase in price, then a bubble exists. The “bubble” is defined in terms of how asset prices behave (Lind, 2009). In real estate research, the concept of bubble is defined as an unusually sharp rise (deviation) in the asset price at extraordinarily high levels from the market fundamentals (Kritayanavaj, 2008). The definition of market fundamentals is “an unmodified set of variables that help to determine an asset’s price which include the current values, dividends, and expectations about the asset’s value in the future” (Garber, 2000, p.4).
In the real estate market, the buyer of a property is prepared to pay a price which he/she thinks is similar to the “fundamental” values based on two criteria; the information on rental flows and the expected changes in the future price of the property (Xiao and Tan, 2007). Therefore, people have expectations of future house price changes during different economic conditions such as an expansion (boom) and recession (bust).

House-price bubble crises occur frequently in most housing markets. For instance, in 2007 a big housing-price bubble burst in the U.S. and the contagion of the subprime crisis spread from the U.S. to many other emerging countries, such as those of East Asia, and the Euro Zone countries of Greece, Italy, Portugal and Ireland (Kim & Kim, 2009). According to Pugh and Dehesh (2001) the real estate bubble is not a new phenomenon. The impact of the recent U.S. subprime crisis differed in size and magnitude compared to past housing bubbles, such as those in Florida in 1929 and Japan in 1989. Therefore, to better understand the current house price bubble, this study also describes two historical bubble events, one in Florida, U.S. (1929) and the other in Japan (1989).

1.3.1 Florida Land Boom of the 1920s

By the 1920s, the prosperity of the U.S. economy allowed people to invest in the property market. Miami has an image as a tropical paradise and outside investors across the U.S. began taking an interest in Miami real estate (Allen, 1931). Due to an outstanding marketing strategy, property prices rose rapidly due to speculation, and a land and development boom ensued (Allen, 1931). Furthermore, the boom and bust of the Florida real estate market is believed to have been caused by speculative bubbles that were in turn caused by the American middle class, who saw Florida as a wonderful residential place (Galbraith, 1954).

However, in the spring and summer of 1926, the boom in the Florida property market ended with the bursting of the bubble, leaving behind the remains of failed development projects such as Aladdin city in south Miami-Dade County, and Isola di Lolando in north Biscayne Bay (Allen, 1931). The story also includes similar property boom parallels in the modern real estate era, as well as the forces of outside speculators, easy credit access for buyers, and rapidly-appreciating property values, all of which directly contribute to the bursting of the real estate bubble (Galbraith, 1954).

1.3.2 Japan’s 1980s Asset Bubble Crisis

Cargill et al. (1996) describe the 1986 Japanese economy as a “bubble economy” due to the higher appreciation of the Japanese yen and easy mortgage financing. After World War II, Japan implemented stringent tariffs and policies to encourage the people to save their income. The large amount of savings in Japanese banks caused the Japanese economy to boom, with development in the banking sector leading to cheaper financing costs, a trade surplus and a stronger yen. During this period, Japan
experienced the most inflated property prices of the 20th Century with asset prices doubling and then tripling within a few years (Cargill et al., 1996). The Japanese bubble peaked with rumours about the higher cost of land beneath the Imperial Palace in Tokyo. The land was assumed to be worth more than the state of California. By 1989, Tokyo’s Giza district had recorded the highest price in Tokyo’s real estate market at US$1.5 million per square metre (Cargill et al., 1996).

Then, in 1990, the bubble burst. The Tokyo stock market collapsed with stock prices declining over 70 percent and real estate losing an estimated 80 percent of its inflated value. Asset prices in Japan finally came down in the first half of the 1990s and as a result the stock prices declined from 1990 to August 1992, and land prices halved for the period 1991 to 1995 (Cargill et al., 1996). After the bubble collapse, the yen appreciated to mid-1995 coinciding with a sharp drop in economic growth (Yurichuk, 2011). The country took an enormous amount of debt, borrowing overseas, in an attempt to stimulate the economy.

The bubble collapse in Japan lasted for more than a decade and the 1990s is commonly referred to as the “lost decade” in Japan. Stock prices bottomed out in 2003, and then went even lower amidst the global crisis in 2008 (Yurichuk, 2011). The economic future of Japan still remains uncertain two decades on from the collapse of the bubble economy (Yurichuk, 2011).

1.3.3 The U.S. Subprime Loan Crisis

The U.S. subprime loan crisis was a set of events and conditions that led to the late-2000s financial crisis, characterised by a rise in subprime mortgage delinquencies and foreclosures, and the resulting decline of securities (Krinsman, 2007).

The percentage of new longer-length subprime mortgages rose from the historical eight percent or lower to about 20 percent from 2004 to 2006. The subprime loan crisis was caused by the lowered lending standards and higher-risk mortgage products. According to Unterman (2009), the short-term interest rates were cut from 6.5 percent to one percent while the interest rates on 30 year fixed rate mortgages fell 2.5 percent. In addition, the interest rate on the one-year adjustable mortgage rate fell three percent (from 7 percent to 4 percent).

After U.S. house sale prices peaked in mid-2006 and began their steep decline forthwith, refinancing became more difficult. On March 13, 2007 the Mortgage Bankers Association reported that 13 percent of subprime borrowers were delinquent on their payments by 60 days or more (Krinsman, 2007). Between June 2007 and November 2008, Americans lost more than a quarter of their net worth (Roger, 2009). Total retirement assets which is Americans’ second-largest household asset, dropped by 22 percent, from US$10.3 trillion in 2006 to US$8 trillion in mid-2008 (Roger, 2009).
period, savings and investment assets (apart from retirement savings) lost US$1.2 trillion and pension assets lost US$1.3 trillion. Taken together, these losses total US$8.3 trillion (Altman, 2008).

The U.S. subprime loan crisis and the historical bubbles of Florida and Japan present good examples of a property market meltdown, and demonstrate that the asset price bubble can grow rapidly and the cost of the bubble bursting can be extremely expensive for the economy (Belke & Wiedmann, 2005). Jung-Myung (2010) warns that the formation of China’s property bubble appears much like that of Japan in the 1980s (see Table 1.1). China has become the world’s second largest economy and careful monitoring for a possible Chinese housing bubble collapse is all the more important.

Table 1.1 Comparison of China –Japan Asset Bubble Economy

<table>
<thead>
<tr>
<th></th>
<th>Japan’s Economic indicators 1986-1991</th>
<th>China’s Economic Indicators 2008-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Growth %GDP</td>
<td>3-4%</td>
<td>8-10%</td>
</tr>
<tr>
<td>Domestic savings</td>
<td>Strong</td>
<td>Very high: 20-40% of income</td>
</tr>
<tr>
<td>Central Bank Interest Rates</td>
<td>Lowered 5 times essentially to zero rate</td>
<td>2008: loan rate: 7.41% deposit rate: 4.41%; 2010: loan rate: 5.31% deposit rate: 2.25%</td>
</tr>
<tr>
<td>Loans/GDP</td>
<td>50% of GDP</td>
<td>40% of GDP</td>
</tr>
<tr>
<td>Local Currency vs. the U.S. dollar</td>
<td>Volatile Yen, strong appreciation followed by strong depreciation</td>
<td>Stable RMB, minimal appreciation against the U.S. dollar</td>
</tr>
<tr>
<td>Growth initiatives- domestic and export</td>
<td>Decreased due to appreciation in the Yen</td>
<td>Decreased due to global economic financial crisis</td>
</tr>
</tbody>
</table>


1.4 Research Problem Statement

The Chinese housing loan reforms started in 1980. The main direction of China’s housing policy over the last twenty years has moved away from the traditional system of welfare allocation (fulifenpei) to a system of monetised allocation (huobifenpei) of housing benefits. This policy encourages people to buy apartments and become home owners (Burell, 2006). These changes in housing policy have resulted in privatisation of public housing and the monetisation of housing benefits, which places new entrants to the housing market in a vulnerable position. In the early 1990s, according to the National Bureau of Statistics of China, the annual urban housing investment in China increased from 523 billion
RMB to 2309 billion RMB. Investment in commercial housing increased from 27 percent of the total urban housing investment in 1991 to nearly 60 percent in 1994 (Wang & Murie, 1999). From 2000 to 2004, China’s annual investment in real estate averaged about US$109 billion and accounted for almost seven percent of the nation’s GDP (Ye et al., 2006). Houses have become the most important new form of private property for urban Chinese (Feng, 2003).

In the year 2010, the private housing sector accounted for over 40 percent (40.8 percent in 2008 and 42.6 percent in 2009) of the buildings under construction; the construction industry being one of the most important industries in China (Wu et al., 2010). Its output constitutes 5.7 percent of Chinese GDP; it employs 14.3 percent of workers in urban areas; and it consumes about 40 percent of the steel and lumber produced in China (Wu et al., 2010). Therefore, the impact of a possible housing bubble burst would be staggering and significant for China’s economy.

In 1988, Hainan province experienced an economic bubble fuelled by a housing boom. In Hainan, the floor space under construction surged by 750 percent between 1990 and 1998, and exceeded 50 square metres per person, while that of Beijing was only nine square metres per person in the same period. Hainan’s housing bubble burst at the end of 1998 and left 7.03 million square metres of housing unsold, a tenth of the national total in that year (Chen et al., 2011).

Empirical research confirms that the bursting of housing market bubbles seriously impacts on the real economy more than that of the stock market (Helbing & Terrones, 2003, Bordo & Jeanne, 2002). According to the study of Ivana and Lubos (2011), the effects stemming from the sudden bursting of property market bubbles generates higher output losses and lasts longer on average (about 4 years) than in the case of stock market bubbles (around 1.5 years). Helbling and Terrones (2003) also found that during the period 1970-2002, the output effects associated with housing price bubble bursts were twice as large as those of equity price bursts, and that the economy slowdown after a housing market collapse lasts about twice as long as the slowdown after a stock market crash (Goetzmann & Ibbotson 1990; Liang et al., 1996). Therefore, a bubble is not just an increase in house prices; real resources are involved in the bubble which have been misdirected during the bubble and have to make painful adjustments in the aftermath of the bubble burst. This involves unemployment, foreclosure, and bankruptcy for many people, especially those in the construction and construction-related industries. The macro-economy will go into recession or depression, such as that which happened during the U.S. subprime housing crisis.

Since 2002 many government officials and economists have advised that some cities in China should be aware of the signs of housing price bubbles (Hui & Yue, 2006). For instance, the house price growth rates are 13.1 percent for the first tier cities, 10.5 percent and 7.9 percent for the second and third tier cities, respectively. These growth rates easily surpass the house price growth rate during the U.S.
subprime crisis in 2007 and are comparable to that during the Japanese housing bubble in 1989 (Fang et al., 2015) Given the potential volatility impact of the property market on the economy, it is important to investigate whether bubbles exist in the housing market in China.

1.5 Research Objectives

This study has developed a dynamic model for investigating house price bubbles in the Chinese housing market.

The objectives of this study are to:

- estimate the relationships between macroeconomic fundamental variables and Chinese house price index in the short-run and in the long-run.
- investigate whether a house price bubble exists in the Chinese housing market from 1999 quarter one (Q1) to 2013 quarter four (Q4), and identify the size of the bubble using macroeconomic fundamentals (such as interest rates, inflation and income).
- examine the efficiency of the Chinese housing market (by investigating the period adjustment correction mechanism; which converts house prices back to equilibrium prices).
- suggest a new technique for modelling house price bubbles in the Chinese housing market, that is the Vector error correction model (nonlinear method).

1.6 Significance of the Study

In the past few years the effervescence of the Chinese real estate market has surged rapidly. Guo and Huang (2010) noted that since 2005, in an effort to quell the speculation on residential properties, the Chinese central government has imposed, along with other supply regulations, an idle land tax, a land appreciation tax, and a business tax, on properties held for less than five years. Unfortunately, the benefits of these measures have been minimal as real estate prices have continued to rise. The house is the largest single asset for most Chinese households and it is also a very important component of the aggregate portfolio of financial intermediaries, such as banks. In addition, housing policy has pervasive economic and social effects in China and much recent domestic policy attention has been focused on housing price stability and mortgage affordability (Guo & Huang, 2010).

In general, a slump in real estate prices is more harmful than a stock market crash, because real estate is the most important collateral that underlies bank loans, and house ownership is more widespread across the population (Goodhart & Hofmann, 2008). However, in China, because of the low leverage level, the risk with respect to people not being able to fund their mortgage commitments might not be very high. Never-the-less, housing investment is an important pillar for economic growth (Liu et al., 2002). Chen and Zhu (2008) conclude from their analysis that an increase in housing investment of one percent will cause a rise in GDP of 0.2 percent in China. A housing bubble might also have an
international dimension due to the ongoing integration of China into world markets. A decline in house prices in China would contribute to lower output growth, and negative spill-over to other countries would occur (Dreger & Zhang, 2010).

Studies on China’s real estate market have so far mainly focused on the vertical process, which is the transition of land and housing systems from centrally planned market-oriented economic systems, to the regional housing market economic systems (Sun, 1998). Some researchers have studied the new legal framework and its implications on real estate development (Lim, 1995; Walker, 1991). Other researchers have examined the stages of land and housing reforms (Wang & Murie, 1996; Qu, Herrink, & Wang, 1995; Tolley, 1991; Walker, 1991; Tang, 1989). Still others have investigated the nature of this young market in terms of land and housing prices, and the continuous influence of the state on market operations (Li, 1997; Chen, 1996; Li & Walker, 1996; Walker & Li, 1994). However, there is a lack of research regarding modelling the house price bubble in China and therefore this study contributes several new insights into the Chinese housing market, as follows:

- Few studies focus on the Chinese housing bubble, and the data periods for the existing literature regarding China’s housing market are mostly before 2007. For instance, the data period for Shen et al. (2005) study is from 1997 to 2003; Hu et al. (2006) study is from 1990 to 2005; and Hou’s (2010) study is from 2000 to 2007. This current study fills a gap in the Chinese housing market literature by investigating the housing markets of six Chinese cities, by drawing data from the period from 1999 to 2013 which includes the 2008 Beijing Olympic Games and the period of the U.S. subprime loan crisis. These two important events are expected to have dramatic effects on house prices in China, which in turn significantly impact on China’s economic growth.
- By providing a better picture of the Chinese housing market and facilitating an understanding of the boom and bust process so that adequate preventive measures against the boom and bust process can be designed.
- By increasing awareness in housing market players (investors, sellers and buyers) of the house price bubble process and its impact on the economy.

1.7 Organisation of the Thesis

This thesis consists of seven chapters. Chapter One provides the introduction and background of the study, problem statement, research objectives and significance of the study. Chapter Two presents an overview of the real estate market in China. Chapter Three discusses the literature review on “bubbles” in housing markets and the real estate cycle. Chapter Four presents the proposed house price bubble model used in this study. Chapter Five discusses the data and methodology of the study and Chapter Six presents the analysis and findings. The conclusion and recommendations are presented in Chapter Seven.
Chapter 2

Summary of China’s Housing Market Developments and Policies

2.0 Introduction

This chapter presents an overview of the Chinese housing market. Section 2.1 provides an overview of the Chinese property market. Section 2.2 addresses the development and characteristics of the Chinese housing market. Housing finance and housing policy in China are discussed in sections 2.3 and 2.4, respectively. Other related issues such as the current status of the Chinese housing market is presented in section 2.5.

2.1 Overview of the Development of the Chinese Housing Market

Over the 30 years from 1949, Chinese urban housing was provided within a socialist system. Through the 1950s and 1960s, private housing was treated as a social asset financed, produced, allocated and administrated by the state through work units and local housing departments. The principles guiding the housing sector were mainly determined by ideological and political considerations (Zhang, 2001; Wang, 1992). At the same time, the Chinese housing system caused many problems such as serious housing shortages, insufficient investment, corruption in distribution, low rents and poor management (Wang & Murie, 1999).

China has transformed from a planned to a market economy since 1978. The housing system reform has been the most radical component of the transition process. In 1998, the previous system of freely allocating apartments to employees through their work units was abolished and replaced with the allocation of housing subsidies (Gao & Asami, 2011).

Supplemental public housing programmes were established to help those who cannot afford houses in the market. The housing system reform greatly stimulated the market provisions of housing and improved the dwelling conditions of people (Gao & Asami, 2011). At present there are three types of housing in the urban areas: (1) “low-income rental housing” which is provided by local governments for the lowest income families; (2) “economically affordable housing” (EAH) for low and middle income families, which is supplied through commercial development where the prices are about 30 percent to 50 percent lower than that of commercial housing. Prices are lower because the owners are exempt from land-related taxes and fees and the net profit for EAH development is controlled at three percent; and (3) “commercial housing” for the remaining households (Gao & Asami, 2011). However, the provision of low-income rental housing and EAH has been very limited compared to the needs of low and middle income families. An income-based criterion has been adopted to determine which families...
qualify for EAH. However, because an efficient income and asset monitoring system has not been established in China, it is difficult to verify the true income level of most families (Gao & Asami, 2011).

The central government of China has budgeted and spent huge amounts over the past decade to fund affordable housing projects. In 1988, the government spent a total of 80.6 billion RMB, which was about 0.99 percent of annual GDP at that time, to build affordable housing. In 2003, government expenditure on affordable housing construction increased to 157.8 billion RMB, which amounts to 1.35 percent of annual GDP (Jin, 2006). The central government also encouraged real estate developers to get involved in real estate by allowing them to acquire land at much lower cost on condition that a certain percentage of the acquired land was developed for price-limited housing projects.

However, the results of these measures have not been satisfactory. The summation of government funded affordable housing projects completed each year are insufficient to meet the needs of large middle-to-low income populations. Some developers even find ways to replace the ‘on condition’ “affordable housing” on lower-cost land, with other projects such as luxurious apartments (Gao, 2010). Developers’ reluctance to provide affordable housing is evidenced by the fact that while total construction volume has skyrocketed, the percentage of affordable housing construction has decreased (see Table 2.1) (China Year Book, 2009).

Table 2.1 Total Building Space of Newly Built-Up Residential Houses for Middle- and Low-Wage Earners in China

<table>
<thead>
<tr>
<th>Year</th>
<th>Construction Floor Space (10,000 square metres)</th>
<th>Construction Floor Space for Affordable Housing (10,000 square metres)</th>
<th>Affordable Housing Construction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>10,996.60</td>
<td>1,720.60</td>
<td>15.6</td>
</tr>
<tr>
<td>1998</td>
<td>16,637.50</td>
<td>3,466.40</td>
<td>20.8</td>
</tr>
<tr>
<td>1999</td>
<td>18,797.90</td>
<td>3,970.40</td>
<td>21.1</td>
</tr>
<tr>
<td>2000</td>
<td>24,401.20</td>
<td>5,313.30</td>
<td>21.8</td>
</tr>
<tr>
<td>2001</td>
<td>30,532.70</td>
<td>5,796.00</td>
<td>19.0</td>
</tr>
<tr>
<td>2002</td>
<td>34,719.40</td>
<td>5,279.70</td>
<td>15.2</td>
</tr>
<tr>
<td>2003</td>
<td>43,853.90</td>
<td>5,330.60</td>
<td>12.2</td>
</tr>
<tr>
<td>2004</td>
<td>47,949.00</td>
<td>4,257.50</td>
<td>8.9</td>
</tr>
<tr>
<td>2005</td>
<td>55,185.10</td>
<td>3,513.50</td>
<td>6.4</td>
</tr>
<tr>
<td>2006</td>
<td>64,403.80</td>
<td>4,379.03</td>
<td>6.8</td>
</tr>
<tr>
<td>2007</td>
<td>78,795.51</td>
<td>4,810.26</td>
<td>6.1</td>
</tr>
<tr>
<td>2008</td>
<td>83,642.12</td>
<td>4,336.97</td>
<td>5.2</td>
</tr>
</tbody>
</table>

2.2 Development in the Chinese Property Sector

2.2.1 Housing Reform

Urban residential housing units in China were nationalised and owned by the central government at the founding of the People’s Republic of China (PRC) in 1949 (Wu et al., 2012), resulting in the Chinese government completely monopolising the land market and controlling land quantity and the timing of developments (Deng et al., 2009). In the following three decades, the State determined the national economic plan and was the monopoly provider of housing. State-owned housing developments were financed by an annual State Budgetary funding, with the units built then allocated to individual households at low rents through their work units (Danwei), which often were state-owned enterprises. During this period, the private housing market was non-existent (Zhao & Bourassa, 2003, Wu et al., 2012).

The State’s monopoly of the residential housing system started to change in the late 1970s (Wu et al., 2012). In 1979, a trial privatisation of state-owned residential housing units began in several coastal cities, and was soon expanded to over 100 cities and then the entire country. This reform led to the emergence of a private housing market (called “commodity housing”) in China (Wu et al., 2012). From 1980, the role of the Chinese government in housing and also how the housing problem can be resolved, has been the subject of continuous debate. The introduction of economic reforms have allowed market forces and private enterprise to play an increasing role in the economy and in the production and consumption of housing in particular (Wang & Murie, 1999). In 1988, the government initiated the Ten Year Reform Strategy. One of the major objectives of this reform was to encourage urban residents to buy their houses, to establish housing development funds, and to reform the rent system in the public sector (Liu, 1989). In the mid-1990s, the government virtually stopped all direct housing funding; the role of the work units (Danwei) in housing provision was also eliminated (Zhang, 2001). Although the state still exerts its influence on the urban development process, the power of the market has increased rapidly, driving land market reforms, and restructuring the system of housing provision (Wu, 2003; Ma, 2004; Qian, 2012).

2.2.2 Urbanisation and Migration

Compared with other countries, China differs in migration and urbanisation patterns due to its unique ‘Household Registration System’ (Hukou) and huge population base (Zhang et al., 2011). Chen et al. (2011) have explored the possible effects of rural-urban migration and urbanisation on China’s urban housing prices and have found that the different processes of provincial urbanisation and the migration situation have significant effects on urban house prices in China.
Urbanisation refers to the expansion in the proportion of a population living in urban areas, and is one of the major social transformations sweeping the globe. Now, more than half of the world’s population live in urban areas, and by the year 2050, 70 percent of the world’s population will be city dwellers (Yu, 2010). Although China has the largest urban population in the world by number, it never-the-less has a comparatively low urbanisation level, approximately 10 percent lower than the world average and 30 percent lower than more developed regions (United Nations, 2004).

Since the mid-1990s, China’s new round of market-oriented economic reforms has driven the population migration and urbanisation processes at an extraordinary pace, mainly through massive rural-to-urban migration and the development of new urban centres (Wang & Murie, 1996; Ma, 2002). Between 1996 and 2005, the urban population increased by over 50 percent from 373 million to just over 562 million. Since 2005, there have been about 15 million new people entering urban areas each year (Wu et al., 2012).

The large internal migration is regulated by the Household Register System (Hukou). A household migrating to a new city without Hukou would suffer from not being able to readily access health, education and other public services. Many housing units are being purchased by people migrating with Hukou from other areas. For example, Table 2.2 shows that in 2009, about one-third of the newly-built private housing units sold were purchased by internal migrants (Wu et al., 2012).

Table 2.2 Composition of Commodity Housing Unit Purchasers

<table>
<thead>
<tr>
<th>Year</th>
<th>From local urban area (%)</th>
<th>From local rural area (%)</th>
<th>From other domestic areas (%)</th>
<th>From other countries /regions (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>70.1</td>
<td>5.8</td>
<td>22.7</td>
<td>1.4</td>
</tr>
<tr>
<td>2006</td>
<td>62.1</td>
<td>8.2</td>
<td>28.4</td>
<td>1.3</td>
</tr>
<tr>
<td>2007</td>
<td>62.4</td>
<td>10.3</td>
<td>26.5</td>
<td>0.8</td>
</tr>
<tr>
<td>2008</td>
<td>64.8</td>
<td>10.2</td>
<td>24.3</td>
<td>0.7</td>
</tr>
<tr>
<td>2009</td>
<td>54.1</td>
<td>11.8</td>
<td>33.5</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Source: Ministry of Housing and Urban-Rural Development

The strength of real demand in small- and medium-sized cities is driven by the dynamism of urbanisation. Urbanisation generates substantial new-housing demand in cities (Seki, 2012). The urban population has risen dramatically because of migration from rural to urban areas. Between 2006 and 2009, China’s urban population grew by 44.8 million. The population of small- and medium-sized cities increased by a total of 42.29 million during this period, compared to a total increase of 2.51 million in the populations of Beijing and Shanghai together (Seki, 2012).

Rapid economic growth and massive rural-to-urban migration are expected to continuously fuel the demand for housing in mainland cities. In 2003, the State Development Planning Commission announced that it is government policy to achieve an urbanisation rate of over 50 percent by 2020,
and the annual demand for urban housing space is projected to increase to about 300 million square metres when the urban population reaches 650 million in 2010 (Xie & Liu, 2004; Gao 2010). In the meantime, China has also undergone an evolutionary process of urban housing commercialisation (Wu, 1996). With China facing simultaneous rapid urbanisation and an urban housing transition, many researchers have expressed their concerns about the urban problems caused by speedy urbanisation (Yang, 1993; Kojima, 1995; Yeung & Shen, 2004). Yang (2002) reports that in 2002, China found itself with not only one of the highest rates of economic growth in the world, but also one of the highest rates of rural inequality in urban income in the world.

Although the housing shortage has been partially addressed through the privatisation process, a big income gap has developed between the rich and poor among urban Chinese residents (Zhao & Bourassa, 2003). According to the National Statistics Yearbook (NBSC, 2009; MLR, 2007), citizens in the first tier cities often find the ratio between housing prices and their household annual income to be around 20. This ratio is significantly higher than the recommended range of two to five by the World Bank (World Bank, 1996). In western countries such as the United States, the median-house price to income ratio is rarely over eight in most regions.

In most major Chinese cities, the ratios between average housing prices and the incomes of the lower-to-middle households are much higher than those in developed countries. In 2005, the average housing price was 22.69 times that of the lowest income household’s annual income (the bottom 20 percent income households), while the housing prices were only 2.45 times that of the highest income household’s annual income (the top 20 percent income households). Compared to the global average ratios, these two ratio values for low/middle income and high income households are 9.7 and 5.6 respectively. Furthermore, in recent years it has been observed that the difference between housing prices and annual income has enlarged for the low/middle income families, while reduced for the high income families (Jin, 2006). The absence of proper housing policies for meeting the need for affordable housing means that skyrocketing housing prices may cause a deterioration in social and political stability in China’s urban regions.

2.2.3 Urban Land Supply System and Land Market

After the land reforms of the early 1950s, urban land in China was owned by the state (the city government directly) and rural land was owned collectively by rural communities. In the urban areas, land management was characterised by direct allocation of land by the state to various state-owned land-users such as the state-owned enterprises’ administrative bodies and public institutions (Wang & Murie, 1999). Under the planned economy, the majority of urban land-users’ land was held in public ownership. After 1978, urban economic reforms changed the composition of the urban economy dramatically and there was an increase in non-public ownership (enterprises with foreign investment
or purely private investment) (Wang & Murie, 1999). Land transfers based on market or price signals became inevitable and in 1987, the first land auction was held in Shenzhen. However, in subsequent years, most land parcels have not been sold publicly via auction or bidding. Instead, the developer has contacted the local government about a land parcel in which it was interested, and then negotiated the price (Wu et al., 2012).

In 1990, a Provisional Ordinance for urban State-owned ‘Land Use Right Transfer’ was issued to guide the urban land market. Under this new system, there was no change in land ownership or in the arrangements for state acquisition of collectively owned rural land for urban construction (Wang & Murie, 1999). Rural farmers did not and still do not have the right to sell agricultural land to other users. However, urban authorities were given the power to acquire and sell land-use rights to developers. The representatives of the state for urban ‘land-use right transfer’ are the city or county governments (Wang & Murie, 1999). The transfer of the right to the use of a piece of land means tenure of the land for an agreed time-period is guided by the contract between the land-user and the state. The central government established time-limits for different categories of land uses (State Council of China, 1990) as follows:

- Residential use: 70 years;
- Industrial use: 50 years;
- Educational, scientific, cultural, health and sport uses: 50 years;
- Commercial, tourism and recreation uses: 40 years;
- Comprehensive (mixed) and other development: 50 years.

Another important point about China’s land supply process is that land auctions are an important source of revenue for local governments. In fact, revenue from the land market has become local governments’ most important off-budget income source (Wu et al., 2012). The local governments’ gross income from land sales grew from 542 billion RMB in 2003 to 1.6 trillion RMB in 2009 (Wu et al., 2012). As the monopoly supplier in the new urban land market, local governments’ behaviour clearly can affect the price and quantity of housing.

In addition to financial advantages that the real estate market development has brought to local governments, the real estate market has gradually become a strong engine for local economic output. Since the mid-1990s, GDP growth has been taken as an important evaluation factor where promotion of local officials is concerned. From this perspective, it is understandable that local officials regard real estate development as an important political tool for enhancing their own political interests and
reputations within the governing system (Gao, 2010). As a consequence, the partial self-interest of central government to maintain social stability, and the self-interest of local governments to promote rapid economic growth, are not completely aligned (Gao, 2010), and in some instances are quite different.

2.3 Housing Finance in China

China’s housing finance system has been completely restructured by the housing reforms. Before the reforms, all economic power was concentrated in central government. Housing was financed solely by the government through budgetary funding which had led to serious housing shortages. The restructuring of China’s housing finance system was very unbalanced in its early stages. Most of the funds were distributed as development loans for production, with little left for housing consumption (Deng et al., 2009). In the early 1990s, the easy availability of development loans was one of the reasons for an oversupply of commercial housing in several regional real estate markets. For example, in the 1990s in the Hainan province, the oversupply caused many development companies to go bankrupt and a large number of properties to remain vacant for years (Deng et al., 2009). Since then, the Chinese government has been more careful to prevent localised real estate bubbles.

In 1994, as part of the housing reform package, the Chinese government started to introduce mortgage loans to home buyers nationwide (Di et al., 2008). However, banks were not comfortable providing loans to individual households and often imposed strict conditions on loan originations. For instance, mortgage loans were only available to those who had bank savings equal to 30 percent of the house’s value. Moreover, the loans had to be paid back in five years, and the first payment had to be no less than 30 percent (Zhang, 2000; Deng et al., 2009). Most urban households could not meet banks’ lending criteria. As a result, individual mortgages remained only a small portion of all bank loans. In June 1998, Chinese banks originated housing loans worth a total of 264.3 billion RMB, but most of them were development loans. Only 35 billion RMB (about 13 percent) were used for home purchase mortgages (Han, 1999). Another significant development of the 1994 reforms, was the establishment of the Housing Provident Fund (HPF). Since then, urban households in China have been able to expect to get both subsidised HPF loans and commercial mortgage loans (Deng et al., 2009).

The HPF is a long term, compulsory, indemnificatory and mutual-aid housing fund. It is a programme that was established by the government to assist home financing for people working in different social organisations. Such organisations include state organisations, state enterprises, foreign investment enterprises, urban collective enterprises, urban/private enterprises and other urban enterprises, public institutions and in-service workers (Chen & Wu, 2006; Nie, 2004). The HPF aims to ease the financial stress of home purchasers and improve housing affordability for low-income classes.
In the HPF programme, both the work unit and the individual make monthly obligatory contributions of a defined proportion of the employee’s salary into the HPF account, which is deposited to a bank selected by the Provident Fund Management Centre (Deng et al., 2009). The People’s Bank of China is responsible for the determination of interest rates applicable to HPF, while the Ministry of Construction and the Ministry of Finance are responsible for overseeing the scheme at the strategic and national levels. At the local level, Housing Committees determine policies in association with Management Centres and designated banks are responsible for the daily operation of the HPF programme (Yeung & Howes, 2006). The designated banks also further supplement the fund with individual housing loans through a mortgage system (Chen & Wu, 2006).

2.3.1 Commercial Mortgage Loans

Five State-owned banks dominate the commercial housing mortgage-loans market in China: the Industrial and Commercial Bank of China (ICBC), Agricultural Bank of China (ABC), Bank of China (BC), China Construction Bank (CCB), and Bank of Communication (BOC), all supervised by the People’s Bank of China Banking Regulatory Commission (CBRC). Together they account for over 90 percent of the commercial mortgage market share (Deng et al., 2009). Although the small- and medium-sized commercial banks are allowed to provide commercial mortgages, their market share is very small. Table 2.3 shows the classifications of Chinese mortgage loans.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Purpose of the loan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal housing loan</td>
<td>Used to support individuals in cities and towns of mainland China to buy/build houses and for housing repairs.</td>
</tr>
<tr>
<td>Second home loan</td>
<td>Used to support individuals for purchasing secondary market-traded houses.</td>
</tr>
<tr>
<td>Housing provident fund (HPF) loan</td>
<td>Bank credit and housing accumulation funds available for HPF participants, and used to buy various types of housing.</td>
</tr>
</tbody>
</table>

Table 2.3 Classified Real Estate Loans in China

Sources: Construction Bank of China, 2009

The Chinese housing loan reforms started in 1980. The main orientation of China’s housing policy over the last twenty years has moved away from the traditional system of welfare allocation (fu li fen pei) to a system of monetised allocation (huo bi fen pei) of housing benefits. This policy encourages people to buy apartments and become homeowners (Burell, 2006). These changes in housing policy have resulted in the privatisation of public housing and the monetisation of housing benefits, which places new entrants to the housing market in a vulnerable position.

Traditionally, the Chinese people have relied on their own earnings and have tried to save enough money to purchase houses (Burell, 2006). In addition, people’s salaries have increased, but the prices of new houses have risen much faster. For example, the price for urban housing in China was set
between 500 RMB and 2,000 RMB per square metre in 1992 (Wu, 1996). However, in the late 1990s most houses in the large cities had reached 3,000 RMB per square metre. In large cities such as Shanghai and Beijing, housing prices are higher and rise more rapidly (Burell, 2006). The majority of urban households have had their wages increased, but these increases have not kept up with the increase in housing costs (see Table 2.4) (Burell, 2006), which mean an increasing demand for housing loans.

<table>
<thead>
<tr>
<th>City</th>
<th>Individual average annual earnings (RMB)</th>
<th>Couple average annual household earnings (RMB)</th>
<th>Time needed for a 60,000 RMB down payment. 30% of household earnings (years)</th>
<th>Time needed to purchase a 300,000 RMB apt. 30% of household earnings (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beijing</td>
<td>18,157</td>
<td>36,314</td>
<td>5.3</td>
<td>27.7</td>
</tr>
<tr>
<td>Shanghai</td>
<td>21,957</td>
<td>43,914</td>
<td>4.7</td>
<td>22.7</td>
</tr>
<tr>
<td>National</td>
<td>11,152</td>
<td>22,304</td>
<td>9.0</td>
<td>44.7</td>
</tr>
</tbody>
</table>

Source: China Labour Statistical Yearbook 2003

Growth in the Chinese housing loan market has been rapid over the past decade, especially after China’s accession to the WTO in 2002, foreign lenders became permitted to participate in the Chinese banking markets and both domestic and foreign banks recognised the business opportunities developing in the housing loans market in China. According to statistics from the People’s Bank of China (2003), the balance of personal housing loans topped 1.18 trillion RMB in 2003 (US$142.51 billion), 26.64 times the figure in 1998 (Wang, 2004). At the end of October 2007, outstanding residential housing loans reached 4.69 trillion RMB, a growth rate of 30.75 percent, up 1.01 trillion RMB from the beginning of the year 2007, accounting for 28.9 percent of total new RMB loans from commercial banks during the same period. Also at the end of October 2007, outstanding individual housing loans reached 2.6 trillion RMB, 619.2 billion RMB more than the beginning of 2007 (Liu, 2007). This has led to a large demand for housing mortgage loans.

2.4 Chinese Housing Policy

After twenty years of reform, China now has more or less a complete set of policy systems covering land management, investment, circulation, transaction and property management, public finance, taxation, planning, construction and sales (Ye et al., 2006). The parties involved in China’s housing policy include government/private enterprise, and service agencies.
2.4.1 Chinese Major Housing Policies Over the Last Decade

The central government has used various measures such as monetary policy, budgetary policy, land regulation policy, legislative policy, and administrative policy to curb rapid housing price appreciation (Wang & Liu, 2007). After June 2003, there were three major intervention policies that greatly changed the conditions of housing supply, and housing demand, and the expectations of the market participants.

**Lending Control Policy**

On the 5th June 2003, the People’s Bank of China (PBC) issued notification No.121, which started a new round of macroeconomic controls. The major objective of this notice was to make the lending behaviour of commercial banks towards housing developers more prudent, as well as control the financial risks of China’s banking sector. Notification No.121 required that 30 percent of the total housing project investment should be equity investment when obtaining commercial lending, but also required that commercial banks be prevented from lending to developers to pay off land-use fees. Before the issue of Notification No.121, many developers had quite large debt-to-asset ratios, and a large portion of them relied on bank loans to acquire land (Wang & Liu, 2007).

In addition, on 23rd August 2003, the PBC issued another notice to increase the deposit reserve rate from 6 percent to 7 percent after 21st September. This was the first attempt to increase the deposit reserve rate in 15 years, (recent market policies reveal that changing the deposit reserve rate is one of the best commonly used intervention instruments for restraining a bank’s liquidity). Such a policy was intended to restrain the excessive money supply in the economy, and therefore cool down the investment momentum (Wang & Liu, 2007). Data from the China Real Estate Yearbook shows that in 2003 about 23.8 percent of real estate development investment was made up of domestic commercial bank loans. Another 38.7 percent of investment was from presale housing units the sale of which also relied heavily on commercial bank loan programmes for individual households.

**Land Supply Regulation Policy**

On 3rd April 2002, the Ministry of Land and Resources (MLR) promulgated the Interim Regulations of the People’s Republic of China, on granting and transferring the right to the use of state-owned land in cities and towns. On the 31st March 2004, Notification No.71 of the MLR was issued; it stated that after 31st August 2004, all state-owned land should be transacted through biddings, auctions, or land-leasing centres. Due to the deadline set by Notification No.71, the transaction volume of land-use rights popped up in the short run before 31st August 2004. The expansion in the number of land transactions caused an increase in the land-bank reserves of developers; this regime change also pushed up housing prices (Wang & Liu, 2007).
Comprehensive Control Policy

Because house prices continued to rise in Shanghai, Beijing, and the coastal cities in 2004 and 2005, the Central Government again tightened its regulation of the housing market. Policy measures were adopted to discourage speculative activities, as well as control housing investment. On 17th March 2005, the PBC adjusted the preferential mortgage interest rate from 5.31 percent, to the benchmark long-term loan interest rate of 6.12 percent, and initiated a lower limit management scheme that allowed commercial banks to give borrowers a maximum discounted rate of 5.51 percent (10 percent off the benchmark rate of 6.12 percent). The ratio of down payment for house purchase was also increased by 10 percent (from 20 percent to 30 percent) in those cities where housing prices were growing at a faster pace. On the 12th May 2005, seven ministries jointly issued a notification designed to stabilise rising housing prices. For instance, property owners who resold their properties within two years of occupancy would be charged sales tax of 5.5 percent on the gross resale price (Wang & Liu, 2007) and vacant land would be charged an extra fee after the original commencement date of its development. Also, if the vacancy period should surpass two years, the land-use right would be confiscated. Buyers of presale units would not be allowed to resell their properties before completion. These series of policies were mainly used to improve the supply structure, regulate excessive demand, and limit housing speculation (Wang & Liu, 2007).

The Development of Affordable Housing Policy

In the 13 years from 1994 to 2006 (inclusive 1994), the affordable housing policy experienced three development stages. The main cause of the changes brought about by the three development stages was the policy whereby the government controlled the land supply, and the construction plans for affordable houses, and thus played an important role in the programme (Niu, 2008).

Initial Stage

The initial stage of the affordable housing policy started in the second half of 1994 and lasted four years (Niu, 2008). In June 1994, a circular from the State Council “Deepening the Housing Reform”, proposed the construction of affordable housing for the first time. This action marked the implementation of the affordable housing policy. The area under construction increased by almost 90 percent between 1996 and 1998, but the proportion of total housing was still low. Therefore, the features of the initial stage can be summarised as having a high development speed and small construction size (Niu, 2008).
**Fast Development Stage**

In July 1998, the State Council’s circular “Further Deepening the Urban Housing Reform and Accelerating Housing Construction” proposed to establish a housing market that would mainly consist of public houses. Following this, the construction of affordable houses began to rise significantly. Table 5 reveals that the affordable housing under construction and total housing under construction both grew rapidly between 1998 and 2000. The development of affordable housing in the early 2000s can be summarised as a process of fast growth of a relatively large size (square metres) (Niu, 2008).

| Table 2.5 Housing Construction in China from 1998 to 2003 |
|---------------------------------|--------|--------|--------|--------|--------|--------|
|                                   | 1998   | 1999   | 2000   | 2001   | 2002   | 2003   |
| Affordable housing under construction (1,000 square metre) | 13,327.6 | 17,700.0 | 18,575.5 | 22,552.7 | 20,950.1 | 20,023.0 |
| Total housing under construction (1,000 square metre) | 36,223.0 | 42,590.3 | 50,498.3 | 61,583.0 | 73,208.7 | 91,390.5 |
| Ratio | 36.79% | 41.56% | 36.78% | 36.62% | 28.62% | 21.91% |

*Source: The Ministry of Construction, 2004*

**Adjusted Stage**

In August 2003, the State Council issued a circular called “Promoting the Stable Development of the Real Estate Market” which proposed a new housing supply structure, where “ordinary commercial housing” was supposed to be the main constituent. In 2004, the “Management Rules of Affordable Housing” was promulgated, and included more restrictive regulations. For example, the floor area of affordable housing units would be required to vary from 60 square metres to 80 square metres, and the profit rate of developers would be required to be less than three percent. However, in December 2007, the central government announced that the affordable housing unit size must be limited to 60 square metres and provided to low-income families only (Niu, 2008).

<p>| Table 2.6 China’s Major Housing Regulatory Policies |
|---------------------------------------------------|--------|---------------------------------|-----------------------------------------------------------------|
| Date of Issue | Issue Authority                              | Main Contents                                                                 |
| July 1998     | The State Council                           | Finalize the establishment of the commodity housing market                      |
| Feb. 1999     | People’s Bank of China                      | Encourage personal consumption loans to boost housing demand                   |
| Oct. 1999     | People’s Bank of China                      | Reduce housing loan rate, extend duration to 30 year period                    |
| Oct. 1999     | State Administration of Taxation            | Exempt taxes on housing provident funds                                        |
| June 2000     | People’s Bank of China                      | Developers’ capital requirements raised to 30%                                |
| Sep. 2000     | State Administration of                     | Reduce taxation on rental income                                              |</p>
<table>
<thead>
<tr>
<th>Date</th>
<th>Authority</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 2001</td>
<td>People’s Bank of China</td>
<td>Residential loans without down payment forbidden</td>
</tr>
<tr>
<td>Feb. 2002</td>
<td>People’s Bank of China</td>
<td>Housing provident fund loan rate reduced</td>
</tr>
<tr>
<td>June 2003</td>
<td>People’s Bank of China</td>
<td>Down payment level for house purchasing raised to 20%</td>
</tr>
<tr>
<td>Apr. 2004</td>
<td>The State Council</td>
<td>Developers’ capital requirement raised to 35% for economic and commodity housing</td>
</tr>
<tr>
<td>Aug. 2004</td>
<td>China Banking</td>
<td>Personal housing instalment income ratio commission controlled to less than or equal to 50%</td>
</tr>
<tr>
<td>Mar. 2005</td>
<td>People’s Bank of China</td>
<td>Favourable policy for residential loan rate cancelled, down payment level for house purchasing raised to 30%</td>
</tr>
<tr>
<td>Mar. 2005</td>
<td>The State Council</td>
<td>Install for the first time the notice on preventing property prices from going up too quickly</td>
</tr>
<tr>
<td>Apr. 2005</td>
<td>The State Council</td>
<td>National eight regulations: 1) stabilize property prices; 2) local governments should take charge of controlling property prices; 3) increase land supply for affordable housing; 4) strictly control resettlement projects; 5) encourage rational consumption; 6) closely monitor property market; 7) strengthen policy execution; 8) establish censorship for price control</td>
</tr>
<tr>
<td>Apr. 2006</td>
<td>People’s Bank of China</td>
<td>Raise residential loan and housing provident fund loan rates</td>
</tr>
<tr>
<td>May 2006</td>
<td>The State Council</td>
<td>National six regulations: 1) encourage constructing middle-sized housing; 2) raise self-owned capital requirement for bank loans; 3) forbid mortgage loans to commodity houses vacant for three years; 4) raise down-payment for large-sized housing; 5) charge higher taxes for vacant land; 6) encourage affordable housing construction</td>
</tr>
<tr>
<td>May 2006</td>
<td>State Administration of Taxation</td>
<td>Fully charge business tax on second-hand housing transactions within the five year holding period</td>
</tr>
<tr>
<td>July 2006</td>
<td>State Administration of Taxation</td>
<td>Charge individual income tax on second-hand housing transactions</td>
</tr>
<tr>
<td>Sep. 2006</td>
<td>Ministry of Foreign Exchange &amp; Ministry of Construction</td>
<td>Foreign purchases of domestic commodity housing forbidden</td>
</tr>
<tr>
<td>Mar. 2007</td>
<td>People’s Bank of China</td>
<td>Raise residential loan rate six times continually over a period of time</td>
</tr>
</tbody>
</table>

Based on the above observations, the housing bubble in China is like the sword of Damocles, threatening balanced and sustainable economic development. The government is in a difficult position as it tries to strike a balance between sufficient housing development to avoid economic recession, and constraining the housing bubble for the social welfare of the public (Gao, 2010). This is indeed one of the big challenges that a transition country can face.
The Chinese government has raised concerns about the rapid growth of house prices, via a series of policy interventions produced over the past years. These include: (1) increased equity down-payment shares from 20 percent to 30 percent for first homes of more than 90 square metres in size; (2) increased equity down-payment shares from 40 percent to 60 percent for second homes; (3) general discouragement of the use of any leverage on third homes or by external buyers (i.e., those not living in the market of the interested purchase); (4) new rules to prevent developers from hoarding housing units; and (5) the pilot implementation of property tax levies in Shanghai and Chongqing since in January 2011. These changes are very important because they raise the cost of carry-on speculative investments in housing; and in some cities such as Beijing, new policies prohibit local households from purchasing more than one unit of housing, and prevent households from buying any homes in cities if they have not been long-time (5 years or more) residents and cannot provide tax or social insurance certificates to show their length of residence (Wu et al., 2012).

2.4.2 New Policies and Guidelines by the Chinese Government to Restructure the Real Estate Market after the 2007 U.S. Subprime Crisis

In response to the global financial crisis in 2008, the Chinese government declared a stupendous stimulus package of 533.2 billion RMB (US$86 billion), around 17.8 percent of China’s GDP. In order to promote real estate lending and development to boost growth, the stimulus package was combined with policy measures that emphasised the importance of stimulating domestic demand by encouraging more housing investment (Gao, 2010). On 27th October 2008, mortgage down-payments for residential housing purchases were reduced to 20 percent. Mortgage criteria for buyers of a second property requiring mortgage lending were loosened in November, 2008. At the beginning of 2009, the holding requirement for residential housing sales tax free-term was reduced from five years to two years. The reserve requirement for local real estate developers was also lowered to 20 percent. Meanwhile, some of the huge increases in bank lending to support the government’s economic stimulus efforts found its way to property speculators, contributing to the boom in home buying and property values (Gao, 2010). As a consequence of the stimulus given by the housing investment policies, the total sold houses and prices rose rapidly. The National Bureau of Statistics of China (NBSC) recently announced that from January to June 2009, the house units sold nationwide reached 341.09 million square metres, an increase of 31.7 percent from the previous year. The People’s Bank of China also reported that new home mortgage loans quadrupled in the first nine months of 2009. Such rapid housing price growth rates serve as an undeniable sign of a housing bubble (Gao, 2010).

In 2009, new policies were introduced designed to tighten loans to discourage real estate speculation, as the housing boom in China was due to the easing of loan restrictions that were in support of real estate investment. People had taken advantage of this economic stimulation policy to purchase houses as an investment in order to hedge against possible inflation. As a result, housing prices were driven
upward as a reflection of the increased demand. Unfortunately, the huge increase in housing related debt could potentially lead to greater financial instability and potential collapse (Fung & Forrest, 2002). Fearing that the housing market was becoming out of control, the State Council issued policies that would confine housing price growth rates (Gao, 2010). On 11th January 2010, the State Council issued guidelines that raised the down payment requirement to no less than 40 percent for families applying to take out a mortgage loan for any property beyond their primary residence; and mortgage rates were required to be settled strictly on the basis of loan risk. Financial leverage came into play at the beginning of 2010. On 12th January 2010, the PBC announced that it would raise the deposit reserve requirement ratio by one-half of a percentage point (see Table 2.7).

Table 2.7 China’s Major Housing Policies Post the 2007 U.S. Subprime Crisis

<table>
<thead>
<tr>
<th>Date of Issue</th>
<th>Issue Authority</th>
<th>Main Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sep. 2008</td>
<td>People’s Bank of China</td>
<td>Reduced residential loan rate and housing provident fund loan rate twice</td>
</tr>
<tr>
<td>Dec. 2008</td>
<td>People’s Bank of China</td>
<td>Lowered the minimum mortgage loan rate to 70% of the benchmark rate, and the down-payment ratio to 20%</td>
</tr>
<tr>
<td>May 2009</td>
<td>People’s Bank of China</td>
<td>Reduced developer’s capital requirement to 20% for economic and commodity housing investment</td>
</tr>
<tr>
<td>Dec. 2009</td>
<td>Ministry of Land and Resources</td>
<td>Required developers to pay at least 50% as the initial payment for land purchases</td>
</tr>
<tr>
<td>Jan.2010</td>
<td>State Council</td>
<td>Increased mortgage down-payments for households’ second residential housing units to 40%.</td>
</tr>
<tr>
<td>Jan.2011</td>
<td>State Council</td>
<td>“National eight” regulations increase minimum down-payment for second mortgages to 60%</td>
</tr>
</tbody>
</table>

Gao (2010), People’s Bank of China, State Council

The Chinese government’s policies toward the housing market fluctuate as the economic climate changes. Several stages of government policy changes are generally recognised and are shown in Table 2.8. During the cooling-off period in 2010 and 2011, many municipal governments banned non-residents from obtaining mortgage loans, and declared that house buyers must put down 60 percent for a second house. All policies were aimed at limiting a household’s demand for more than one house for investment purposes.
<table>
<thead>
<tr>
<th>Time Period</th>
<th>Policy Climate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998-2002</td>
<td>Boom (encourage the development of private housing markets)</td>
</tr>
<tr>
<td>2003-2007</td>
<td>Cooling off (higher interest rates and bank-required reserve ratios; administrative measures to stabilize home prices)</td>
</tr>
<tr>
<td>2008-2009</td>
<td>Boom (lower interest rates and the required reserve ratios; administrative measures and guidelines to encourage the development of housing markets; economic stimulus packages; pilot securitisation programmes; personal home mortgages)</td>
</tr>
<tr>
<td>2010-2011</td>
<td>Cooling off (higher interest rates and required reserve ratios; new restrictions on home purchases and mortgage down payments; administrative measures and guidelines to encourage the development of housing markets)</td>
</tr>
<tr>
<td>2012</td>
<td>Boom (lower interest rates and required reserve ratios; lower interest rates on mortgages)</td>
</tr>
</tbody>
</table>

Table 2.8 Government-Promoted Booms and Cooling-off Periods in the Housing Market

Barth, Lea and Li (2012), p18

2.5 Current Status of Affordable Housing in China

Currently, there are three major affordable housing programmes that the Chinese government has developed to improve housing affordability for its citizens. The programmes are: (1) the Economical and Comfortable Housing (jing ji shi yong fang) Programme; (2) the Housing Provident Fund Programme; and (3) the Cheap Rental Housing Programme (Deng et al., 2009). Urban households can purchase either economically affordable or commodity houses. To qualify for the lower cost category, applicants must have “hukou” and meet various requirements, including those pertaining to average living area, household income and household net assets. Once purchased, an economically affordable house cannot be sold for five years (Barth, Lea & Li, 2012).

2.5.1 The Economical and Comfortable Housing Policy

The programme aims to serve lower-middle and middle income urban families who may not be able to purchase market-rated housing (Zhang, 2002). According to Di et al. (2008), The Economical and Comfortable Housing (ECH) policy differs from both the previous public housing policies and the private housing initiatives in two ways. First, affordable units are developed for sale, not for rent. Thus, the government does not need to subsidise their operation. Second, most of the ECH units have been built by real estate developers for profit and sold to eligible families through market transactions. The ECH relied heavily on the generosity of local governments to provide most of the development subsidies (Rosen & Ross, 2000). In addition, Zhang (2002) reported that local governments were expected to provide free or low-cost land to ECH developers as well as reduce or even waive various development fees and real estate taxes. In turn, local governments regulated the sale price of ECH units, keeping the profit margin to no larger than three percent. Nationwide, the prices of ECH units were usually 15 percent to 20 percent lower than market prices (Liu et al., 2008). Table 2.9 shows the differences between ECH and commercial housing (Zhang, 2002).
Table 2.9 Differences between ECH and Commercial Housing

<table>
<thead>
<tr>
<th>Nature</th>
<th>Economical and Comfortable Housing (ECH)</th>
<th>Commercial Housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property rights</td>
<td>Partial property rights</td>
<td>Full property rights</td>
</tr>
<tr>
<td>Land acquisition</td>
<td>Allocated by the state according to approved annual land-use plans</td>
<td>Obtained through bidding, tenders and negotiations</td>
</tr>
<tr>
<td>Housing prices</td>
<td>Controlled by the state</td>
<td>Decided by the market or developers</td>
</tr>
<tr>
<td>Housing standards</td>
<td>Guidelines for housing types, floor space, and standards, set by the state</td>
<td>Decided by the market or developers</td>
</tr>
<tr>
<td>Planning and design</td>
<td>Bidding</td>
<td>Bidding or negotiation</td>
</tr>
<tr>
<td>Development</td>
<td>Bidding (no sub-contracting allowed)</td>
<td>Bidding or negotiation</td>
</tr>
</tbody>
</table>


Table 2.10 shows the differences between low-rent housing programmes and economically affordable housing programmes (Barth, Lea & Li, 2012).

Table 2.10 Comparison of Programmes that Assist Low-Income Households

<table>
<thead>
<tr>
<th>Target</th>
<th>Low-rent housing programme</th>
<th>Public rent housing programme</th>
<th>Economically affordable housing programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest income urban households</td>
<td>&lt;50 sqm Need to leave when own home is purchased</td>
<td>&lt;60 sqm</td>
<td>Urban households that cannot afford commodity houses</td>
</tr>
<tr>
<td>Low-mid income urban households, new employees and select residents with stable jobs but no hukou*</td>
<td>60 sqm which may only be owner occupied while paying off the mortgage. If buying other homes, need to leave or pay the difference between affordable house and commodity house</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Owner

| Government | Investor (can be transferred, but not to owners) | Limited ownership, but can become full ownership after satisfying certain criteria |

*people with official registration at cities of residence

The ECH programme was significantly expanded in the 1998 reform. According to the 1998 reform, ECH housing would be accessible to most urban residents (70% to 80%) (Deng et al., 2009). While critics have questioned the rationale for providing subsidised housing to a majority of the population, the Chinese government believed that such an incentive was necessary to push most urban households into the market after the 1997 Asian Financial Crisis. Thus, it is clear that the primary goal of ECH was
to stimulate housing consumption, not to help needy families (Deng et al., 2009). According to Cai’s (2009) and Zhang’s (2007) studies, wealthy households often purchased the ECH units, pushing higher quality housing and housing prices beyond the reach of middle and lower income families. In Beijing, for example, a recent study found that the median housing value among ECH units is about 780,000 RMB, higher than the average value of the entire housing stock (Deng et al., 2009).

Throughout most of the programme’s history, there were no national standards. Local governments were asked to implement their own development standards based on housing conditions (Liu, 2009). Unfortunately, local governments were subject to pressure from both developers and wealthy local buyers. As a result, local development standards for ECH housing were often too high, making the housing unaffordable to its targeted group (Liu, 2009).

### 2.5.2 Housing Provident Fund

The Housing Provident Fund (HPF) based on Singapore’s Central Provident Model, was introduced in Shanghai in 1991 and became a nationwide housing savings programme after 1994 (Zhang, 2000). HPF is a compulsory housing savings programme in which both employer and employee contribute a certain percentage of the employee’s salary, initially set at five percent, to the employee’s HPF account, administered by the China Construction Bank. HPF has played a major role in facilitating the transformation of China’s housing system. It allows work units to contribute a cash subsidy instead of directly building public housing units for their employees. In addition to a home purchase, HPF can also be used for other housing related activities such as home improvement, housing repairs and self-construction (Zhang, 2000).

The interest rate of HPF loans is lower than that of commercial housing mortgage loans. For example, for a five year loan, the interest rate for a HPF loan was set at 8.1 percent in 1997, while the interest rate for commercial loans remained at 12.42 percent. Between 2002 and 2006 (inclusive), the PBC steadily increased the interest rate of commercial loans from 5.04 percent to 6.39 percent (over the 5 years) in order to control the overheated investment and the soaring housing prices. By contrast, the interest rate of HPF loans (over the 5 years) increased from 4.05 percent to 4.59 percent. Currently, the interest rate for HPF loans (over the 5 years) remains at 4.5 percent, which is 2.1 percent lower than the interest rate for commercial loans (The People’s Bank of China, 2013).

In 2006, the HPF programme covered 60 percent of all salaried workers in urban areas, but the participation rate varied widely across cities (Ye & Wu, 2008). In more developed coastal regions such as Jiangsu and Zhejiang provinces, the participation rate reached approximately 90 percent. In the less developed inland areas, however, the participation rate was below 50 percent (the Yearbook of China Real Estate Market, 1997; Wang & Murie, 1999). The poor participation rate was partially due to
employers not wanting to contribute to employees’ HPF accounts. An additional difficulties was that since the contribution was salary based, workers with higher salaries received larger employer contributions (Deng et al., 2009). For example, studies show that government institutions offer better HPF opportunities than collective enterprises, and higher-level government institutions offer even better opportunities than municipal and district-level institutions (Lee & Zhu, 2006).

The Chinese government took great pride in the success of the HPF programme in accumulating housing savings. By 2008, the HPF had accumulated over 2 trillion RMB, with over 73 million urban employees participating (Deng et al., 2009). As the fund grew, it became more challenging to manage. Like other housing programmes, the HPF is locally administered, with central government setting the principles and rules (Deng & Fei, 2008). For example, the fund is deposited in the China Construction Bank, its daily operations (such as approving withdrawals or originating loans) were conducted by an HPF management centre set up by local governments (Deng et al., 2009). According to Chen (2009), the strong local government involvement is what distinguishes HPF from the commercial mortgage sector. In the commercial mortgage sector, the availability of mortgage capital and its terms are determined by commercial banks and are strictly monitored by China’s Central Bank. Local governments have no control over it. In contrast, local governments are responsible for local real estate markets. For example, in 2008, in view of the weak economy that resulted from the global financial crisis, many local governments relaxed the requirements for HPF loans through measures such as reducing the minimum down payment or raising the maximum loan limit in order to promote housing consumption (Deng et al., 2009).

The management and operation of the HPF Scheme has followed three guidelines:

(1) Individual savings complemented by work unit subsidy;

(2) Administration under a single authority;

(3) Use for specified housing purpose only.

The guidelines require that both the employers and the employees, from both the state owned enterprises and the private/joint venture companies, set up and contribute to the HPF. The HPF is an important source of finance for housing production and consumption, for both the state-owned institutions and non-state owned enterprises workers (Yeung & Howes, 2006).

There are basically three components in the operation of the HPF:

(1) Housing Committee - which is responsible for the planning of residential housing in the city/province;
2. Provident Fund Management Centre - which is responsible for the operation and management of the Fund; and

3. Designated Banks - interest rates charged on loans by HPF were lower than the mortgage rates charged by commercial banks. Thus, potential home buyers preferred to use loans from HPF which has resulted in continued heavy reliance on HPF (Yeung & Howes, 2006). According to the Mortgage Units Director of the HPF Centre, applications for mortgages from the Centre became increasingly popular. From 1999 to 2004, the Centre provided HPF loans amounting increased from 0.6 billion RMB to 7.2 billion RMB in Beijing (Burell, 2006).

2.5.3 Cheap Rental Housing

In 1998, reform of the cheap rental housing (CRH) system was undertaken, for people who could not afford to purchase ECH units or to rent market housing. The target groups included seniors, people with disabilities, and extremely low-income households (Ye et al., 2006). The aim of this reform was to improve the living quality for urban poor and local governments were asked to reserve some old public housing units as CRH. According to the Ministry of Housing and Urban-Rural Development of China, as a consequence, the average living space among urban residents rose from 6.7 square metres in 1978 to 28 square metres in 2008. However, over 10 million urban households still live in less than 10 square metres (Deng et al., 2009).

In 2004, China’s central government had increasing concerns about urban poverty and how it might threaten both social stability and economic prosperity. As a result, China’s central government issued an order called “ways to provide cheap rental housing for the poorest urban residents”, with the goal of strengthening the social rental housing system and renaming it the “Cheap Rental Housing” (CRH) programme (Deng et al., 2011). In 2006, China’s central government mandated that every municipal government dedicate five percent of its net gain from land conveyance fees to the CRH programme. But there is no enforcement mechanism, and many local governments are reluctant to contribute. From 1998 to 2006, only about 550,000 low-income households benefited from either the CRH or the former social housing programmes, and the two programmes together have produced only about one percent of the total housing units built during the same period (Tan, 2009).

In 2009, the Chinese government decided to expand its affordable housing production significantly. On 22nd May 2009, the central government issued an ambitious plan called “Cheap Rental Housing Guarantee Plan” for 2009 to 2011. According to the plan, the government would take three years to solve the housing problem for 7.5 million low-income urban households. Three-quarters of the low-income urban households (about 5.6 million) would live in new developments, and one-quarter (about 1.9 million) would be accommodated in existing housing through the support of rental subsidies (Deng...
et al., 2011). The goal in 2009 was to build 1.8 million CRH units and provide rental subsidies for 830,000 new households (Ministry of Housing and Urban-Rural Development of China, 2009d).

To ensure implementation of the CRH programme, the central government also allocated a fair-share goal to each individual province. Officials at lower government levels would be evaluated on how well they implemented the plan. In terms of funding, in 2009 the central government allocated 7 billion RMB to subsidise CRH projects in less developed areas (such as middle-east provinces) (Deng et al., 2011). Currently, the central government requires that at least 10 percent of the net gain from land conveyance fees, together with the capital gains in HPF investment, are to be used for CRH (Deng et al., 2011).
Chapter 3
Housing Bubble Theory

3.0 Introduction

This chapter presents an overview of housing bubble theory and studies. Section 3.1 describes the theory of housing bubbles. Section 3.2 explains the three types of price expectation theory, and the housing bubble studies are reviewed in section 3.3. Section 3.4 concludes with the relevant literature that supports the existence of housing bubbles.

3.1 Housing Bubble Theory

There are three major bubble theories which describe the acceptance and rejection of the existence of bubbles in the housing market (Thornton, 2006). The three theories are: (1) supply side economics theory; (2) Keynes and Shiller theory; and (3) Austrian School theory. These theories provide a good framework for understanding the existence of house price bubble phenomena.

3.1.1 Supply Side Economics Theory

Bank lending plays a crucial supply-side role in the financing of commercial real estate. Banks lend for the purchase of land for development, and for existing buildings, and they also lend to non-financial firms based on real estate collateral. Therefore, the lending attitude of bankers has a major impact on the behaviour of housing investments and transactions, and in addition, the state of the commercial housing sector affects the performance of the banking sector (Davis & Zhu, 2011). According to Herring and Wachter (1999), the property cycles and banking crises have been correlated in a remarkable number of instances in a wide range of countries. For example, short-term capital inflow found its way into Thailand’s real estate market, as banks competed to lend to real estate developers and investors (Tan, 2009). Property cycles could also lead to bank crisis, such as in the U.S. where farmland prices rose sharply from 1972 and reached a peak in 1981, which is more than 2.5 times higher than the 1960 value. From 1981 to 1988, farmland prices collapsed to the level of the late 1960s, leaving many farmers with land worth less than their outstanding mortgage obligations. The collapse led to defaults and the failure of more than sixty agricultural banks (Carey, 1990). In the early 1980s, rising real estate prices have caused the Great Depression in Sweden a decade later. Property prices began to rise during the 1980s, and rose more sharply from 1985 to 1989. In 1989, property prices were 450 percent higher than at the beginning of the decade. However, property prices collapsed from 1989 to 1993, finally achieving a level just below that of 1982. The banking system fuelled the boom in property prices and suffered serious damage when property prices collapsed (Herring & Wachter, 1999). By the end of
1993, the accumulated losses of the Swedish banks were equal to five percent of Sweden’s GDP for that year (OECD, 1994). A common striking feature of many financial crises around the world is that the most seriously affected economies often first experience a collapse in real estate prices and a consequent weakening of their banking systems, and then a business cycle bust (Herring & Wachter, 1999).

According to Collyns and Senhadj (2002), Davis (1993), and Davis and Zhu (2009), there are three dimensions of interaction between the real estate cycle and the credit cycle. First, property prices may affect the volume of bank credit, not only directly through the wealth effect for property owners and the changes in the volume of real estate loans, but also indirectly through loans that are collateralised by real estate assets. Second, bank lending may affect property prices via liquidity effects. Changes in credit availability and lending attitudes have a sizable impact on the demand for real estate and investment decisions on new construction. Third, credit and property cycles can be driven by common economic factors, such as volume of bank loans and interest rates. Credit cycle behaviour is largely determined by economic conditions and prospects (e.g. GDP and interest rates) (Davis & Zhu, 2009).

Theoretically, there is potential bidirectional causality between property prices and bank lending such as, the movement in property prices may change the borrowing capacity and credit demand of corporations and households (Bernanke & Gertler, 2000; Kiyotaki & Moore, 1997). Aoki et al. (2004) presented a general equilibrium model that describes how the credit channel may form part of the monetary transmission mechanism. The authors’ research focuses on the macroeconomic effects of imperfections in credit markets, and their results show that property that influences the availability of bank lending prices, may also influence the availability of bank lending via the wealth effect, as a household’s borrowing capacity can be raised by an increase in house prices. Koh et al. (2005) found that the Asian property prices ran-up and then collapsed in the 1990s and suggest that excessive bank lending caused a housing market bubble. Banks competed by increasing loan amounts, and by reducing interest rates for certain customers, and also by extending renovation loans. Bank managers often underestimated the default risk of their loans, made in order to capture a larger market share (Koh et al., 2005). When the value of the underlying asset falls below the outstanding balance of the loan, the borrowers may simply “put” the asset back to the lender, and walk away from any future payments of the principal or interest on the loan (Pavlov & Wachter, 2004). Koh et al. (2005) study found that the presence of incentives to under-price real estate loans was prevalent during the Asian real estate bubble, and that the incentives were a major factor in fuelling the asset bubble in the Asian financial crisis. Krugman’s (1998) study shares similar findings and notes that the excessive risky lending of financial institutions created property price inflation.
On the other hand, credit availability may also affect property prices, as increases in credit availability may expand the demand for property. Previous studies have documented the coincidence of property price cycles with bank lending cycles (Kiyotaki & Moore, 1997; Allen & Gale, 1997; Bernanke & Gertler, 2000; Zhu, 2003). For example, Shimizu (2000) uses the theory of bank lending and collateral to explain banks’ lending and the important role played by rising land prices in Japan, and Shimizu’s (2000) empirical study on the relationships between land prices and bank loans indicates that in Japan, the loans to small- and medium-sized firms were significantly affected by land prices. Gerlach and Peng (2005) investigated the long-run relationship between bank lending and property prices in Hong Kong, using a vector autoregressive framework with multivariable such as, property prices, bank lending, interest rates and gross domestic product (GDP). The authors reveal that the strong correlation between property prices and bank lending appears to be due to bank lending adjusting to property prices. In a similar study, Hofmann (2003) analysed the direction of causality between bank lending and property prices in 20 industrialised countries over the last two decades, using both time series and panel data techniques. The findings of the study suggest that property price cycles reflect changing beliefs about future economic prospects, and therefore drive credit cycles rather than excessive bank lending as the major cause of property price bubbles.

Home mortgage loans have played a significant role in the financial sector as they account for nearly one third of the total lending activities such as purchase of commodity houses in Guangzhou in 2005 and Shanghai in 2006 and 2007 (Li, 2010). Hofmann (2003) investigated whether there is any potential two-way causality between bank lending and property prices, which may give rise to mutually reinforcing cycles in the property and credit markets. For example, more optimistic expectations about future economic prospects could increase property prices and raise the borrowing capacity of firms and households by increasing the value of collateral. Allen and Gale (2000) explained that real estate bubbles result from the proxy relationships in the bank loan sectors. Investors use money borrowed from banks to invest in risky assets, which are relatively attractive because they can avoid paying off the loan by defaulting. This risk shifting leads investors to bid up asset prices. Collyns and Senhadji (2002) found that credit growth has a significant contemporaneous effect on residential property prices. The authors conclude that bank lending contributed significantly to the real estate bubble in Asia prior to the 1997 Asian financial crisis. Gerlach and Peng (2005) analysed the direction of causality between bank lending and property prices in Hong Kong based on standard regression techniques, controlling for potential simultaneity problems. Their study shows that short-run and long-run causality goes from property prices to bank lending.

Apart from bank lending, international capital flows (hot money) also increased the money supply for Chinese housing market since 1998. The inflow of international capital can lower the credit risk for Chinese banks, enlarge the housing supply and demand, and strengthen the real estate companies’
business competition, as well as boost the whole industry (Song & Gao, 2007). In recent years, the real estate industry has attracted overseas investment which mainly focuses on trading in housing as well as real estate development. The inflow of international capital into the Chinese real estate market promotes public demand for commercial housing, thus making house prices rise (Song & Gao, 2007).

“Hot money” refers to the flow of speculative funds (or capital) from one country to another in order to earn a short-term profit on interest differences and exchange rate shifts (Chari & Kehoe, 2003). Martin and Morrison (2008) estimate that the aggregate hot money that flowed into China from 2003 to the first quarter of 2008 amounts to about 1.75 trillion dollars, about 104 percent of China’s total foreign exchange reserves as at the end of March 2008. The speculative capital inflow is believed to have fuelled inflation, driven up stock prices, and helped to accelerate a worrisome bubble in the real estate market (Zhang & Fung, 2006).

3.1.2 Keynes and Shiller Theory

“The idea that there has been a speculative bubble is inherently a statement about some less-than rational aspect of investor behaviour”


Keynes was a proponent of behavioural finance which believes that bubbles exist because of psychological factors. For example, a burst bubble implies that many people will deny the real factors and psychologically believe that the “disequilibrium” will quickly return to what they consider normal (Thornton, 2006). This view is supported by economists including Paul Krugman and Robert Shiller (Thornton, 2006). From Krugman and Shiller’s perspectives, housing bubbles are fundamentally caused by psychological factors. The business cycle is seen as the ebb and flow of mass consciousness and emotions, and the important factors for deviations in the business cycle are psychological factors. Case and Shiller’s (2003) study shows positive relationships between housing bubbles and consumer psychological factors. For example, a housing bubble occurs when there is a sharp rise in housing prices, and an expectation of future housing price rises, which will attract new buyers (generally speculators) who are more interested in profits from trading rather than in the use of the house (Sun & Zhang, 2008). A speculative bubble in many housing markets, including Los Angeles and San Francisco and the large swings in single-family home prices are poorly explained by fundamental forces such as income, population and interest rates but could well be explained by the speculative forces such as consumer psychological factors.

Rising profits and rising property prices lead to “speculative behaviour” where economic decisions are no longer based upon economic fundamentals (Thornton, 2006). Housing market booms develop because people exhibit over-confidence in the economy and investors likewise increase their tolerance
for taking risks. Their investment mania will cause the housing price bubble to inflate (Thornton, 2006). Asset markets can become increasingly jittery when a boom is strong. A discontinuous shift from boom to crash may thus come from some investors crossing a psychological threshold in terms of nervousness about the sustainability of the existing price structure (Earl, Peng & Potts, 2007).

Several studies have investigated the relationships between the psychological factors and house prices (Roehner, 1999; Raines & Leathers, 2000; Shiller, 2000; Shiller, 2004). Shiller’s (2004) study shows that a speculative contagion undermines any bubble, and the author employs psychological factors such as whether a buyer’s expectation is optimistic or pessimistic about the future direction of house prices, to explain housing bubbles. If people emotionally believe that the house prices will continue to rise, they will be willing to spend even more, and this drives house prices higher. Shiller (2004) explains that once people form a speculation expectation on house prices in one city, then this expectation spreads to other cities, creating a contagious effect in the housing market. Raines and Leathers (2000) and Shiller (2000) found that behavioural finance could explain the existence of speculative bubbles such as systematic biases in risk preference, framing effects and systematic departures from rational behaviour. This is consistent with Roehner’s (1999) study which shows that speculative behaviour results in an increase in house prices for other districts in the Paris housing market.

3.1.3 The Austrian School of Thought

The Austrian business cycle theory believes that there are changes in both economic fundamental and psychological factors during bubbles that cause the changes in the business cycle (Thornton, 2006). A unique feature of the Austrian approach is that it does not see a need for prices to increase uniformly across markets, or for prices to increase to extreme levels in all markets. In this theory, Austrian economists (Krugman, 2005; Thornton, 2006), emphasize that misallocation of resources could cause a bubble boom, which means that if more resources are allocated to housing construction, fewer resources are available to other areas of the economy, such as manufacturing. This mismatch of resources across industries would soon be corrected however and the resources would be channelled towards more efficient uses through a process of “bust” or recession (Thornton, 2006).

According to the Austrian Business Cycle (ABC) theory, the central bank creates the business cycle by driving up the supply of money, which in turn lowers the interest rates and leads to a “boom”. Interest rate cuts lead to higher home prices, and a construction boom and higher consumer spending results in an increase in debt. If the government implements an expansionary monetary policy, then a bubble could develop somewhere in the economy; and if the new money is directed towards housing, a bubble will develop in the housing sector (Thornton, 2006). According to the ABC theory, the housing bubble also fuels the construction of new homes causing the wages of the construction workers to rise, and
resulting in labour reallocating itself to other construction and related industries. The housing market bubble also increases construction material prices and land prices (Thornton, 2006).

### 3.2 Price Expectation Theory

“The price expectation theory is “a sharp rise in price of an asset or a range of assets in a continuous process, with the initial rise generating expectations of further rises and attracting new buyers (generally speculator) interested in profits from trading rather than in its use or earning capacity. The rise is then followed by a reversal of expectations and a sharp decline in price, often resulting in severe financial crisis—in short, the bubble bursts.”

---- Kindleberger (1987, p20)

Real estate price expectation is central to the efficient pricing of real estate. If price expectations are based on an extrapolation of past price increases, then this is likely to lead to classic speculative bubbles. Investors “speculate” on a continuation of the past high rates of price appreciation (Malpezzi & Wechter, 2002). Investors’ self-fulfilling expectations generate a rational bubble regarding future asset price growth, which is not directly related to macroeconomic fundamentals. A rational bubble grows at a rate that produces the expected rate of return, it gains in size as investors expect the asset to be sold at a profit in the future (Kubicova & Komarek, 2011).

Krugman (2005) suggests that a housing bubble builds on the expectation of a capital gain. For instance, if people think house prices will continue to rise, they will willingly spend more, thus driving the prices higher. This means that the return on assets grows faster than the historical average returns, based on the investor’s assumption that the asset price will continue to rise and generate the required expected rate of return. If investors believe the bubble will burst in the future, it will indeed burst as a result of self-fulfilling expectations (Kubicova & Komarek, 2011).

In general, as prices increase in the housing market, more people become willing to participate in the housing boom due to the increasingly higher returns expected from their investment. The expectation that prices will continue to rise leads homebuyers to pay far more for homes than they otherwise would have (Baker, 2008). The subsequent increase in the demand for housing triggers a housing bubble because in the short-run the supply of housing is relatively fixed and an increase in demand leads to an increase in housing prices in the intermediate term (Baker, 2008). There are several models extant of how expectations are formed: (1) the myopic expectation model assumes investors are “flying blind” going forward. At the other extreme, perfect foresight assumes that people know the future; (2) the rational expectation model states that people use all available information to make optimal forecasts about changes in future prices; and (3) the adaptive expectation model assumes that people are backward looking; that is, the future will be like the past (Malpezzi & Wachter, 2002).
Understanding the expectations of buyers, sellers and investors, helps to improve the efficiency and impact of sudden shocks in the housing market (Smart & Lee, 2003). The reactions of property prices toward different economic shocks can be explained using two types of price expectation theories; rational expectation hypothesis (REH) and adaptive expectation hypothesis (AEH).

3.2.1 Rational Expectation Hypothesis (REH)

Expectations of individuals are rational if investors are exposed to the same set of information about the prediction of relevant economic theories (or the “objective” probability distributions of outcomes) (Muth, 1961). Rational expectation happens when investors use the available information to estimate future events or future economic conditions. Such an estimation of future events is essentially the same as the predictions of the relevant economic theory (price expectation theory), and such expectations are called “rational” (Muth, 1961). There are three good reasons for assuming rationality. First, it is a principle applicable to all dynamic problems. Second, if expectations are not moderately rational, then there would be opportunity to make profits in commodity speculation. Third, rationality is an assumption that can be modified (Muth, 1961).

Smart and Lee (2003) used the concept of expectation to explain how the efficiency of the housing market in Hong Kong can be determined. In the efficient market hypothesis, expectation of future prices is similar to the rational expectation hypothesis assumptions (Malpezzi & Wachter, 2002). The efficient housing market hypothesis is related to the concept of a “random walk”, in which changes in asset prices follow a random pattern and are unpredictable. This implies that if real asset price formation follows a random walk, it is not possible to earn excess investment profits, and there is no incentive for speculation (Malpezzi & Wachter, 2005). Under the rational expectation hypothesis, a the house price only follows a random walk when there is a random movement in the behaviour of exogenous variables (Meen, 2003).

Several researchers (Clark, 1995; Capozza & Seguin, 1996; Clayton, 1997) in housing market studies have adopted the REH. The formula for REH is given as follows (Clayton, 1997).

$$Hsg_p^* = \frac{Hsg_{p,t+1}^e - Hsg_p}{Hsg_p}$$  \hspace{1cm} \text{(3.1)}$$

Where $Hsg_{p,t+1}^e$ is the forecasted house price in one year, $Hsg_p^*$ is the equilibrium house price and $Hsg_p$ is the current house price. However, if the housing market follows the REH, the house price forecast one year from now, using all available information about the housing market’s operation will be:
Where $Inf_t$ is the information available to people in the housing market at period t. Equation (3.2) implies that people have full knowledge about the factors and parameters which cause the movement of current values, and caused the movement of past values of house prices (Dong-An, 2005). Therefore, the difference between house price expectation and real house price occurs by a random error (see equation 3.3)

$$Hsg_{p,t+1} = E_t\left[Hsg_{p,t+1} | Inf_t\right] + \epsilon_{t+1}$$

Clayton (1997) explains that house price expectations rely on an understanding of house prices, rents and other exogenous variables in the current market. Holding other things constant, the future expectations for house prices are positively associated with house prices and negatively related to rents (Dong-An, 2005).

Kerr (2002) found that house price violability is not affected by capital evaluation, lending and taxation, but that investors’ individual decision-making can create remarkable bubbles. For example, the impact of expectations about land prices caused the property bubble burst in Japan in 1989. The result of the collapse of land prices wiped out the nation’s wealth equivalent to US$5.85 trillion, and securities by US$4.44 trillion, with security sinking to about one third of their 1989 level (McCormack, 2002).

Eugene (2006) explains the rational expectations based on twin assumptions. First, individual investors use all available information to forecast future prices as they have perfect information about the future without any information cost (Malpezzi & Wachter, 2002). Second, individual investors have a correct model of the fundamental structure of the economy. Bubbles or manias may arise if either of the assumptions are violated. If the first assumption is violated there will be an irrational bubble and if the second assumption is violated there will be a rational bubble. The asset prices will deviate from fundamentals (Blanchard & Waston, 1982). The bubble will be rational as long as the bubble component in the stock price is equal to the expected discounted value of the future bubble (De et al., 1990).

The market participants in such bubbles also believe that, based on rational expectations, house prices may be different from the economic fundamentals due to the uncertainty of prices in the rational model. The rationality of the bubble in house prices is determined through the bubble component, which is the expected discounted value of the future bubble (Eugene, 2006).

Malpezzi and Wachter (2002) addressed the definition of an efficient market where the value of real estate market prices should be equal to what property purchasers are willing to pay for it. A capital
market is said to be efficient if it fully and correctly reflects all relevant information in determining prices. An efficient market requires expectations to be formed rationally. If expectations are “backward looking” instead, it is possible to predict prices based on past trends, and excess profits that could be earned (Xiao & Liu, 2010).

However, some researchers suggest that the real estate market may be inefficient (Arrow, 1986; Garzlaff & Tirtiroglu, 1995; Rosenthal, 2008). Because the information is incorporated into prices, the investor is unable to make profits by trading on the information. Thus, an efficient capital market is one where economic profits do not exist (Malpezzi & Wachter, 2002). Clayton’s (1997) study of the real estate market efficiency shows that the housing market is inefficient, and house prices deviate from fundamental or intrinsic values. In this case, a sharp run-up in house prices is partly due to irrational expectations such as fads, noise traders and trend chasers. Moreover, there is difficulty in estimating the observed patterns of rational expectation in the housing market (Arrow, 1986). This is due to the irrational assumptions underlying the REH (Malpezzi & Wachter, 2002).

There is further evidence for rejecting the rational expectation hypothesis. If local house price cycles are driven in part by irrational expectations or psychological factors rather than changes in market fundamentals, then house prices would exceed the intrinsic value in market upswings where a market correction is inevitable, and the irrational bubble will collapse (Clayton, 1998). The intangible expectation leads prices to race ahead of fundamental or intrinsic values. Thus, housing booms are driven primarily by irrational house price expectations and investor psychology, rather than housing market fundamentals (Clayton, 1998). Specifically, the slope estimates are negative and statistically significant. House price changes move in the direction opposite to that predicted by the asset-based rational expectation model of house price dynamics (Clayton, 1997). Brook et al. (2001) employ a variance bound test to test the rationality of real-estate share prices in the U.K. and indicate the existence of irrational speculative bubbles. Xiao (2007) suggests the real estate market to be inefficient due to the high transaction costs, collateralised lending processes, loan under-pricing, myopic pricing and restrictions in supply. The author also argues that markets with more responsive regulatory environments or less natural constraint will experience less speculation and house price volatility.

3.2.2 Adaptive Expectation Hypothesis (AEH)

Speculation can be used to describe a world in which investors’ expectations are formed in some inaccurate ways. Speculative bubbles based on adaptive expectations imply that speculators enter the market when prices are rising which leads to an increase in demand. When prices are falling, speculators bail out (Malpezzi & Wachter, 2002). The adaptive expectation hypothesis (AEH) assumes future house prices are determined using past information and trends in house prices. The AEH is also
known as backward-looking expectation and depends on extrapolating past price changes (DiPasquale & Wheaton, 1996).

Shiller (2001) explains that investors’ psychological and behavioural factors could help to better understand speculative bubbles in the financial market. The essence of a speculative bubble arises from price increases which increase the investor’s enthusiasm which leads to an increase in demand for housing, and hence further price increases. The high demand for housing is generated by the public memory of high past returns, and the optimism of those high returns can enlarge positive forces affecting the housing market (Shiller, 2001). According to Hoyt (1933), speculative influences may push real estate activities far out in advance of real economic growth. However, investors who believe in AEH are optimistic during the rising prices of the property market. Such optimistic beliefs are held even when property market values are decreasing, as market participants are still willing to pay higher prices (Davis & Zhu, 2004).

Based on the AEH or backward-looking expectations, the expected house prices in each period are associated with past trends in house price movements, and it could also be assumed that expected house price will be the same as the moving average of the current price appreciations (Dong-An, 2005). Several studies such as Hamilton and Schwab (1985), Levin and Wright (1997) and Malpezzi and Wachter (2002) argue that AEH can be used to explain house price movements. The house price movements of U.K. from 1974 to 1994 are believed to be associated with the historical movement of house prices, or AEH (Levin & Wright, 1997). Malpezzi and Wachter’s (2002) result is derived using previous changes in the U.K. real estate house price market to predict future changes in the U.K. real estate house price market.

DiPasquale and Wheaton (1996) show that the peak in house prices is reached when there is an overflow of housing stock supply from the construction sector. This causes speculators to exit from the market immediately (Malpezzi & Wachter, 2002). A speculative bubble is frequently used to explain persistent overvaluation followed by market collapse (Kindleberger, 1987). According to Stiglitz (1990), “if the housing price is high today is only because investors believe that the selling house price will be high tomorrow and when fundamental factors do not seem to justify such a high house price then a speculative bubble exists” (p.13). The identification of speculative bubbles in the housing market requires accurate estimates of both the contemporaneous “fundamental economic value” and housing purchasers’ expectations of future price appreciation (Goodman & Thibodeau, 2008).

Ott et al. (2008) research supports the finding that real estate markets often violate the random walk and rational expectations hypotheses. In addition, Hwang and Quigley (2002) found that condominium prices in Singapore from 1990 to 2000 also did not follow a random walk hypothesis. If real estate price formation follows a random walk, then it is not possible to earn excess investment profits, and there
will be no incentive for speculation (Malpezzi & Wachter, 2005). Malpezzi and Wachter (2002) explain that in an AEH, the real estate market does not follow a ‘random walk’ because it draws on past information. Hence, the efficient market hypothesis is rejected in the property market, because of less efficient information available to all people.

### 3.3 Review of Housing Bubble Studies

The real estate market has the longest and most reliable history of boom and bust cycles stretching back to the early 1800s. There are a large number of studies on real estate or housing bubbles. Researchers point to speculation as a prime force behind these real estate developing cycles (Malpezzi & Wachter, 2002). Evidence of speculative bubbles in the real estate market has been found in countries worldwide. Several researchers have found quite modest housing bubbles in countries such as Australia (Bourassa & Hendershott, 1995), Sweden (Hort, 1998), and New Zealand (Bourasa et al., 2001). The housing markets in London (Levin & Wright, 1997), Paris (Roehner, 1999) and Dublin (Roche, 2001) are also reported to be affected by regional housing market speculative behaviour.

Abraham and Hendershott’s (1994) study shows there was a 30 percent “above market” premium in prices in the northeast of the U.S., and a 15 percent to 20 percent premium in prices in the west coast of the U.S. at the end of 1992. During the middle and late 1980s, U.S. house prices experienced significant real rates of appreciation. In three northeast cities (Boston, Nassau-Suffolk and Newark), housing prices rose by 92 percent between 1983 and 1988. House prices rose over 50 percent in eleven west coast cities between 1984 and 1990. Goodman and Thibodeau (2008) examined house price bubbles in 84 metropolitan statistical areas in the U.S. from 2000 to 2005. The comparison of computed nominal appreciation rates with observed appreciated rates from the Office of Federal Housing Enterprise Oversight data indicates that only 39 metropolitan statistical areas experienced a house price bubble. Only California reported a rate of house price appreciation at 149.7 percent.

According to Sornette, Woodard and Zhou (2009), from 1995 there were two major housing bubble episodes; the real estate surge peaking in the U.S. in mid-2006 and the subprime boom in the U.S. which topped in 2007. Abraham and Hendershott (1992) integrate two proxies in the real estate market; (1) the tendency of a bubble to burst; and (2) the tendency of a bubble to swell. These proxies were found to adequately explain the large cyclical swings and speculative pressures in the real estate prices on the west coast of the U.S. (Abraham & Hendershott, 1992).

Labonte (2003) examined the movement of the U.S. housing price index (HPI) with other economic fundamental factors such as income, inflation and interest rates. The study shows evidence of bubbles in different regions, such as housing bubbles in California and New England between 1997 and 2002. Mankiw and Weil (1989) found that demographic changes had important effects on U.S. house prices,
while Cappozza et al. (2002) study shows that city size, real income growth, population growth and real construction costs have stable relationships with house prices. According to Goodman and Thibodeau (2008), house prices in some Californian cities increased by more than 15 percent annually, during the same period that house prices in Texas cities increased by only four percent per year.

Garino and Sarno (2004) used co-integration and the Markov-regime switching model to test U.K. house prices with fundamental factors such as mortgage rates, real personal disposable income per capita, treasury bill interest rates, and the consumption expenditure deflator, over the period 1983 to 2002. The authors’ results reveal the presence of explosive bubbles in U.K. house prices over the sample period. Similarly an OECD (2005) study of 17 international house prices, points to 30 percent overvaluation in U.K. house prices in 2003 to 2004, as evidence of house price bubbles.

Levin and Wright (1997) show that speculation is a significant factor in determining house prices in the U.K. between the years 1972 and 1974. The figures in Levin and Wright’s study suggests that the speculative component impacts most strongly in those regions which have greater price volatility, such as London city, the south east and the south west of the U.K. Brooks et al. (2001) applied variance-bound tests to test for bubbles in U.K. property house prices from January 1986 to January 1998. Both studies indicate the existence of irrational speculative bubbles in the property market of the U.K. The authors used co-integration analysis to provide further evidence on the presence of bubbles, and concluded the existence of real estate bubbles in the mid to late 1990s.

The Paris housing bubble that started in 1984 burst between 1990 and 1991. Roehner (1999) examined 20 districts in Paris and described the price movement of house prices in different districts by characterising each district in terms of the relative strength of speculative trading versus price-supply inelasticity. Roehner’s finding points to the transmission of speculative behaviour which plays a major economic role in the increase in prices, in those areas with lower incomes and comparatively poor housing standards.

In the study of the Australian housing market, Hatzvi and Otto (2008) use the asset pricing model and quarterly data to explain the behaviour of 36 local government areas (LGAs) with regard to property prices and rents in metropolitan Sydney from 1991 to 2006. Hatzvi and Otto’s (2008) study shows the presence of speculative bubbles on the property prices of LGAs in the outer western suburbs of Sydney. The property prices of LGAs in the outer suburbs of Sydney exhibited 60 percent of the variation in house prices, which cannot be explained by the variation in the fundamentals (rent ratios).

During the last 15 years, Australian real estate house prices have increased by 35 percent in the capital city, with Canberra, Brisbane, and Sydney experiencing an increase of 48 percent to 61 percent; and 20 percent in Adelaide, Melbourne and Perth (Bourassa & Hendershott, 1995). Bourassa and
Hendershott (1995) estimates that six of the Australian state capital cities use growth in employment, growth in real construction costs, after tax real interest rates, real income growth, and population growth, to explain the house price behaviour. The authors conclude that speculative bubbles did exist in the Australian housing market from 1979 to 1993.

With regard to the Asian housing market bubbles, Glindro et al. (2007) explored housing bubbles by investigating house price overvaluations in nine Asia-Pacific countries over the period from 1993 to 2006. The study uses a wider set of fundamental variables in the model such as equity prices and exchange rates, and institutional factors such as corruption, financial sector factors and property rights. Their results suggest that speculative housing bubbles may exist in Seoul, Beijing and Shanghai for the period 1993 to 2006. There have been quite a number of studies on the real estate price bubble in South Korea. Kim and Suh (1993) applied standard rational expectation models and suggested a bubble existed in both Korea and Japan during the period 1974 to 1989. Lee (1997) tested a bubble in Korean land prices for the period 1964 and 1994. The study used a structural model with GNP, interest rates and money supply as the fundamental variables. Lee found evidence to reject the hypothesis that only market fundamental variables drove the land prices in Korea. Kim (2004) uses two approaches: first, linear regression in a time series analysis; and second, the concept of discounted cash flow (DCF) for examining the presence of bubbles in the real estate market in Korea. Kim (2004) includes interest rates, income, inflation and real GDP growth rates from 1980:Q1 to 2002:Q4. Using the first approach, Kim’s study shows evidence of housing bubbles occurring in two periods; from 1991:Q1 to 1993:Q4 and from 2001:Q3 to 2002:Q4. In the second approach, the results indicate a greater likelihood of bubbles occurring in the Gangnam district in Seoul. This finding is consistent with the property prices in Gangnam district which is the most expensive and speculative area in Seoul (Kang, 2007).

The large swing in property prices in Japan in the late 1980s and early 1990s has intrigued many researchers. Ito and Iwaisako (1995) examined Japanese property prices to determine whether the variations in property price could be attributed to the fundamental factors. The results suggest that during the early 1980s rational explanations and fundamental factors could not be used to explain the changes in house prices in Japan. Basile and Joyce (2001) used the same method to measure the size of the asset price bubble, which is the difference between the ‘ex post’ returns of an asset and the required return. Their study shows that the housing market bubble grow evenly through mid-1990s before declining.

The housing market in Hong Kong has been studied extensively presumably because of the high volatility. Chan et al. (2001) used a signal extraction approach and a standard present value model to detect rational bubbles in the Hong Kong housing market. The study assumes that current housing prices are determined by the present value of current rental income, and the expected market price
for the next period. The study investigated bubbles in Hong Kong (Hong Kong Island, Kowloon and New Kowloon) for the periods 1990 to 1992 and 1995 to 1997. The evidence of the existence of a bubble is caused by a misspecification error.

Xiao and Tan (2007) found similar bubbles in the Hong Kong housing prices. The study used a set of recursive equations to study housing price bubbles in Hong Kong. Their sample includes monthly data stretching from December 1980 to January 2003. Their results show that speculative bubbles collapse periodically in Hong Kong; the housing bubbles were in the stage of collapsing during the first half of the 1980s, the bubbles appeared again in 1997, and then collapsed after the Asian financial crisis of 1997. Kalra et al. (2000) used time series analysis techniques to examine the determinants of residential property prices in Hong Kong for the period 1980 to 1998. The study shows that half of the movements in Hong Kong property prices are explained by macroeconomic fundamental variables, and the other half are explained by the inflating of bubbles, followed by the bursting of bubbles.

Over the last two decades, China has achieved rapid economic growth, accompanied by rapid development of the real estate market. For example, the Shanghai Housing Price Index (SHHPI) in the China Real Estate Index System (CREIS) was 656 points in January 2000, but increased by 63 percent (to 1,084 points) in December 2003 (Yue & Hui, 2006). Yue and Hui (2006) use a combination of standard econometric methods (such as Granger causality tests and generalised impulse response analysis) to investigate whether there was a housing price bubble in Hong Kong, Beijing and Shanghai for the period 1990 to 2003. The authors found that Hong Kong experienced the formation and then the bursting of a huge housing bubble around 1997, and found that a bubble appeared in Shanghai in 2003. Qi and Li (2004) built a model to explain the increase in China’s real estate prices by examining the relationship between real estate prices and bubbles. The results of their study show that three main factors contribute to the increase of real estate prices and the formation of real estate bubbles in China. These factors include an increase in market demand for real estate assets, more opportunities for credit from financial institutions, and an oligopoly competitive market (Qi & Li, 2004).

Hou (2010) used a combination of different quantitative indicators (a comparison of housing market prices with the rational expectation prices, mortgage loans, and the price to income ratio and the price to rent ratio) to examine whether housing price bubbles exist in Beijing and Shanghai. Hou’s result shows that Beijing appeared to exhibit a housing price bubble between 2005 and 2008, and that a housing bubble perhaps existed in Shanghai from 2003 to 2004.

### 3.4 Conclusion

The world economy is currently facing its worst global crisis since the 1930s Great Depressions. The global financial crisis erupted from the 2007 U.S. subprime loan crisis which has spill over effects
globally such as the Eurozone crisis. The crisis havoc in many financial markets that have yet to fully recover. A wide consensus among analysts and commentators has emerged on the central role of the bursting of the housing bubble played in the U.S. and other developed economies, in the unfolding of the current crisis (Arce & Salido, 2011). Wyss (2007) reports that between 1997 and 2005, house prices in the U.S. on average increased by 75 percent, by 160 percent in the U.K., by 130 percent in Australia, by 65 percent in New Zealand, by 145 percent in Spain, by 80 percent in Sweden and by 185 percent in Ireland. Japan and Hong Kong are still reeling from their own property bubbles bursting over a decade ago. The sharp increase in house prices in several industrialized economies such as the U.S., U.K., Australia and Spain (Glindro et al., 2007) has attracted much attention due to the negative impact created by the bursting of bubbles in those economies (Labonte, 2003; IMF, 2005; Gyntelberg & Remolona, 2006). Governments and organisations such as the Bank of International Settlement (BIS), the International Monetary Fund (IMF) and the Organization for Economic Cooperation and Development (OECD) have raised concerns about the issue of asset price instability (overshooting the fundamental variables) in the housing market (Gyntelberg & Remolona, 2006). Therefore, it is important to understand the theoretical and conceptual framework underlying housing bubbles before suggesting any monetary or fiscal policies to prevent future housing bubble crises.

In the real estate market, bubbles occur when property values increase rapidly and reach levels that are unsustainable given the current economic conditions (Knight, 2002). The housing bubble phenomena can be argued in terms of rational expectation equilibrium in which homeowners, who extract utility from their houses, coexist with investors, who hold houses only for resale purposes and do not expect to receive any dividend in the form of rent or utility from occupancy (Case & Shiller, 2003). A bubble in house prices starts when the appreciation of house prices becomes irrational, and does not depend on economic fundamental factors such as inflation and interest rates (Malpezzi & Wachter, 2005). Shiller (2008) states that the cause of the recent housing bubble that happened in the U.S. in 2007, is actually a social contagion in housing boom thinking, mediated by the common observation of rapidly rising prices. This social contagion appears to justify the belief that the boom will continue. This idea occurs when a price rise or fall is expected to continue to rise or fall; hence in an “up” market buyers will push prices up even further encouraging other buyers to do likewise (Shiller, 1984).

Case and Shiller (1988) also suggest that an exogenous increase in house prices tends to induce potential buyers to purchase houses before prices rise too much, and the increase in demand accelerates the pace of the price increases. The general definition of a bubble in relation to the housing market can be summarized as follows: the observable characteristic of a bubble in the housing market is an increase in the price level due to the expectation on the part of market participants of a future
increase in the asset price. This increase in house price is not caused by macroeconomic factors (Coleman, 2008).

It is also important to understand the difference between the recent housing bubbles and previous ones. According to Shiller (2008), the recent housing bubble was one where economic pressures raised the price of every available piece of real estate, so the bubble became a nationwide or even a worldwide phenomenon. Real estate bubbles from other times have always been relatively local. For instance, the Florida land bubble took place between 1921 and 1925, but nevertheless had a relatively modest effect on urban home prices nationwide. The recent housing bubbles in Asia (in 1997) and the U.S. (in 2006) had a huge impact on urban house prices worldwide (Shiller, 2008).
Chapter 4

Housing Bubble Model

4.0 Introduction

This chapter provides an overview of the theoretical framework used to examine the presence of bubbles in the housing market. Section 4.1 discusses the fundamental variables used to determine house prices. Section 4.2 describes the general structure of the housing market including housing demand, housing supply and the mortgage market. Section 4.3 presents the four conventional house price models used to determine house price bubbles.

4.1 Macroeconomic Fundamental Variables of House Prices

In a competitive housing market, house price is determined by housing supply and demand (Quigley, 1999). Therefore, house fundamentals are composed of supply and demand factors that can be measured by macroeconomic variables, such as employment, interest rates, inflation, income, and population growth. The literature on forecasting house prices considers that economic fundamentals provide sufficient information and also provide a large number of economic variables that affect house price growth. For instance, income, interest rates, construction costs, labour market variables, stock prices, industrial production, and the consumer confidence index act as potential predictors of a house price bubble (Abraham & Hendershott, 1996; Cho, 1996; Johnes & Hyclak, 1999; Rapach & Strauss, 2009).

Since the last decade researchers have studied bubble phenomena by tracking the movements of market fundamentals and housing prices. Hui and Yue (2006) and Qin and Kwang (2006) use supply and demand factors as fundamental price factors and different compositions of the fundamental factors to test the impact on house prices in Hong Kong, Beijing and Shanghai. Case and Shiller (2003), Bourassa et al. (2001) and Hui and Yue’s (2006) studies suggest that house prices seem to have interacted abnormally with market fundamentals, such as disposable income, mortgage rates and local GDP. Case and Shiller (2003) explored the relationship between house prices and fundamental variables. Their log-linear regression result shows a high correlation between house prices and income, mortgage rates and employment rates. Hui and Yue’s (2006) study investigated the existence of a housing bubble in Shanghai in 2003, and they believe the existence of a housing bubble can be attributed to the movement of market fundamentals (such as GDP, income, interest rates and the house price index).
Froot and Obstfeld (1991) posit that deviations in asset prices from fundamental values can be explained by the presence of a particular type of rational bubble that depends exclusively on aggregated values of fundamentals, such as real disposable income. Fraser et al. (2008) modelled the housing bubble component related to fundamentals such as the house price index, interest rates, the consumer price index and real disposable income. Giussani and Hadimatheou (1991), Milne (1991) and Chen and Patel (1998) show a positive relationship between income and house prices in their studies. The authors used a co-integration test to determine the significance of the relevance between house prices and the fundamental variables, and concluded that a relationship between house prices and income exist in a long-run equilibrium situation. Kim and Lee’s (2000) study also shows an equilibrium relationship between income and house prices. Capozza et al. (2004), Sutton (2002), Case and Shiller (2003) and Farlow (2004) point out that real income and interest rates are important determinants of real house prices.

Bjorklund and Soderberg (1999) examined the 1985-1994 property cycles in the Swedish property market and concluded that a housing bubble may exist if the ratio of property values to rent increases too much. Lee (1997) tested the presence of a bubble in land prices in Korea between 1964 and 1994. Lee (1997) used a structural model with gross national product, interest rates and money supply as the fundamentals, and consequently rejected the hypothesis that only the market fundamentals drive land prices in Korea. The author suggests that other factors such as income should also be taken into consideration. For instance, people demand higher quality accommodation when their income rises (Tse & Love, 2000). Other studies on real estate bubbles also suggest incorporating income into the bubble analysis (Giussani & Hadjimatheou, 1991; Milne, 1991; Case & Shiller, 2003). Holly and Jones (1997) used a data set gathered from 1939 to 1994 to investigate house price behaviour in the U.K., and found the single most important determinant of real house prices to be disposable income; where over the last 60 years real house prices have increased broadly in line with income in the U.K.

McQuinn and O’Reilly (2006) examined the behaviour of housing prices in Ireland for the period 1980 to 2005. The authors used an intuitive theoretical model of house prices where the demand for housing is driven by how much individuals can borrow from financial institutions. Their result shows that disposable income and interest rates accurately describe house prices for most of the study period. Malzubris (2008) found that much of the increase in house prices in Ireland from 1992 to 2006 can be explained by demographic factors; an increase in disposable incomes, very low interest rates, tax treatment of house ownership, and an increase in the purchase of houses for investment purposes.

Further information on the theoretical background used to determine various determinants of house prices can be found in Poterba’s (1984) study and Gallin’s (2006) study. Table 4.1 shows several housing
market studies, which use fundamental variables to explain housing market behaviour. These variables help to explain the variation in the housing market across different countries.

The changes in financial and monetary regulations in China may have influenced China’s house prices. For example, interest rates and inflation variables are used to explain the impact of credit market liberalization on the demand for housing in China. Most of the studies listed in Table 4.1 show significant relationships between house price index and macroeconomic fundamental variables such as the construction costs, incomes, employment, interest rates and inflation.
<table>
<thead>
<tr>
<th>Researchers</th>
<th>HPI*</th>
<th>Interest rates</th>
<th>Money supply</th>
<th>Income</th>
<th>Construction costs</th>
<th>Employment rates</th>
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<td>Zhao &amp; Gao (2010)</td>
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* HPI=house price index
4.2 Housing Market and Interrelated Sectors/Markets

The selected supply and demand factors have been widely used to test the impact of house prices with different compositions of the factors (Hui & Gu, 2009). For example, a decrease in housing demand against fixed housing supply will cause a downward movement in house prices, and the developers are more likely to supply fewer houses (Porchockchai, 2007). Hui and Yue (2006) used the interactions of the housing demand and supply equation to predict house prices, and compared the equation with the real house prices in Beijing, Shanghai and Hong Kong, to test for the presence of housing bubbles in the three major cities in China. Housing demand is a function of house price, disposable income and local GDP; and house supply is a function of house price and vacant new dwellings. The findings of the study suggest that Hong Kong experienced a huge housing bubble around the year 1997; there appeared a bubble in Shanghai in 2003; but Beijing had no sign of a bubble in the same period.

Tsai (2012) used the vector error correction model (VECM) to examine long-term and short-term correlations among housing prices with supply and demand factors in the Taiwan housing market. The study indicates that construction costs are an important supply side factor affecting house prices. Construction costs are subject to the effect of the derived demand for housing as they represent the raw materials pertaining to the housing market. Rental prices are a demand side factor in the housing market because the rental and homeownership markets are intimately connected. Empirical results show that house prices stimulate changes in the construction costs and rent prices.

The market price for a house is jointly determined by a demand and supply function where the equality of demand and supply results in the equilibrium of housing prices (Tsai, 2012). The demand factors affect the ability to purchase; the demand factors are used to analyse and estimates the house prices (e.g. income, interest rates and inflation) (Tsatsaronis & Zhu, 2004). Housing supply factors consist of the cost of land and construction costs (Malpezzi, 1996). The housing supply factors are used to differentiate between the factors, which affect investment in the existing housing supply, and the factors which determine the new supply of housing. Thus, most studies consider only the demand side factors (DiPasquale & Wheaton, 1992; Follain, Hendershott & Ling, 1992; Malpezzi, 1996).

4.2.1 Financial Sector and Mortgage Market Factors

The real estate market is sensitive to interest rates and bank lending. Banks increasing mortgage lending to households to buy houses, could cause a boost in house prices (Kim & Min, 2011). For example, the Bank of Korea (2003) reported that the ration of collateralized household lending to the total household lending was 56.1 percent at the end of 2002, implying that households switched their strategy from “buying a house by saving” to “buying a house by borrowing” which usually causes great speculative increases in house prices.
Bank lending could fuel financial crises, especially in those countries where banks play a dominant role, such as Japan where the banks hold 75 percent of the total social assets (Herring & Wachter, 1999). Issing (2002) shows that surplus monetary liquidity from bank lending is an indispensable factor in explaining the real estate price bubbles. Asset prices increase because mortgage lending constraints are relaxed and supply of credit increases. Borrowers will optimally choose to buy rather than rent, and this aggressive lending will cause demand shocks of assets (Pavlov & Wachter, 2011). The supply of credit by the banks will increase during the house price boom, and lead to an increase in the price of real estate; which increases the economic value of bank capital and the value of loans collateral, leading to a decline in the perceived risk of real estate lending. Consequently, an increase in real estate prices will increase the supply of credit to the real estate industry. These factors are likely to further encourage the increase in credit supply and further increase house prices (Herring & Wachter, 1999). In the case of the Japanese bubble economy in the late 1980s, the Japanese government expanded bank lending during the yen appreciation, which resulted in stock and real estate bubbles (Okina & Shiratsuka, 2004).

In the 1990’s, house prices in China were rather low at the beginning of the real estate market privatization process and the Chinese government wanted to boost the economic growth process with a high price strategy in the real estate market. The banks had a goal imposed by the government to increase loans by 15 percent per year. As the banks had to meet this goal they offered loans to speculators and this in turn led to speculative behaviour (Wang, 2012). Deng and Fei (2008) show that the ratio of mortgage loan balances to total bank loans increased from 0.5 percent in 1998 to more than 10 percent in 2004. Therefore, banks play an important role in encouraging speculative behaviour in the real estate market (Wang, 2012).

**4.2.2 Consumption Factors**

An increase in house prices will stimulate consumers’ house consumption. An increase in household income or wealth causes an increase in purchasing power and leads to higher consumption for a better house (Ofori, 1990). Individuals with higher income are more willing to pursue bigger homes to improve their living conditions, or purchase an investment house to benefit from the housing inflation in the future (Yang & Shen, 2008). With the progress of urbanization accelerated, Chinese real estate is developing very quickly and house prices are trending upwards. Thus, investors increase their investment in the housing market, because they have the expectancy that the house prices will increase. The expectancy of price growth could be the reason the housing bubble forms (Sato, 1995).
Consumers who are optimistic about economic prospects are likely to increase their consumption of housing and non-housing goods. House price booms also increase the volume of housing transactions (Stein, 1995). For example, during a housing market boom, people are very optimistic about the future increases in house prices. This optimism about house prices will increase people’s consumption (Herring & Wachter, 1999). A bubble is believed to be caused by excess consumption (Grimes & Chressanthis, 1997). This over optimism and excess consumption in the housing market can be explained by the herd behaviour, which describes the tendency of people’s actions to follow those actions taken by others, so that they will not be left behind. Herding can take the extreme form where people make decisions simply based on the observed actions of others, rather than on their own private information (Wong, 2001).

Herding behaviour can be defined as “the elusive phenomenon that individuals prefer to follow others in thinking, feeling, and taking action, while ignoring their own original decisions” (Lan, 2014 Pg. 115). Herding behaviour is an obvious intent by investors to imitate the other investors’ behaviour (Bikhchandani & Sharma, 2000). In the real estate market, the house price fluctuations are no longer solely based on movements of fundamental economic variables, but also depends on the interaction of the trading group psychology and behaviours of real estate market (Wang, 2013). Hott (2012) study calculates the fundamental house price and compares it to the actual price for seven European and three non-European OECD countries between 1975 and 2011. The comparison indicates that house prices fluctuate more than fundamental justifies. The study then incorporates herding approach with the house-price model and found the calibration of the herding behaviour can explain fluctuations of actual house prices. Lan (2014) study applied the least square method and quantile regression method to test the herding effect of Chinese housing market at both national and cities levels for the period of 1998 to 2013. The results show the investors in Chinese residential housing markets tend to herd before the financial crisis in 2008, and there is no herding behaviour during and after the financial crisis.

### 4.2.3 Construction Factors

Construction costs are an important factor affecting house prices. Construction costs are subject to the effect of the derived demand for housing, and are the raw materials pertaining to the housing market (Tsai, 2012). Glaeser and Gyourko’s (2005) study shows that house prices are determined by construction costs, even when growth in demand for housing is high. In some fast-growing southern U.S. markets such as Houston, Atlanta, and Charlotte in 1980 and in 1990, the easy availability of land explains why the population can grow but house prices remain flat. When demand rises, builders acquire land and build new houses. In this case, construction costs determine the prices of houses in those markets (Gyourko & Saiz, 2004).
Muth (1960) shows that if the long-run supply of housing were perfectly elastic, then house prices would be determined solely by construction costs. The expectation of house price appreciation would mean the expectation of growth rate in real construction costs. Himmelberg, Mayer and Sinai (2005) found that house prices grew relative to construction costs in most of the metropolitan areas of the U.S. (e.g. Boston, Los Angeles, New York, San Francisco). Changes in construction costs explain neither the overall rise in real house prices nor the cross-sectional differences in appreciation rates across markets.

### 4.2.4 Economic Factors

Housing price bubbles have important implications for the domestic and global economy. The real estate sector is closely interrelated with other sectors of a country’s economy. For example, the forward businesses of the real estate market include property sales, mortgages, insurance, maintenance, improvements and management, while the backward businesses comprise cement, steel and timber (Mak, Choy & Ho, 2012). Kim and Min (2011) state that house price bubbles not only negatively impact the domestic economy through a negative wealth effect and inefficient wealth allocation, but could also cause global recession. When a house price bubble bursts, it causes serious negative effects on the financial system and the economy. In addition, asset price decline has stronger effects on the economy than asset price increase, as the collapse of asset prices hurts the stability of the financial system (Kim & Min, 2011). Further, the problems in the financial system could spread to other sectors in the economy and result in a banking crisis, currency crisis, and stock market crisis (Kallberg et al., 2002).

Liu and Shen (2005) identified a number of potential ways in which real estate prices affect the macro economy. For example, changes in real estate prices can lead to changes in consumption through the wealth effect, to a boom or recession in the construction industry, to expansion or shrinkage in the credit supply, and to the increase or decrease in investment by the construction companies (Kim, 2000). Because real estate prices affect consumption and investment, any changes in house prices will have a significant effect on economic fundamentals (Liu & Shen, 2005). Liu and Shen (2005) used the Granger causality test to confirm that unemployment rate, total population, changes in construction costs, and changes in the consumer price index, are all Granger causalities of house prices.

### 4.3 Models of House Prices

Traditionally, the house price cycle played an important role in understanding a country’s business cycle. Since homes imbed much individual wealth, the movements of house prices provide important signals for consumption, output, inflation and investment (Topel & Rosen, 1988). Changes in the real estate cycle are often linked with changes in macroeconomic fundamentals, such as interest rates and
economic growth. Gupta, Kabundi and Miller (2011) compared the performance of the dynamic structural general equilibrium model (DSGE) to a series of time-series models (standard vector-autoregressive and Bayesian vector autoregressive) to forecast the U.S. real house-price index, and the turning point in 2006. The authors found the DSGE model actually could accurately forecast a turning point of house prices. Gupta, Jurgilas and Kabundi’s (2010) study shows that the models used to forecast real house price inflation not only can provide policy makers with an idea about the future direction of the overall macro-economy, but can also provide important information for designing better and more appropriate policies for controlling the housing prices.

Roche (2001) used quarterly data on new house prices in Dublin for the period of January 1976 to January 1999 and applied a regime-switching model to estimate a non-linear relationship between house prices and macroeconomic fundamental variables. The findings from the regime-switching model indicate the presence of speculative bubbles in house prices in Dublin. Chan et al. (2001) used the GMM (generalized method of moments) method to test for the existence of bubbles. They found evidence of house price bubbles in Hong Kong during the period of 1985 to 1997. Hui and Yue (2006) applied the Granger causality test and the generalized impulse response analysis and found that Shanghai had a house price bubble in 2003.

Lecat and Mossonnier (2005) suggest two theoretical approaches for examining the level of house prices: structural models and the asset pricing approach. The supply and demand for property is examined in the structural model by capturing both the returns from residential investment and the utility of the property. The investment in a property is examined in the asset pricing approach. Economic and finance based approaches are alternative models for determining house prices. The econometric models include the asset market, reduced form, and error correction models. These models are determined by an underlying set of housing demand and supply fundamental determinants. Many researchers have used these models to analyze house prices (Poterba, 1984; Muth, 1988; Dipasquale, 1999; Oikarinen, 2009)

4.3.1 Asset-Market (User-Cost Approach) Model

The housing market is defined as a market for housing services allocated by the supply and demand mechanism. The inelasticity of housing supply is the most important characteristic that differentiate the housing market from goods and services market. (Selim, 2009). Selim (2009) study used hedonic regression and artificial neural network (ANN) and found that the water system, pool, type of house, number of rooms, house size, locational characteristics and type of the building are the most significant variables that affect the house services and influence the house prices in Turkey in 2004. Houses provide housing services that are consumed daily and are considered a long term investment asset. House prices can be influenced by an interaction of taxes and inflation (Manchester, 1987).
Hendershott (1980) emphasizes the interaction of inflation and income tax as one of the major factors that influences the demand for housing. Schwab (1983) suggests that the changes in the inflation rate could be caused by the changes in real interest rates. In this case, a fully anticipated increase in the rate of inflation will be reflected in the nominal interest rates, and will reduce house prices.

The asset-market model determines house prices by distinguishing the relationship between the quantity of housing services and the real estate user cost of housing services (Poterba, 1984). Housing services are an important component of consumption expenditure. In 2006, National Income and Product Accounts (NIPA) reported that housing services represent 15 percent of aggregate consumer consumption expenditure in the U.S. Thus, it is important to pay attention to the valuation of housing services (Diaz & Luengo-Prado, 2008). Housing services can be defined as the rental service from housing, which consists of houses purchased or rented for occupancy (Dipasquale & Wheaton, 1996).

The underlying framework of the asset market model is based on the capital theory equation where the equilibrium price of an asset is equal to the present discount value of future net income derived from owning the asset (Diewert et al., 2009). The asset market model also assumes the price of a house equals the present discounted value of its net future service flow (rental of the house) (Poterba, 1984).

Equation (4.1) describes the general asset market model:

$$H_{sgh} = QD_{sgh} + UC_{sgh}$$  \hspace{1cm} (4.1)

Where;

$$H_{sgh} = \text{the price of the house}$$

$$QD_{sgh} = \text{the quantity demanded for housing services (real rental service)}$$

$$UC_{sgh} = \text{the user costs which consist of} \ (M_r) \text{the mortgage rates,} \ (P_t) \text{the property taxes,} \ (In_t) \text{income tax,} \ (MR_c) \text{maintenance and repair cost and} \ (EC_{cg}) \text{expected capital gain.}$$

$$UC_{sgh} = f(M_r, P_t, In_t, MR_c, E_{cg})$$  \hspace{1cm} (4.2)
The quantity of housing services is defined as the real rental price of housing, which is the amount paid by the consumer in consuming house stock (Pain & Westaway, 1997) (see equation 4.3)

\[
QD_{hsg} = \left( \frac{1}{(1 + R)^t} \right) \tag{4.3}
\]

Where \( \frac{1}{(1 + R)^t} \) is the discounted real rental price (future inflow of housing services), with \( R \) as the rental price. The unobservable of the real rental price causes many researchers (Ayuso & Restoy, 2006; Diewert et al., 2009) to use proxies such as disposable income, demographic indicators, and real interest rates, to determine the demand for housing services (Pain & Westaway, 1997). Therefore, the real rental price of housing services \( R_t \) is the proxy with the following observable determinants shown in the following equation (Meen, 1990);

\[
R_t = f(Y, P, H_{s}, W) \tag{4.4}
\]

Where \( Y = \) real disposable income

\( P = \) population

\( H_{s} = \) supply of houses

\( W = \) consumers’ asset wealth

In equilibrium, the user cost and real rental price should be equal. According to Poterba (1984), people use housing services until the marginal value of the housing services, which is \( QD_{hsg} \) (rental price) is equal to their cost.

The house price in the asset market model is determined by combining the housing services demanded (equation 4.3) and the real estate user cost (equation 4.2) as follows:

\[
H_{s,t} = R_t + E_t \left[ \frac{H_{s,t+1} (1-\delta)}{1+i_{t+1}} \right] \tag{4.5}
\]
Where \( H_{sg,t} \) = house price at time \( t \)

\[ R_t = \text{real rental of housing services at time } t \]

\[ E_t = \text{expected capital gain at time } t \]

\[ i_{t+1} = \text{discount rate} \]

\[ \delta = \text{constant rate of depreciation} \]

The asset market model provides new insight on how credit availability determines the quantity of housing services demanded. This approach focuses on the interaction between inflation, taxes and house prices (Deleeuw & Ozanne, 1981). Poterba (1984) employs the asset market method to examine the impact of inflation on tax subsidies to owner occupied housing. The estimated results suggest that inflation on tax induced house prices increased by as much as 30 percent in U.S. house prices in the 1970s, and this was attributed to tax provisions for mortgage interest deductibility.

Meen (1990) uses the user-cost approach to examine the impact on the housing market that the rationing system of mortgage supplies used in the early eighties in the U.K., caused. The study also examines the effect of inflation on real house prices with and without rationing. Meen’s (1990) study shows that the mortgage demand and supply can be identified from a direct estimation of excess mortgage demand or mortgage rationing by the user-cost approach, and that inflation leads to an increase in house prices.

### 4.3.2 Reduced-Form Housing Equation Model

The standard housing market model consists of demand and supply equations. The demand equation includes variables such as housing stock, real income, interest rates and other fundamental variables that determine house prices. The supply equation which determines the supply of new houses shows how the stock of houses changes over time as new houses are completed (Cameron et al., 2006).

The reduced-form housing equation model can be applied to a demand equation only or demand and supply equations. However, the supply of housing equation is far less convincing than that of the demand for housing equation (Dipasquale, 1999). The use of the reduced demand form equation model assumes short run housing supply is inelastic and ignores supply side factors (Dipasquale, 1999).

The reduced-form housing equation derived from Glaeser et al. (2004) study is given as follows:

\[
H_{sg,D} = f(Y, P, W, UC, N) \tag{4.6}
\]
Where $H_{sg}^D$ is the demand for houses, $Y$ is the real disposable income, $P$ is the price of houses, $W$ is the wealth, $UC$ is the cost of housing capital, and $N$ is the user cost; (equation 4.6 is similar to equation 4.2). The house supply is explained in equation (4.7) below.

$$H_{sg}^S = f(P, C, Z) \quad (4.7)$$

Where $H_{sg}^S$ is the supply of houses, $P$ is the price of houses, $C$ is the construction costs, and $Z$ is the restriction or constraint which causes a shift in supply.

In a reduced-form, the equilibrium house price ($H_{sg}^E$) equation is given as follows:

$$(H_{sg}^E) = H_{sg}^D(Y, P, W, UC, N) + H_{sg}^S(P, C, Z)$$

$$H_{sg}^E = f(Y, W, N, C, Z) \quad (4.8)$$

The estimated values from the equilibrium house prices (equation 4.8) are compared with the market values of house prices. Any deviation from the equilibrium price is considered to be a house price bubble.

House prices are subject to the impacts of supply as well as demand. While supply is affected by construction costs, demand is determined by the renting/buying considerations of the public. The supply and demand models are used to investigate the movements of house prices. These models incorporate factors that affect housing supply and demand. The equality of supply and demand model makes it possible to predict the equilibrium house price, whereby the models are used to determine whether house prices deviate from economic fundamentals (Muth, 1988; Hendry, 1984; Meen, 2002; Tsai, 2012). Muth (1988) uses the reduced-form model to examine the dynamic behaviour of the housing market and whether the housing market dynamic behaviour is caused by changes in the stock of the housing supply. The study concludes that a strong cyclical component appeared in the U.S. housing market. Malpezzi and Maclellan (2001) used a reduced-form equation to estimate supply elasticity of houses in the U.S. and the U.K from 1914 to 1947. The results show that the house price elasticity of the U.S. was between four and 10 before the Second World War while in the same period the price elasticity was between one and four in the U.K.

Ozanne and Thibodeau (1983) used the long run supply and demand model (reduced-form) to analyze the variation in house prices in the entire metropolitan housing sector in the U.S. The model divides the metropolitan housing sector into renters and homeowners in 54 metropolitan areas in the U.S., from 1974 to 1976. The results suggest that the reduced form equations can explain 90 percent of the
variation in the rent index and 60 percent of the variation in the house price index. Ozanne and Thibodeau (1983) used several exogenous variables in their model, such as average tenant income, mortgage rates, expected appreciation in rental prices, number of renters, demographic characteristics of renters, price of rental properties, real estate taxes, land prices and non-land prices (building materials and labour).

A limitation of the reduced-form model is the difficulty of evaluating rational expectation, as many studies employ a backward-looking expectation (Oikarinen, 2009). Further, the supply and demand model cannot completely capture the dynamic movements in house prices. Theoretical models constructed by Chen and Tsai (2007) posit that housing supply exhibits a lag, where the lead and lag relationships among the variables should be considered. For example, house prices should affect future housing supply because developers decide whether to increase housing supply based on current house prices (Tsai, 2012).

4.3.3 Vector Error Correction Model

One of the most popular econometric frameworks for dealing with multiple time series is the vector error correction model (VECM). VECM is a restricted vector autoregressive model (VAR) designed for non-stationary series that are known to be co-integrated. The VECM has co-integration relationships built into the specification so that it restricts the long-run behaviour of the endogenous variables to converge to their co-integrating relationships, while allowing for short-run adjustment dynamics. The co-integration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments (Tumbarello & Wang, 2010).

VECM is a reduced form linear dynamic simultaneous equation model in which all variables are treated as endogenous. A reduced form representation can be consistently estimated by regressing each variable on a number of lags of all endogenous variables. The VECM has proved to be a convenient method of summarizing the dynamic relationships among economic variables.

The VECM used by Sing et al. (2006) and Oikarinen (2009) is given as:

$$\Delta hsg_{p,t} = \delta e_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta hsg_{p,t-1} + \sum_{i=1}^{q} \beta_i \chi_{t-1} + \epsilon_t$$

(4.9)

Where $\Delta hsg_{p,t} = hsg_{p,t} - hsg_{p,t-1}$,

$\epsilon_{t-1} =$ the lagged value of house price deviation estimated from the long-run
relationship and \((\delta \neq 0)\) suggesting a co-integrating vector in the model

\[ \alpha_p \text{ and } \beta_q = \text{coefficient matrix jointly to be estimated in the VECM with } p \text{ and } q \text{ lags} \]

\[ \chi_i = \text{vector consisting of macroeconomic variables} \]

\[ \varepsilon_i = \text{independently and identically distributed random error terms} \]

One of the advantages of VECM is that it can provide short and long-term explanations of the behaviour of house prices (Wang et al., 2008). The VECM allows us to examine how much consumption will change in response to a change in the explanatory variable, as well as the speed of change (Hill et al., 2011). In addition, each variable in VECM is treated as endogenous and associates with its own past values and the past values of other variables (Tuluca et al., 2000).

The VECM has been used by several researchers to determine the long-run and short-run relationships of house prices, household borrowing (Oikarinen, 2009), and household mobility (Sing et al., 2006). Oikarinen (2009) uses the VECM method to examine the long-run relationships and short-run dynamics between household borrowings and house prices in Finland. Oikarinen’s study shows there are co-integrating long-run relationships between household borrowings, house prices and GDP. The analysis indicates that house prices substantially influence the number of housing loans. Furthermore, the study findings suggest that the effects of housing wealth on the boom-bust cycles in the overall economy are greater than that of the stock market.

Sing et al. (2006) tested the house price dynamics associated with the mobility of households in the public resale and private housing markets in Singapore. The authors use various kinds of house price index (such as apartment price index, resale house prices, house price index, detached house price index, semi-detached house price index, and condominium price index) as endogenous variables in their model. The macroeconomic variables (such as consumer price index, gross domestic product, prime lending, exchange all-share index of Singapore, and unexpected inflation rate) are used as exogenous variables in the model. The VECM result shows the error correction terms are significant in explaining the price variations in the Singapore housing market.

The VECM has some limitations however. First, the candidate variables or terms to be selected can not be large, because the VECM model can only handle up to eight or twelve variables (Gupta et al., 2010). Second, the VECM model has an important deficiency in selecting explanatory variables and may face an over-fitting problem (Zhang, Hua & Zhao, 2011).
4.3.4 Ratio Approach Model

The price-to-rent ratio is an indicator that is frequently used to assess whether house prices are rising at unsustainable rates and thereby creating a bubble (Barth, Lea & Li, 2012). For instance, Clark (1995) showed that the price-to-rent ratio could be reflected by the expected future increase in rent. The existence of housing market efficiency implies that the current price-to-rent ratio can be used to predict a future increase in rent. Bjorklund and Soderberg (1999) use the value of the gross income multiplier to examine the 1985 to 1994 cycles in the Swedish property market and conclude that if the ratio of property value to rent increases too much, a bubble would exist.

The price-to-rent ratio measures the relative costs of owning or renting a house. The volatility of price-to-rent and price-to-income ratios is often interpreted as evidence of inefficiency in real estate markets (Scherbina & Schlusche, 2012). The value of the price-to-rent ratio measures how much the buyers pay for the property for every unit of received rent. Rents are very closely related to supply and demand, and are therefore supposed to be stable. If price-to-rent ratios start increasing and rents remain constant, this can be a reliable signal for a housing bubble (Wu et al., 2010).

Other transaction costs, such as tax advantages to the homeowner and depreciation of housing are significant determinants of rental supply and housing demand. Hence, the inclusion of these transaction costs can be described in the following equilibrium house price-to-income ratio;
where \( r_{\text{f}} \) is a risk-free rate, \( r^* \) is a risk premium, \( T_x \) is the tax rate, \( dp \) is depreciation costs and \( gw \) is anticipated depreciation.

The ratios of house price-to-income ratio and house price-to-rent ratio are two basic indicators measuring housing affordability. Low values of the price-to-income ratio indicate a low share of housing consumption in the consumer’s budget, which will improve housing affordability for the consumer. A high price-to-income ratio implies there exists considerable risk in the housing market (Hou, 2010).

The price-to-rent ratio contributes to the diagnosis of the rent equation. The ratio indicates the time it takes to regain the original amount the consumer has invested, reflecting the return of housing as an investment. If the rent remains steady, the returns will lower if the house prices keep increasing. The higher the ratio, the larger the risk is for falling house prices. In summary, a large deviation of house prices from rent could be used as a typical characteristic of a housing bubble (Hou, 2010). Liu (2014) used the housing price-to-income ratio and housing price-to-rent ratio of 35 cities in China for the period 1998 to 2010, with the panel KSS unit root test, to examine whether a bubble was present in the housing market of China. The study found that the housing bubbles were not a serious problem in China at the time. The housing price-to-income ratio was found to be stationary in 34 cities out of the 35 cities examined, in China.

There are different arguments about the proper values of the price-to-income ratio and the price-to-rent ratio, depending on the openness of the economy or the various regulations of the time, in the housing market. However, a typical sign of a bubble is that the rental fee or the disposable income experiences a large deviation from the house prices. This shows that the price-to-income ratio and the price-to-rent ratio are not adequate for modelling bubbles in house prices. Both ratios are more likely to ignore the changes in different market fundamental variables; for example, demographic changes, asset prices and house-building credit conditions (Cameron et al., 2006). The ratio approaches cannot determine whether the increases in house prices are caused by economic fundamental variables or speculation activities during the house price bubble period (Cameron et al., 2006). This suggests that the two ratios are not designed to efficiently capture housing bubbles. Himmelberg et al. (2005) attempted to measure the annual cost of single family housing for 46 metropolitan areas in the U.S. and found that the price-to-rent ratio and the price-to-income ratio can be misleading as they fail to account both for the time series pattern of long-term interest rates and the predictable differences in the house price long-run growth rates.
4.4 Conclusion

This chapter provides a detailed discussion of related housing market theories and the previous models. The housing market literature reveals several empirical models used by researchers to determine house prices. These include the asset-market model (4.3.1), the reduced form model (4.3.2), the vector error correction model (4.3.3) and the ratio model (4.3.4). Each of these models produces different results regarding the existence of housing price bubbles.

House price is determined by housing supply and demand. Thus, fundamental variables composed of supply and demand factors, are relevant in modelling the determinants of house prices (Quigley, 1999). The literature on forecasting house prices considers that economic fundamentals provide sufficient information on house price movements. The commonly used variables in the housing market studies are interest rates, income, and inflation. These variables can act as potential predictors of house price bubbles (Abraham & Hendershott, 1996; Cho, 1996; Johnes & Hyclak, 1999; Rapach & Strauss, 2009).

In this study the price income ratio and VAR/VECM techniques are employed to investigate housing bubbles in the Chinese real estate market.
Chapter 5

Research Methodology and Data Collection

5.0 Introduction

This chapter provides an overview of the research methodology and data used to investigate the house price bubbles in China’s housing market from 1999:Q1 to 2013:Q4. Section 5.1 explains the methodology of the study. Section 5.2 describes the time-series data used in the study and Section 5.3 summarizes the chapter.

5.1 Research Methodology

Previous research papers have explored many approaches for analysing the real estate bubble phenomena. These include the asset pricing model (Lin, 1996), present value method (Smith & Smith, 2006), ratio approach model (Clark, 1995) and vector error correction model (Wang et al., 2008). Hui and Gu (2009) explain that the outcomes of bubble studies depend on the selection of the data set and the techniques employed.

In this current study the data set includes macroeconomic factors such as income, mortgage rates and inflation. This study applied the price-to-income ratio (affordability ratio) to test whether house prices are overvalued in China’s housing market. However, the price-to-income ratio approach ignores the variations in the economic fundamental variables which means that the price-to-income ratio cannot determine the causality relationships between macroeconomic fundamental variables and house price bubbles. Thus, the data in this current study is also analysed using more sophisticated methods; vector autoregressive model (VAR) and vector error correction model (VECM). The VAR and VECM models estimate with time series data were pioneered in Sims (1980) study, where the author applied the vector auto regressive framework to estimate the joint stochastic processes describing the economic variables under consideration. The use of price-to-income ratio, and the VAR and VECM models differentiate this current study from previous studies which used only one technique. The ratio approach can be used to identify the house price bubble levels among different cities. However, the VAR and VECM models provide more robust results when investigating the existence of bubbles, and when identifying the size of the bubbles in the Chinese housing market. Furthermore, VAR and VECM models estimate the short-run and long-run relationships between house price index and macroeconomic fundamental variables.
The proposed housing bubble model used in this current study adopts a general-to-specific approach with price-to-income ratio, vector autoregressive model and vector error correction model. This current study employs several assumptions as follows:

- Secondary data used in this study are assumed to represent the “true condition” of the Chinese housing market.
- The insufficient data such as employment, construction sector and other housing supply factors are excluded from this study. The housing supply variables are assumed to have a less significant effect on the movement of house prices in China’s housing market.
- The scope of this study focuses on eight Chinese cities from three different house price growth rate groups and covers three tiers of Chinese cities.
- The term “house price” used in this study refers to the asset price of houses, not the land prices they are associated with.

5.1.1 Housing Affordability Measures

The surge in property prices and the rise in real estate investments in China has caused concern about housing affordability for Chinese people. In particular, there is a heated debate over whether a property bubble has developed in China (Shen, 2012). The price-to-income ratio is regarded as an affordability measure. It is an indicator that measures whether housing is affordable for the people. If house prices start to increase and substantially property becomes unaffordable, then it indicates an overpriced housing market (Shen, 2012). A low value of the price-to-income ratio means a low share of housing consumption in the consumer’s total disposable income, which improves housing affordability (Hou, 2010). Ding (2012) defines the housing price-to-income ratio as being based on the house price and the resident’s disposable income. The housing price-to-income ratio is different between regions, because the housing price-to-income ratio in China is influenced by local economic development and local governments’ policies on the real estate industry.

The formula for the price-to-income ratio is given as follows (Wu et al., 2010):

\[
\text{Price-to-income ratio} = \frac{\text{average house price per sq.m floor area} \times \text{housing size per person}}{\text{average per person’s disposable income}}
\]

Both the average unit sale prices of houses in Renminbi (RMB) per square metre, and the per person’s disposable income, are reported by the Nation Bureau of Statistics in China. The unit size used in the calculation is presumed to be 30 square metres per person in the household (Wu, Gyourko & Deng, 2012). According to Wu et al. (2012), the 30 square metres assumption is based on: (1) the statistics
published by China’s Ministry of Housing and Urban-Rural Development, which lists per capita living space in urban China. Per capita living space in urban China increased from 20.3 square metres in 2000 to 27.1 square metres in 2006. Based on the positive trend yields, Wu et al. (2012) assumed that the per capita living space increased to 30 square metres in 2010; and (2) since 2006, the state requires that no less than 70 percent of newly built private housing units in China be larger than 90 square metres, for an average household size of about three people.

Direct comparison of the price-to-income ratio to the bench-mark ratio to investigate the housing bubble in China is inconclusive. For example, some households may purchase a house of less than 30 square metres, which means that the price-to-income ratio overestimates the share of disposable income in housing (Wu et al., 2012). Unreported income is another reason why the price-to-income ratio can overstate the share of income in housing. According to Credit Suisse’s (2010) research, unreported income in China amounts to 30 percent of the country’s GDP. In order to determine the economic fundamental factors that influence house prices and housing bubbles, other econometric techniques are used in this current study.

5.1.2 Integration Properties of Time Series Data

Time series variables are stationary when their means and variances are constant over time, and the covariance between the means and variances from the series depends only on the length of time and not on the actual times. In contrast, non-stationary variables have time dependent means and covariances. A random process time series is integrated in the order d; in the series the random process requires a difference of d time in order to achieve stationarity (Engle & Granger, 1987). If the time series $Y_t$ is stationary at the level denoted by $Y_t \sim I(0)$; if its level series $Y_t$ is non-stationary but its first difference series $\Delta Y_t$ is stationary, denoted as $\Delta Y_t \sim I(1)$.

The order integration of a time series variable can be determined by the number of autoregressive unit roots that the time series contains. For example, the autoregressive model of order one is given as follows (Hill, Griffiths & Lim, 2011):

$$Y_t = \rho Y_{t-1} + v_t$$

(5.1)
Where \( Y_0 \) is a fixed initial value, \( \rho \) is the autocorrelation coefficient and \( \nu_t \) is ‘white noise’. When \( |\rho| < 1 \), the series \( Y_t \) is stationary since it has a constant mean and variance that are independent of time. The properties of the stationary \( Y_t \) are:

Mean: \( E(Y_t) = \mu \)

Variance: \( Var(Y_t) = E(Y_t - \mu)^2 = \sigma^2 \)

Covariance: \( \gamma_k = E[(Y_t - \mu)(Y_{t+k} - \mu)] \)

Where \( \gamma_k \) is the covariance between the values of \( Y_t \) and \( Y_{t+k} \). In contrast, when \( \rho = 1 \), \( Y_t \) is non-stationary and both its mean and variance are time dependent. The properties of nonstationary \( Y_t \) are:

Mean: \( E(Y_t) = E(Y_0 + \sum \nu_i) = Y_0 \)

Variance: \( Var(Y_t) = t\sigma^2 \)

The autoregressive model of order one AR (1) is an important univariate time series model for explaining the differences between stationary and non-stationary series. It is given by:

\[
Y_t = \rho Y_{t-1} + \nu_t \tag{5.2}
\]

Let \( L \) be the lag operator where \( L Y_t = Y_{t-1} \), then the AR (1) equation can be written as:

\[
(1 - \rho L)Y_t = \nu_t \tag{5.3}
\]

The stationarity is associated with the root of the equation \( 1 - \rho z = 0 \) which is \( z = \frac{1}{\rho} \). If the root of the equation is more than one in absolute value, then \( |\rho| < 1 \) and hence \( Y_t \) is stationary. On the other hand, if the root of the equation equals one, \( \rho = 1 \) which indicates \( Y_t \), then it has a unit root and is non-stationary (Hayashi, 2000).
Suppose a time series variable is non-stationary with zero drift and no deterministic trend \( Y_t = Y_{t-1} + v_t \).

However, the first difference series \( \Delta Y_t = v_t \) is stationary since the shock is defined as ‘white noise’.

Thus, a single unit root non-stationary series only needs to be differenced once in order to achieve stationarity. The definition of the order of integration of a time series variable can be explained as a non-stationary series integration of order one or \( I(1) \). This could extend to the more general case where a non-stationary time series \( Y_t \) containing \( d \) unit roots is said to be \( I(d) \), since \( Y_t \) needs to be differenced, \( d \) time, to become stationary (Hayashi, 2000).

The major reason to test for stationarity in time series data before running a regression analysis is because if the non-stationary time series variables are estimated by traditional regression analysis, it will result in spurious regression results (Granger & Newbold, 1974). A spurious regression result has a high \( R^2 \) and t statistics that appear to be significant, but the results are without any economic meaning. The output looks significant because the least squares estimates are not consistent and the t statistics do not follow the t distribution. Thus, the integration properties of data should be tested before the regression analysis is performed. The Augmented Dickey-Fuller (ADF) test is applied to test the unit roots of the data in this current study.

### 5.1.3 Augmented Dickey-Fuller Unit Root Tests

While intended for a unit root in a time series variable, an ADF test is a scaled up version of the Dickey-Fuller test for a larger and more complicated set of time series models. The Augmented Dickey-Fuller tests (1981) for the autoregressive unit root test are based on the following ordinary least square regression equations:

\[
\Delta y_t = \gamma y_{t-1} + \sum_{s=1}^{m} a_s \Delta y_{t-s} + v_t
\]

\[
\Delta y_t = \gamma y_{t-1} + \sum_{s=1}^{m} a_s \Delta y_{t-s} + v_t
\]

\[
\Delta y_t = \alpha_0 + \gamma y_{t-1} + \lambda t + \sum_{s=1}^{m} a_s \Delta y_{t-s} + v_t
\]

Where \( \Delta y_t \) denotes the first order difference of the logarithmic series; \( \alpha_0 \) is a constant; \( t \) refers to a time trend; \( m \) is the lag term; \( \gamma, \lambda \), and \( a_s \) denote the coefficients; and \( v_t \) represents a white noise term. The first model is a pure random walk model, the second model adds an intercept and drift.
term, and the third includes both a drift and a linear time trend. The null hypothesis of the above model is to test whether the time series variables contain unit roots.

Another important issue regarding the implementation of the ADF test is the selection of the number of lagged first-difference terms $\Delta y_{t-\delta}$ which are needed to induce an appropriate white noise error structure in the estimated ADF test regression equation. As documented by Enders (2004), the Dickey-Fuller test is sensitive to the number of lags in the estimated equation. Too few lags may cause the test to over-reject a true null hypothesis of a unit root at any chosen significance level, and too many lags may reduce the power of the test as more parameters are estimated, and the number of effective observations is reduced. More lags could cause a high probability of falsely rejecting a true null of a unit root against a false stationary. In this study, the Bartlett criteria is used to determine the lags for the ADF test, the equation of Bartlett criteria is written as $\text{int}(12(T/100)^{1/4})$, where $T$ is sample size, and this criteria result is adopted in the Eviews 8.0 software used to estimate the stationarity for our data.

5.1.4 Econometric Analysis

This section explains the techniques used to model the Chinese house price index (CHPI), which is conditioned on the macroeconomic variables such as income, mortgage rates and inflation. The underlying assumption in this model is that house prices in China do not react asymmetrically to different economic shocks. This current study uses the VAR and VECM model to determine the short-run and long-run relationships between the macroeconomic fundamental variables and the CHPI. The co-integration approach of Johansen and Juselius (1990) was conducted to test the long-run co-integration relationships between macroeconomic fundamental variables and the CHPI. If co-integration relationships exist between the macroeconomic fundamental variables and the house price index, then the VECM model is applied to investigate the short-run and long-run effects from the macroeconomic fundamental variables to the CHPI and the equilibrium house price indices. If there are no co-integration relationships, the VAR model is retained to estimate the short-run relationships between the macroeconomic fundamental variables and the house price index.

5.1.4a Vector Autoregressive Model and Co-integration Test:

The VAR model is a general framework used to describe the short-run dynamic relationships between stationary variables (Hill, Griffiths & Lim, 2011). The VAR model has been widely used in macroeconomic research because it allows the direct estimation of the joint stochastic processes that describe the variables under consideration. The VAR method also allows the researchers to treat all variables as jointly endogenous (Sun, Gan & Hu, 2010). Researchers who have applied the VAR model to identify macroeconomic factors that influence house prices include MacDonald and Stokes (2013)
and Gupta, Jurgilas, Kabundi and Miller (2011) for the United States; and Aye, Balcilar, Bosch and Gupta (2014) for South Africa. MacDonald and Stokes (2013) applied the VAR model to examine the relationship between economic factors (federal fund rates, unemployment rates and mortgage interest rates) and house prices in the U.S. MacDonald and Stokes’s (2013) study found a negative relationship between the federal fund rates and house prices. Gupta, Jurgilas, Kabundi and Miller (2011) tested the influence of change in monetary policy on the U.S. housing sector over the period 1986 to 2003. The study found that national level housing status, housing permits, and housing sales, fell in response to the tightening of monetary policy.

The VAR model is applied to examine the interrelationships between variables, while dependent variables and independent variables are stationary and not co-integrated. However, if dependent and independent variables are stationary and co-integrated, then the VECM model is used to examine the interrelationships between the variables. Therefore, the co-integration test is required before determining the model to use to examine the interrelationships between the variables.

In the housing market studies, the co-integration technique can be used to estimate the long-run relationships between house prices and macroeconomic variables, and the speed of adjustment for the real house prices to return to the equilibrium price (Lee & Gholami, 2002). The co-integration relationship can be explained as the non-stationary variables that become stationary through linear combination with one another in the long-run, which means the non-stationary variables could have long-term equilibrium relationships (Wang et al., 2013). Even if the equilibrium relationships among the variables are disrupted in the short-term, the degree of variation of the variables will eventually decrease and return to the equilibrium in the long-run (Wang et al., 2013; Stohldreier, 2012).

Ender (1995) notes that co-integration occurs when the variable data indicates no stationarity individually, but stationary if the variables are combined together. The maximum likelihood estimation (MLE) of the Johansen (1988) test is used in this current study’s model to test the existence of co-integration relationships between the Chinese house price index (CHPI), income, mortgage rates and inflation, as well as to determine the number of co-integration vector groups.

The co-integration test starts by selecting an appropriate number of lags to include in the vector autoregressive model. The lag length is determined using standard model selection criteria which minimize Aikake Information Criterion (AIC), Schwarz Information Criterion (SC) and Hannan-Quinn Information Criterion (HQ) (Sun, Gan & Hu, 2012). Since the sample size is not large in this current study, only small lag-lengths are included in the VAR model. The standard VAR equation is adopted from Pollakoswki and Ray’s (1997) model and is given in the equation below:
\[ X_t = L(A)X_{t-1} \]  \quad (5.5)

Where \( X_t \) is the vector of change in CHPI, income, mortgage rates and inflation; and \( L(A) \) is the lag order polynomial.

Thus, the process \( X_t \) is integrated of order of \( I(1) \) with the co-integrating rank \( r \), and follows a vector autoregressive process of order \( p \), VAR(\( p \)),

\[ X_t = A_1X_{t-1} + A_2X_{t-2} + \ldots + A_pX_{t-p} + \mu + \varepsilon_t \]  \quad (5.6)

Where

\( X_t = \) A vector of 4 variables each of which is \( I(1) \)

\( A = 4 \times 4 \) matrix of short-run parameter for CHPI, interest rates, inflation and income

\( \mu_t = \) a \( 4 \times 1 \) vector of constants

\( \varepsilon_t \sim MVN(0,\Omega) \) i.e. “well behaved” random disturbances

In the unrestricted VAR equation (5.6), each variable is regressed on its own lag and on the lags of other variables. In addition, the \( \Pi \) matrix \( (4 \times 4) \) holds the information on the long-run equilibrium relationship between the variables of concern; the rank in the \( \Pi \) matrix describes the number of co-integration relationships. Furthermore, the \( \Pi \) matrix is used to test whether this current study can reject the restriction implied by the reduced rank \( \Pi \) (Johansen, 1988; Johansen & Juselius, 1990).

In the VAR equation (5.6), no restriction is imposed on possible co-integrating relationships. According to Bourassa et al. (2001), the VAR model only contains information on the short-run and ignores the long-run relationships that may exist among the variables. This condition in the VAR model is regarded as a specification mistake that can be corrected by imposing restrictions. With regard to the differences between the short-run dynamics and long-run equilibrium relationships, the VECM model is derived from the restrictions imposed on the VAR equation (5.6).
Equation (5.7) contains two important matrices, $\Gamma$ and $\Pi$, $\Pi = \sum_{i=1}^{p} \Gamma_i - I$; $\Gamma_i = -(\sum_{i=2}^{p} A_i)$, $p$ is the lagged term, and $I$ is an identity matrix. The matrix $\Gamma$ is used in the first difference of the variable $X_{t-2}$ and it contains contemporaneous short-run adjustment parameters. Matrix $\Pi$ is a matrix for the levels variables in $X_{t-1}$ and it contains information about the long-run equilibrium relationships. Furthermore the rank of the matrix $\Pi$ gives the number of co-integrating vectors (Hu & Chien, 2014). Consider the following three possible cases of the rank of $\Pi$:

1) $\Pi = q$; all variables in the system are I (0)

2) $\Pi = 0$; all variables in the system are stationary in the first difference (I (1)).

3) $\Pi = r$ is between 0 and q, indicating that the variables are co-integrated.

Johansen (1991) showed that the number of distinct stationary co-integration relationships $r$ among the variables $X_t$ is given by the rank of $\Pi$, where $0 < \text{rank } (\Pi) = r \leq p-1$. The reduced rank condition permits the null hypothesis of at most the $r$ distinct stationary co-integrating vectors to be formulated as:

$$\Pi = \alpha \beta'$$

Where the parameter $\alpha$ measures the speed of adjustment of the $\Delta X_t$ with the lag in the error correction term and $\beta$, which is the co-integrating matrix, which contains the long-run equilibrium parameter of $r$. The error correction terms in the $\beta' X_{t-k}$ are stationary.

This current study determined the number of co-integration vectors ($r$) that exist among the CHPI, income, mortgage rates and inflation (i.e. the rank of $\Pi$) using two Johansen tests, the Trace Test ($\lambda_{\text{Trace}}$) and the Maximum-Eigenvalue Test ($\lambda_{\text{Max}}$). The trace statistic tests the null hypothesis $r \leq r_0$ against the alternative $r > r_0$ for $r_0 = (0, 1, ..., p)$ and is defined as:
\[ Q_{\text{max}}(H_1(\tau \leq r_0)|H_1(p)) = -T \sum_{i=r_0+1}^{\Lambda} \ln(1 - \lambda_i) \]

\[ Q_{\text{max}}(H_1(\tau = r_0)|H_1(\tau = r_0 + 1)) = -T \ln(1 - \lambda_{r_0 + 1}) \]

Where \( \Pi > r \) = the estimated values of the characteristics roots obtained from the estimated \( \Pi \) matrix

\( T \) = the number of usable observations

The major difference between the maximal eigenvalue statistic test and the trace statistic test is that the maximal eigenvalue statistic tests against a specific alternative, whereas the trace statistic tests against a general alternative. Since the co-integrating relationships are associated with non-zero eigenvalues testing, the null of the \( r \) co-integrating vectors is equivalent to testing; how many of the largest order eigenvalues are significantly different from zero, and how many of the smallest ordered eigenvalues are not significantly different from zero (Sun, Gan & Hu, 2012).

This current study uses the trace test as Lutkepohl et al. (2001) suggest that the powers of the corresponding trace and maximum eigenvalue tests are very similar. In general, the trace statistic tends to have greater power than the maximal eigenvalue statistic when \( \lambda_i \) are evenly distributed. The maximal eigenvalue statistic has greater power when the \( \lambda_i \) are either too large or too small.

Based on the log likelihood ratio \( \ln[L_{\text{max}}(r)/L_{\text{max}}(q)] \) the trace test is conducted sequentially for \( r = q-1, \ldots, 1, 0 \). The test examines the null hypothesis that the co-integration rank equals \( r \) against the alternative that the rank equals \( q \). The hypotheses are (Hu & Chien, 2014):

\[ H_0 : \Pi \leq r, \text{ for the } r \text{ group of co-integration vectors} \]

\[ H_1 : \Pi > r, \text{ for the least } r \text{ group of co-integration vectors} \]
The trace test statistics are calculated as follows:

\[
\lambda_{trace} = -T \sum_{q=1}^{n} \ln(1 - \hat{\lambda}_q)
\]

Where \( \lambda_{trace} \) denotes the statistical value of the Johansen trace test; \( \hat{\lambda}_q \) presents the estimated value of the \( q \)th eigenvalues; \( T \) refers to the number of samples, and \( n \) numbers of eigenvalues that obey the chi-square distribution under the test (Hu & Chien, 2014).

The above Johansen co-integration tests allow us to find out how many co-integration relationships exist between the CHPI and macroeconomic fundamental variables. If more than one co-integration relationship exists, then we can identify the relationships between the CHPI and the macroeconomic fundamental variables simultaneously, by imposing restrictions on these co-integration relationships based on China’s economic conditions (Johansen, 1995). The VECM model also allows us to test the short-run dynamic relationships among the related variables without losing the long-run relationships.

**5.1.4b Vector Error Correction Model**

Often there are strong long-run relationships between macroeconomic fundamental variables. However, these long-run equilibrium relationships can be defective in the short-run due to cyclical shocks. Following cyclical deviations, the variables tend to return to equilibrium over time. For example, a vector error correction model tests whether the economic relationship is in equilibrium or not. If the relationship is not in equilibrium then the question remains as to how long it will take to reach equilibrium again (Stohldreier, 2012).

The common dynamic model is the VECM, used to test the price movements in the short-run and long-run. Following the analysis on the long run impact on the macroeconomic variables in China’s housing market, the VECM model is used to determine the time it would take for the housing market to reach the equilibrium position, once it has deviated from equilibrium due to an exogenous shock to the economy (Adams & Fuss, 2010).

The VECM model incorporates both short-run and long-run relationships. It is based on the lag of the CHPI and the residuals estimated from the co-integration relationships between all the variables used in this current study based on equation (5.7) assuming the rank \( r = 1 \). The standard VECM model in the Johansen approach can be shown in a scalar form as follows (Harris, 1995):
\[ \Delta hpi_{p,t} = \delta e_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta hpi_{p,t-i} + \sum_{i=1}^{q} \beta_i X_{t-1} + \epsilon_t \]

(5.8)

Where \( \Delta hpi_{p,t} \) is the change in the house price index \( (hpi_{p,t} - hpi_{p,t-1}) \)

\( e_{t-1} \) = the lagged value of the house price index deviation estimated from the long-run relation and \( (\delta \neq 0) \) suggests a co-integrating vector in the model

\( \alpha_p \) and \( \beta_q \) = coefficient matrices jointly to be estimated in the VECM with \( p \) and \( q \) lags

\( X_t \) = a vector consisting of macroeconomic variables (income, mortgage rates and inflation)

\( \epsilon_t \) = independently and identically distributed random error term vectors

The VECM model can be used to identify significant co-integration relationships between house prices and fundamental variables (Ashworth & Parker, 1997). The model explains the short-run changes in the house price index based on changes in the co-integrated variables, and shows a long-run equilibrium between the house price index and the repressors. In the VECM model, if house prices are too high as reflected by a positive error term, the negative coefficient reduces house prices in the following period until they are in equilibrium (Adams & Fuss, 2010). The error correction mechanism of the VECM model reveals a highly significant adjustment. For example, if the coefficient of the error correction term is -0.5, it implies that an economic disequilibrium in the market will resolve after two years.

Numerous studies in the housing market have found significant co-integration between house prices and fundamental factors (Kenny, 1998; Song & Gao, 2007). Kenny (1998) applied the co-integration analysis and vector error correction model to test the long-run and short-run dynamic relationships between economic factors (house stocks, income, mortgage rates) and house prices in Ireland. The author discovered the long-run demand for housing responds negatively and proportionately to the increase in the price of housing while mortgage interest rates show negative effects on the long-run housing demand. Song and Gao (2007) used the Johansen test to examine whether co-integration
relationships exist among international capital flows, land prices, and the inflation rates of the Chinese housing market. The authors’ results show the presence of two co-integrations at the five percent significant level, which exhibit long-run equilibrium relationships among these variables.

Tsai’s (2012) study applied the vector error correction model to investigate the long-run and short-run relationships between the house price index (HPI), construction cost index (CCI), and the rental price index (RPI), of the Taiwan housing market. Tsai’s results show the relationships among the three indices are nonlinear. The housing price index stimulated changes in the CCI and the RPI. This phenomenon can be explained, as the deviations of the CCI and RPI from the HPI are greater. Song and Gao (2007) used the VECM model and Granger causality test to examine the relationships between house prices and international capital flows. Their empirical results show that foreign capital helps to boost the rise in house prices in the long-run, and the increase in house prices attracts foreign capital inflows in the short-run.

5.1.4c Equilibrium House Prices

After the co-integration tests, the VECM model was applied to examine the adjustment of the CHPI from the changes in the Chinese macroeconomic conditions. However, Hendry’s (1984) study argues that ‘equilibrium correction’ is a better description for VECM than ‘error correction’. This is because the random drift variables tend to converge in the long-run through a linear combination of co-integration (Harris, 1995). Therefore, the deviation from the equilibrium price is only temporary and will be corrected in the long-run.

Assuming a linear relationship, the equilibrium house price equation, \( HPI^*_t \) during period \( t \), is described by income (Inc), mortgage rates (Mtr), and inflation (Inf), as follows:

\[
HPI^*_t = \alpha_0 + \alpha_1 \text{Inc}_t + \alpha_2 \text{Mtr}_t + \alpha_3 \text{Inf}_t
\]

(5.9)

\[
HPI_t = HPI^*_t + \theta_t
\]

If all variables (income, mortgage rates and inflation) are constant, the real house price index appreciation would be constant and equal to \( HPI^*_t \). The adjustment term \( \theta_t \) represents adjustment dynamics and error term. The HPI* is to be estimated from the co-integrating equation (5.8). The extent of the deviation of China’s house price index from the actual price index is computed using the estimated values from the vector error correction equation (5.8). Empirically, this current study estimated equation (5.8), obtained the coefficients equation (5.8), and then plugged the estimated coefficients (\( \alpha_0, \alpha_1, \alpha_2, \alpha_3 \)) into equation (5.9) to get the estimated HPI. The comparison of real HPI and estimated HPI will reveal some signs of boom and bust in the Chinese housing market.
The objective of the VECM is to uncover stationary relationships among a set of non-stationary data. These relationships have a natural interpretation as long-run equilibrium relationships in the economic sense. Simultaneously, the VECM procedure estimates the speed at which the variables adjust in order to re-establish any equilibrium (Hill, Griffiths & Lim, 2011). This estimate could provide a particularly useful guide to housing market authorities (Kenny, 1998).

The concept of long-run equilibrium has been tested in the housing market by many researchers such as Miles (1994), Chen and Patel (1998), Jud and Winkler (2002) and Grimes, Aitken and Kerr (2004). Grimes, Aitken and Kerr (2004) use quarterly regional panel data drawn from 14 regions in New Zealand from 1981 to 2002. Their tests indicate the regional housing markets converge to an equilibrium which is the long-run efficiency of the market. The authors’ result shows that the price dynamics are influenced by past regional house sales activities, and that the dynamic adjustment process depends on whether the house prices are above or below their long-run equilibrium. Chen and Patel (1998) applied the VECM model to examine the dynamic relationships between house prices and income, short-run interest rates, stock price index, construction costs and house completions. The authors’ findings reveal long-run equilibrium relationships between house prices and the five macroeconomic fundamental variables. Their study explains that the long-run relationships between house prices and macroeconomic fundamental variables can drift away momentarily, but will return to their long-run equilibrium.

5.1.4d Size of House Price Bubbles

The standard size of the bubble can be an important indicator for measuring the housing market bubble. This current study focuses not only on analysing the house price rise, but also the importance of reporting the standard size of the bubble. Previous housing market studies report various sizes of price deviations between real house prices and their long-run equilibrium prices, as the indicator for the housing bubble (Abraham & Hendershott, 1992; Hui & Yue, 2006; Hui & Gu, 2009).

In China, Hui and Yue (2006) used the VECM model and impulse response function to show that the pattern and magnitude of the estimated bubbles conform quite well to the discrepancies between the actual and predicted house prices. The authors’ finding indicates that the size of the house price deviation from the equilibrium house price, departed by 22 percent in Shanghai at the end of 2003, which can be attributed to a housing bubble. Hui and Gu (2009) used the household income of Guangzhou as the main factor, and applied the VAR model to estimate the house price bubble and analyze the size of the bubble at different times. The authors use a state-space model (SSM) to estimate the bubble price which is regarded as the unobservable variable (bubble price). The parameters of the SSM model consists of two equations, one is a measurement equation which
expresses the relations between observable variables (income) and unobservable variable (bubble price); while the other is a transition equation which mainly describes the dynamic of house price. The real estate bubble price fluctuation is observed if the transition equation result is statistically significantly different from zero (Hui & Gu, 2009). Hui and Gu’s study shows the variation in household income can affect the growth of housing price, and the size of the bubble is explained by the actual price deviation from 20 percent to 43 percent, compared to the equilibrium price, for the period of April 2006 to October 2007.

In Korea, Kim’s (2004) study paid particular attention to the debate of house price bubbles. The author’s study reveals that the well accepted standard to define a house price bubble is when the movement of house prices deviates from the long-run equilibrium price. Kim applied the long-run average of the ratio between the median price of existing houses and the per capita personal income (PPI) as a proxy for long-run equilibrium relationships; a bubble exists during a particular period if the observed PPI exceeds the threshold defined as the long-run average PPI price. Kim’s (2004) study reveals a house price increase from 44 percent to 50 percent for the period of 1999 to 2003, which indicates the existence of a house price bubble. The excess or deviation of house prices from fundamental variables by eight percent to 28 percent is an indication of the existence of house price bubbles in Spain (Martinez-Pages & Maza, 2003). In Thailand, several provinces recorded a 30 percent appreciation in the house price index, providing evidence of housing bubbles (Calhoun, 2003).

As discussed above, the deviation or overvaluation in house prices is between 20 percent and 50 percent. Due to the lack of standardization and the lack of an acceptable percentage of deviation which can substantiate the existence of a housing bubble, this current study uses the 22 percent deviation or overvaluation of the CHPI from its long-run equilibrium price, as an indicator for the existence of a housing bubble in the Chinese housing market. This figure is consistent with previous studies. According to the report from the World Economic Outlook (2000), house price bubbles occur when there is a 10 percent to 20 percent deviations in house prices from fundamental factors such as interest rate and income. Shen et al. (2005) examined housing markets in Beijing and Shanghai housing using a Granger causality test and generalized impulse response analysis. The economic fundamentals utilised in their model included disposable income, GDP and the stock price indices for both cities. The study found a 22 percent deviation from the actual house price index, and the predicted house price index, as a sign of a housing bubble in Shanghai in 2003. By contrast, Beijing exhibits no sign of a bubble in the same year; the actual house price index in Beijing is below the equilibrium house price index. Dreger and Zhang (2010) applied panel co-integration method to test the housing bubble of 35 major Chinese cities. The authors compared the long-run equilibrium house prices and the real house prices for the period of 2008 and 2009. Their showed the average size of the bubble deviates by about 23 percent of the real house prices from the long-run equilibrium house prices.
According to Abraham and Hendershott (1996) and Hui and Yue (2006), the increase discrepancy between the actual house price level and the fundamental price level indicates the trend of house price bubbles; that is, the larger the deviation of house prices from their fundamental values, the more likely a bubble exists in the market. Hui and Yue (2006) describe the difference between equilibrium and the actual house price level as the bubble indicator. Using a similar argument to Hui and Yue (2006), this current study estimates the excess price of China’s House Price Index (CHPI) from its equilibrium price, using equation (5.10) as follows:

\[ \text{House price excess}_t = [R_{\text{CHPI}} - LR_{\text{CHPI}}] \]  

(5.10)

Where House price excess \(_t\) is a proportion of the bubble that exists in China’s housing market, \(R_{\text{CHPI}}\) is the real value of CHPI and \(LR_{\text{CHPI}}\) is the estimated long-run equilibrium price of CHPI. The value of \(LR_{\text{CHPI}}\) is estimated using the VECM technique via Eviews 8.0 software. The percentage change in the equilibrium house price is calculated by inserting the value obtained from the VECM into the equation (5.10).

### 5.1.4e Impulse Response Function and Variance Decomposition

The standard practice in a VAR analysis is to report the results from the co-integration tests, impulse response and forecast error variance decompositions (Stock & Watson, 2001). These statistics are more informative than the estimated VAR regression coefficients or \(R^2\). An impulse response function refers to the reaction of any dynamic system in response to an external change involving an endogenous variable. It describes how a parameter reacts to previous shocks in itself or other parameters. Compared to the Granger causality test, this method offers an advantage that indicates whether the impacts are positive or negative, and whether they are a temporary jump or a long-run persistence (Shen, Hui & Liu, 2005). This current study applied the impulse response function to investigate how changes in the macroeconomic fundamental variables affect the house price index. The results could be helpful to policy-makers making future housing market policies.

Following the VAR (p) model, the impulse response function is given as:

\[ X_t = \sum_{i=1}^{\nu} A_i X_{t-i} + \mu + \varepsilon_t \]  

(5.11)

According to Sims (1980) and Keating (1996), the Cholesky decomposition can identify the partially recursive structural model. Equation (5.11) can be transformed to a vector moving average representation (VMAR) form as follows:
\[ X_i - \sum_{t=1}^{\rho} A_t X_{t-i} = \mu + \varepsilon_i \]

then \[(1 - A_1 L - A_2 L^2 - \ldots - A_p L^p)X_i = \mu + \varepsilon_i \]

then \[X_i = \frac{\mu}{(1 - A_1 L - A_2 L^2 - \ldots - A_p L^p)} + \frac{\varepsilon_i}{(1 - A_1 L - A_2 L^2 - \ldots - A_p L^p)} \]

Hence, \[X_i = \alpha + \sum_{t=1}^{\infty} C_i \varepsilon_{t-i} \quad (5.12)\]

Where \( \alpha \) is a constant vector of (nx1); C denotes the matrix of (nxn), \( \xi_i \rightarrow \) \( C_0 = I \) (identity matrix); L represents the lagged factor.

Equation (5.12) assumes that each of the parameters will be affected by the standard error shock of the current and the lagged terms. According to Hu and Chien (2014), either orthogonalizing the disturbance or preventing the elements of \( \varepsilon_i \) from correlation, means the Cholesky decomposition will take the squared root of a positive definite matrix. Furthermore, the Cholesky decomposition decomposes a positive definite matrix into the product of a lower triangular matrix and its conjugate transposition.

The lower triangular matrix, V (i.e. \( VV' = I \)) is incorporated into the Cholesky decomposition as follows:

\[ X_i = \alpha + \sum_{t=1}^{\infty} (C_i \times V) \times (V' \times \varepsilon_{t-i}) \quad (5.13)\]

If \( D_i = C_i \times V \) and \( \xi_{t-i} = V' \times \varepsilon_{t-i} \)

Then \[X_i = \alpha + \sum_{t=1}^{\infty} D_i \xi_{t-i} \quad (5.14)\]

Where \( \xi_{t-i} \) denotes a series of random shocks which are irrelevant to the current terms.

An impulse response function traces the effect of one standard deviation shock, to one of the innovations on the current and future values of the endogenous variables in the VAR model. Thus, the impulse response function can be used to describe the dynamic response of the system, which helps to analyze two-way dynamic relationships of the variables (Hui & Yue, 2006). The size of the change in the random shock of a specific parameter that impacts other parameters, can be observed by the impulse response function (Hu & Chien, 2014). Chen and Patel (1998) estimated the impulse response function for six years (twenty-four quarters) in Taiwan. Their study found in response to a one standard deviation disturbance originating from interest rate increases, that house prices in the first quarter
increased by 0.4 percent; but decreased by 0.1 percent and 0.25 percent between the second to fourth quarters, respectively. This implies that higher interest costs could both increase house prices and reduce demand, and consequently decrease house prices.

Another way to disentangle the effects of various shocks is to consider the contribution of each type of shock to the forecast error variance. Similar to the impulse response function, the variance decomposition demonstrates the extent and importance to which the variance of a particular shock variable can be accounted for by a shock in another variable (Hill, Griffiths & Lim, 2011). Equation (5.14) can be written as follows (Hu & Chien, 2014):

\[ X_t - E_{t-s}X_t = D_0 \xi_t + D_1 \xi_{t-1} + \ldots + D_s \xi_{t-s+1} \]  

(5.15)

Where \( E_{t-s}X_t \) denotes the possible forecast error of the t-s-th term when forecasting the t-th term. The variance matrix of the t-s-th term forecast error can be observed as

\[
E(X_t - E_{t-s}X_t)(X_t - E_{t-s}X_t)' = D_0 E(\xi_t \xi_t')D_0' + D_1 E(\xi_{t-1} \xi_{t-1}')D_1' + \ldots + D_s E(\xi_{t-s+1} \xi_{t-s+1}')D_s' \]  

(5.16)

Equation (5.16) indicates that the variance of each variable can be expressed as the sum of all the variables, which can be used to evaluate the explanatory power of a specific variable in itself and to other variables (Hu & Chien, 2014).

5.2 Data

This study covers the period from January 1999 to December 2013 (15 years) using quarterly time series data, which comprises China’s house price index (CHPI) and macroeconomic variables such as income, mortgage rates and inflation. The house price growth can be explained by the demand and supply factors. The demand factors include real GDP, mortgage rate and the mortgage credit-to-GDP ratio, while supply factors consist of the land supply index and real construction cost (Case & Shiller, 2003; Hui & Yue, 2006; Glindro et al., 2011). However, the supply factors often assumed that the long-run relationship in the house price is non-existence (Oikarinen, 2009). Compare with the supply factors, the growth of housing prices is more closely related to demand variables, such as increases in household income (Chen and Li, 2011). Due to the limitation of data, this study includes three demand macroeconomic fundamental variables (such as, income, mortgage rates and inflation) to estimate the short-run and long-run relationships in the house prices. The data for CHPI, income, mortgage rates and inflation were obtained from the National Bureau of Statistics of China, and the People’s Bank of China.
To standardize the data into similar time frequencies, monthly data of mortgage rates and inflation rates were converted into quarterly frequencies. The conversion of data into quarterly frequencies was undertaken for several reasons. First, the main housing market data such as China’s house price index is reported in quarterly frequency. Therefore, to avoid any distortion in these variables, other data were also converted into quarterly frequency. Second, the use of quarterly data is consistent with many other housing market studies. For example, Zhao and Gao (2010) analysed the factors which impact on Chinese house price fluctuations, using quarterly data of interest rates, inflation rates, stock price index, and house price index, from 1994 to 2006. Ghent and Owyang (2009) used quarterly data of mortgage rates, inflation (CPI), and T-bills, from 1982:Q1 to 2008:Q4 to examine the relationships between macroeconomic variables and house prices in 51 states in the U.S. The authors found that the decline in U.S. house prices did not cause a decrease in employment in the U.S.

In order to complement previous studies which are based either on cross-sectional regressions or the panel data approach with city-fixed effects, this current study attempts to test the cities separately. Separate testing allows the relationships among house prices and economic fundamental variables to vary across the different cities. These cities differ in terms of culture, economic development, and other infrastructure, which could affect the estimated coefficients (Leung, Chow, Yiu & Tam, 2010). Fang, Zhang and Fan (2002) and Lu (2002) indicate that Chinese urban development has large regional differences. Housing reform in urban China is decentralised, with central government implementing the housing reform framework and local government implementing housing policies and reform programmes. Thus, the housing market environment varies significantly between cities. This current study observed the house price bubble at the city level. In order to provide a better overview of China’s real estate market, eight Chinese cities were chosen from three different groups based on three years of house price growth rates (from 2010 to 2012 inclusive) and the differences in the city tier levels (see Table 5.1). According to Jone Lang LaSalle (2009), Chinese cities are divided into different tiers based on their GDP levels and population sizes. Table 5.1 shows high growth rates generally in house prices per square metre for second and third tier central inner cities with lower house prices (except for Fuzhou). The low or negative increases in per square metre house price cities are mainly the first and second tier cities with higher house prices.

### Table 5.1 House Price Growth Rate of Chinese Major Cities (2010 to 2012 inclusive)

<table>
<thead>
<tr>
<th>City</th>
<th>Growth rate (2010-2012)</th>
<th>Tier of city</th>
<th>House prices (2012) per square metre (RMB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kunming</td>
<td>58.7%</td>
<td>T3</td>
<td>5404</td>
</tr>
</tbody>
</table>

1 The average house price for group one is 5988 RMB per square metre; group two is 6223 RMB per square metre; and group three is 9045 RMB per square metre.
Our study focuses on eight Chinese cities, namely, Kunming, Xi’an, Urumqi, Zhengzhou, Guangzhou, Nanjing, Changchun and Beijing based on the house price growth rates and the tier levels of the cities. These cities are in the top house price growth rate brackets in each of the city groups, which cover the first tier, second tier and third tier cities. For example, Kunming (T3) is a third tier city with the fastest house price growth rate in group one, making it the leading city in group one. Xi’an (T2) has the fastest growing house prices of the second tier cities in group one, making it the leading second tier city in group one. These cities were chosen to provide a better understanding of local housing markets and differences of housing market status between first tier, second tier and third tier cities.

### 5.2.1 Chinese House Price Index (CHPI)

House price index is an important index for academic researchers to use in order to gain a better understanding of the determinants of house prices, the efficiency of housing markets, analyses of housing affordability, and to test whether housing bubbles exist (Bourassa, Hoesli & Sun, 2006). Kim and Suh (1993) use the house price index to measure changes in house prices, and to investigate the
possibility that speculation caused the prices of houses to deviate from their given long-run equilibrium levels in Korea and Japan. The authors’ results suggest that a growing rational bubble existed in Korea and Japan for the period of 1974 to 1989. A house price index could be used to measure the changes in house prices that influence the current value of houses (Lum, 2004). For instance, an increase in purchase prices leads to an increase in the expected asset prices of houses in the future. The increase in house prices tends to induce potential buyers to purchase houses before the prices increase too much, and the resulting increase in demand tends to accelerate the pace of the price increases (Case & Shiller, 1988; Yoo & Nelson, 1990; Kim & Suh, 1993). The National Bureau Statistics (NBS) of China started to construct quarterly housing price indices for 35 large- and medium-size cities in 1997. The construction of the “NBS 35-City Index” is derived from raw information on housing transaction prices collected from the sample housing complexes and send to the NBS by the local authorities. The average transaction price is calculated in each month and compared with the same month in the previous year (Fang et al., 2015).

The Chinese real estate market is relatively new. It was established in 1998 when the government abandoned the welfare housing system and allowed people to purchase their own houses. Thus, the time length of the real estate market data is rather limited. The China Statistics Bureau (SBC) provides data for the house price indices of 30 Chinese cities from 1998 to 2013. The indices are recorded on a quarterly basis. The house price index (residential commercial house price index) is calculated with respect to the previous year quarterly data, and only the growth rates of the house prices are reported, and not the actual price levels for the quarterly data.

Levin and Wright (1997) suggest that the most common factors used to study house price movements are income, inflation and mortgage rates. This is consistent with other studies which show the development of the Chinese housing market has been influenced by rising incomes, rapid pace of urbanisation, and expansion of the mortgage business by commercial banks (Peng, Tam & Yiu, 2005; Yang & Shen, 2008; Shih, Li & Qin, 2014). In order to capture the effects of the determinants on Chinese house prices, the exogenous factors such as income, mortgage rates and inflation are used as fundamental variables in this current study.

### 5.2.2 Income Variables

Income is a commonly used proxy of the borrower’ financial wealth and the borrower’s ability to purchase a house (Dinh & Kleimeiter, 2007). There is no doubt that income is an important factor influencing the consumption of housing (Hou, 2010). Case and Shiller (2003) investigated the relationship between house prices and personal income using quarterly data, from 1985:Q1 to 2002:Q3 covering 50 states in the U.S. The authors’ finding reveals a positive relationship between income and house prices; whereby an increase in income levels leads to higher house prices. Ortalo-
Magne and Rady (2006) argue that a change in personal income will induce changes in monetary liquidity, which in turn influences housing demand and real estate prices.

Black et al. (2006) indicate that disposable income is the key factor for constructing a time-variable present-value model for studying house price bubbles. This is consistent with the studies of Case and Shiller (2003), Black et al. (2006), and Bischoff (2012). For example, Case and Shiller’s (2003) study reveals income alone almost completely explains house price increases in the vast majority of the states of the U.S. The authors’ findings report that a lagged appreciation in the housing fundamentals (such as income, employment and interest rates) with a coefficient of 0.3 is considered a bubble builder. Bischoff’s (2012) study combined the real estate model with the spatial equilibrium approach to investigate the interdependency of house prices, rental prices, building and land prices, and income, in one simultaneous equilibrium analysis. The author used the cross-sectional data in a study of a majority of German cities in 2005. The result shows that the interaction of real estate prices and income is predominantly significant and positive.

5.2.3 Mortgage Rate Variables

Mortgage rates have been widely used to estimate house prices. Bank mortgage rates affect the potential borrowers’ borrowing decisions and the actions of the borrowers; the mortgage rates charged by the bank could determine the demand for capital by the borrowers (Petersen & Rajan, 1994). Himmelberg et al. (2005) point out that house prices are predictably more volatile in fast-growing locations where house prices are especially sensitive to changes in mortgage rates. The authors argue that low mortgage rates lead to higher housing demand and that this contributed to the U.S. subprime loan crisis in 2007. Hubbard and Mayer (2009) point out that declining mortgage rates are the common factor with booming house prices. The authors’ results show that house prices across the U.S. cities adjusted upwards 85 percent due to the changes in the after-tax costs, which is driven by changes in the mortgage rates. For instance, a decline in mortgage rates from six percent to five percent could reduce the cost of owning a house by up to 16 percent, and an increase in house prices of 13.6 percent. McDonald and Stokes (2013) used the Granger causality analysis, and monthly housing price index for the period 1987 to 2010, for 10 American cities, to determine the causes of the housing bubble in the U.S. Their results indicate that the interest rate policies of the Federal Reserve from 2001 to 2004, which pushed down the mortgage rates, as one of the important causes of the housing bubble.

The mortgage rate is an important factor that influences the Chinese house price index. House prices in China have surged rapidly over the last decade particularly in the first-tier cities such as Beijing and Shanghai. Rising house prices lead to a large gap between house prices and people’s incomes, which implies that the increase in people’s incomes cannot keep up with the rise in house prices. For example, in 2003, the national average annual earnings for a couple was about 22,304 RMB, and the time
required to purchase a 300,000 RMB apartment with 30 percent of the household’s total earnings is 44.7 years (Burell, 2006). The gap between house prices and people’s incomes leads to an increase in demand for mortgage loans. Thus, the mortgage rate has a close relationship with housing demand and future house prices.

### 5.2.4 Inflation (Consumer Price Index)

The consumer price index (CPI) captures the general price increases due to the inflationary mechanisms. A positive relationship is hypothesized with the CHPI and the CPI, as housing is one of the largest expenditures for the Chinese people. House prices are expected to be in line with general price increases (Leung et al., 2010).

Development in the housing market also has an impact on the consumer price index. According to Meltzer (1995), there is a connection between monetary growth and the consumer price index with house prices being the intermediary, which means that any rise in house prices may eventually be transmitted to consumer price inflation. Zhang (2013) used a standard multivariate dynamic model to examine the relationships between money, house prices and the consumer price index (inflation) in China from 1998 to 2010. The author reveals that when construction goods’ prices are sticky, monetary growth initially changes the house prices; the changes in house prices are then transmitted to consumer price inflation in China. The results indicate that the recent real estate market boom dominates the underlying pattern of inflation behaviour in China. In addition, the development of the housing market may increase the consumer price inflation because the housing market has become an important real capital market in China. Rising house prices may transmit to the goods market and eventually lead to increases in consumer price inflation (Meltzer, 1995; Zhang, 2013).

### 5.3 Conclusion

This chapter has explained the models used to investigate the existence of house price bubbles in the Chinese housing market. This current study uses time-series data of the CHPI, income, mortgage rates, and inflation, from 1999:Q1 to 2013:Q4. This current study also uses price to income ratio and VECM techniques to test for the existence of house price bubbles, whereas previous studies have relied on only one technique.

The co-integration test of VAR was applied to investigate the long co-integration relationships between the CHPI and the macroeconomic fundamental variables. Where there were no co-integration relationships, the VAR model was used to estimate the short-run relationships between macroeconomic fundamental variables and the CHPI. Otherwise, the VECM model was applied to investigate the short-run and long-run relationships between the CHPI and the macroeconomic fundamental variables. The long-run equilibrium values were also obtained from the VECM estimation.
results. In addition, the deviation or overvaluation of the CHPI from its long-run equilibrium price by 22 percent is regarded as a house price bubble in this current study.
Chapter 6
Discussion of Empirical Findings and Results

6.0 Introduction

This chapter reports the results of the housing bubble model presented in Chapter 5 and discusses the findings for the Chinese housing market. Section 6.1 provides evidence of house price bubbles in the Chinese housing market. The housing affordability measures and empirical results for the price-to-income ratio approach, the vector autoregressive model, and the vector error correction model, are discussed in turn in section 6.2.

6.1 Evidence of House Price Bubbles in the Chinese Housing Market

In this section this current study compares several economic indicators (such as disposable income growth rates, and mortgage lending growth rates) with the Chinese house price growth rates, to identify the signs (or indicators) of housing bubbles in eight Chinese cities (Kunming, Xian, Urumqi, Qingdao, Guangzhou, Changchun, Beijing and Nanjing). Figure 6.1 shows the annual growth rates of Chinese house prices for eight cities, for the period of 2002 to 2013. Figures 6.2 and 6.3 present comparisons between the average annual Chinese house price growth rates to disposable income growth rates and the growth of mortgage rates, for the period 2000 to 2011. The annual data of real house prices was obtained from the National Bureau of Statistics of China.

![Figure 6.1 Annual Growth Rates of Real House Prices of Eight Cities in China](image)

Source: National Bureau of Statistics of China and Author’s calculation

Note: 1. **2007 September**: down payment for first time homeowners increased to 20%; second home increased to 40% from 30%
   2. **2008 October and November**: minimal down payment reduced to 20%; reduced transaction
tax to 1% from 1.5% and stamp tax waived

3. **2010 April**: down payment on second home increased to 50% from 40%; increase in down payments on first home larger than 90 square metres to 30% from 20%

4. These figures are based on the calculation from the annual growth rates of the real house prices. For example, the annual growth rate for year 2004 equal to the real house price of 2004 minus the real house price of 2003, and over the real house price of 2003.

5. The data shows changes in 2008 is relatively bigger than other changes within the whole sample period. This could be due to the restrictive policy introduced by China’s central bank to cool down the heat in the housing market in 2008. But this is not new in the sample period. Chinese government introduced many policies prior to 2008 and at best we can say the 2008 policy is more effective or more stronger than others policies.

Figure 6.1 shows that house price growth movements for the period 2002 to 2013 among the eight Chinese cities in which the house price growth exhibits volatility, are similar. Figure 6.1 shows a continuous increase in the house price growth rates from 2002 to 2007. The annual house price growth rates reached its peak in 2007 and abruptly declined in 2008, and the negative house price growth rates appeared in Nanjing and Qingdao in 2008. House prices increased rapidly in 2009, reached a new high in 2011 and fell in 2012. The overall trend of the house price growth rates move in similar direction. However, there is heterogeneity of house price growth rates across different Chinese cities. The reaction speed to the government policies vary among Chinese cities, and land prices across Chinese cities are different. The house price growth rates in China are not driven by construction costs alone, but also by the rising land prices. The gap in land prices is large between Chinese cities. For example, in 2011, the residential land prices in the most expensive market was RMB 5,470 per square metre in Shanghai, and RMB 222 per square meter in the least expensive city such as Urumqi (Deng et al., 2012). The national real land values have risen around 10% per year on average. In Beijing, the land prices was 27.5% per annum since 2004 (Wu et al., 2015). The land price in Urumqi exhibits negative land price growth from 2007 to 2011 (Deng et al., 2012).

Figure 6.1 shows that house prices exhibit large swings with cyclical downturns from macroeconomic conditions, and that the government attempts to curb either the overheating or overcooling housing market. Government policies tend to prevent either price appreciation or depreciation, and to avoid the excessive speculation and to avoid the housing bubble bursting in China’s housing market (Liu, 2014).
Figures 6.2 and 6.3 show the growth rate movement of house prices in Beijing. The trend between the average annual growth rate and the house price growth rate of other Chinese cities are similar with Beijing. However, the disparity of the growth rate of income and the growth rate of house prices is smaller in second-tier and third-tier Chinese cities. For example, the average annual growth rate of per capita disposable income for urban residents was 11.7 percent in the second-tier cities, and the house price growth in the second–tier cities grew on average by 16.8 percent from 2003 to 2007 (Fang et al., 2015). The figures show the growth rates of income and mortgage rates in a nonlinear trend.

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2 Due to the limitation of data availability (no national data available for house prices and disposable income) this current study uses Beijing as an example to compare the growth rates between house prices, disposable income and mortgage rates.
The growth rate of house prices in Beijing (dotted line) is different from the macroeconomic fundamental variables such as income and mortgage rates, particularly for the period 2008 to 2010 (U.S. post-subprime crisis period). According to China’s National Bureau of Statistics, housing sales prices in 70 Chinese cities rose by 12.4 percent per year from 2009 to May 2010. During the same period, nationwide sales prices for commercial and residential real estate increased 22 percent and 19.5 percent, respectively (Yurichuk, 2011). However, the growth rate of disposable income is much slower and the mortgage growth rate is negative. Disposable income increased from 6490.2 RMB to 7064.2 RMB annually; the income growth rate is 8.84 percent for the period 2008 to 2009. The mortgage rate decreased from 7.83 percent in 2008:Q1 to 5.94 percent in 2009:Q1. Thus, house prices in Beijing heavily out-grew disposable income and the mortgage rate in the two periods (2008 and 2010). Both figures also show a positive relationship between house prices and disposable income. This relationship is consistent with housing market theory; more houses are purchased when households' incomes increase (Barot & Takala, 1998).

Figures 6.1, 6.2 and 6.3 show Chinese house price movements rely heavily on government policies and macroeconomic conditions. Chinese house prices exhibited an increasing trend from 2002 to 2007, until the government intervened by tightening loan policies and raising mortgage interest rates throughout 2007; the mortgage rate increased from 6.12 percent in early 2006 to 7.83 percent at the end of 2007 (Ahuja et al., 2010). The down payment for first time homeowners increased to 20 percent while for second home owners it increased to 40 percent from 30 percent (Barth, Lea & Li, 2012). The Chinese government imposed restrictive policies to bring house prices down to a ‘reasonable level’. The property sector made up about 12 percent of the GDP in 2012; a collapse in house prices would have a significant negative spillover effect on the overall economy (Chen & Funke, 2012). To maintain stability in the economy, reasonable growth in house prices is necessary. Wang and Liu’s (2007) study identified three Chinese government intervention objectives in the housing market: (1) to stabilize house prices, (2) to restrain investment in housing development, and (3) to improve the efficiency of the housing market.

House prices dropped rapidly during 2007 to 2008 in response to the subprime loan crisis (Zhang & Cheng, 2010; Guan, Jiao, Zhu & Ren, 2013; Ning & Hoon, 2012). The crisis affected China’s economy through both trade and financial channels. For example, China’s exports to the U.S. decreased 12.3 percent in 2008 (Yurichuk, 2011). The Shanghai Stock Exchange plunged more than 60 percent in mid-2008. The Chinese economy registered one of its slowest growth rates of 6.8 percent in the last quarter of 2008. Economic growth in 2008 was nine percent, which ended China’s nearly four years of double digit growth (Tong & Zheng, 2010). To address the global financial crisis, the state council of China announced in October 2008, a four trillion Renminbi (RMB) stimulus package to boost the economy. The government also encouraged banks to issue 9.5 trillion RMB in new loans in 2009, and 7.95 trillion
RMB in new loans in 2010. This massive capital injection was critical for achieving its GDP growth target, but the excess liquidity triggered a huge surge in house prices in China (Yao, Luo & Loh, 2011). House prices growth rates in the four first-tier cities (Beijing, Shanghai, Guangzhou and Shenzhen) rose from 24 percent to 42 percent in 2010 (EIU Views Wire, 2010). Rising house prices during 2008 to 2010 in China was caused not only by excess liquidity but also by the irrational behaviour of consumers and investors; where investors take excessive risk when house prices rise, but become overcautious when prices decline (Yao & Luo, 2009). Chinese people purchase a house as an investment, with an over-optimistic behaviour and believe that house prices will increase in the future. According to Glaeser et al. (2008) a housing market with over-optimistic home-buyers is inelastic. The speculation behaviour left many vacant houses for a long period of time in China; about 20 percent to 30 percent vacancy rate in major Chinese cities in 2006 (Mak, Choy & Ho, 2007). At the beginning of 2010, the State Council of China issued two policies to control the irrational demand in houses. The first policy issued in April 2010 revealed that the down-payment required on a second home was raise to 50 percent from 40 percent; and the down-payment for the first home larger than 90 square metres increased to 30 percent from 20 percent (Barth, Lea and Li, 2012). The second policy issued by the People’s Bank of China was to adjust the reserve rates from 15.5 percent to 17.0 percent at the beginning of 2010 to cool down the housing market. The government intervened in the housing market because house prices in major cities such as Beijing and Shanghai more than tripled between 1999 and 2010. The stability of the housing market is important for China’s economy, as the total value of China’s residential housing market reached 91.5 trillion RMB at the end of 2009, nearly three times the nominal GDP of the same year (Zhang, Hua & Zhao, 2011).

Figures 6.1, 6.2 and 6.3 provide some information on the behaviour of the Chinese housing price index, and macroeconomic fundamental variables such as income and mortgage rates, but the figures are insufficient to draw conclusive evidence about the existence of house price bubbles in China. The main objective of this current study is to test whether the Chinese housing market experienced a house price bubble between 1999:Q1 to 2013:Q4 using several econometric methods. This includes the simple price-to-income ratio method, the vector autoregressive model, the co-integration test, and the vector error correction model (VECM). This current study also examines the relationships between the Chinese house price index and the macroeconomic fundamental variables such as inflation, income and mortgage rates.

6.2 Results of Econometric Methods

6.2.1 Housing Affordability Measures

The price-to-income ratio is the most common indicator used to provide evidence of the existence of a housing bubble in the Chinese housing market. The ratio is an index of price to income, which
represents the consumers’ payment capacity. A higher house price-to-income ratio means lower payment capacity. Internationally, the benchmark index of house price-to-income ratio in developing countries is “7”, which means no bubble exists in the market if the price-to-income ratio is below “7”. Because of the characteristic of the housing system and the unreported income, the benchmark index used in China studies is “8” (Ning & Hoon, 2012). Shen (2012) reveals the average price-to-income ratio was 9.1 for urban residents in China in 2009. Lin, Chang and Chen (2014) suggest that a benchmark value for price-to-income ratio is more than 10. Thus, a household with a price-to-income ratio over 10 would have a serious housing affordability problem. When we compare the price-to-income ratio with other nations, such the U.S. (2.9) and U.K. (5.1), it is easy to conclude that houses are much less affordable in China. The price-to-income ratio reveals the home-buyers payment capacity, and by comparing the ratio with the “benchmark index” this study can test whether the house price is rational and whether a housing bubble exists in the market. The national average annual growth rate of house price was 10.5 percent for the period of 2009 to 2013 (National Bureau Statistics of China, 2014). Thus, this current study uses “11” as the benchmark index to indicate the presence of housing bubbles in China. The housing Price to Income Ratio (PIR) in Chinese cities is higher than that in Europe and America may be the result of the cultural background. Many Chinese people believe that land is the only thing in the world worth working for. Chinese homebuyers who purchased houses as investments, had high budgets and low income; purchased houses that were newly constructed or located downtown exhibit relatively high PIR (Lin et al., 2014). Malpezzi and Mayo (1997) used the price to income ratio (PIR) data from 51 countries to analyse the various countries’ housing affordability, and the study shows that the housing PIR in Beijing (14.8) is much higher than in Europe and America (such as Munich 9.6, Toronto 4.2 and Washington D.C. 3.9). To provide further descriptive evidence of the existence of housing bubbles in the Chinese housing market, this current study calculated the price-to-income ratio among the eight Chinese cities for the period 2002 to 2012 (see Table 6.1).

<table>
<thead>
<tr>
<th>Year</th>
<th>Beijing</th>
<th>Changchun</th>
<th>Qingdao</th>
<th>Nanjing</th>
<th>Guangzhou</th>
<th>Kunming</th>
<th>Xian</th>
<th>Urumqi</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>8.93</td>
<td>8.01</td>
<td>8.56</td>
<td>8.72</td>
<td>9.37</td>
<td>8.09</td>
<td>9.53</td>
<td>7.14</td>
</tr>
<tr>
<td>2007</td>
<td>14.55</td>
<td>8.29</td>
<td>10.74</td>
<td>9.18</td>
<td>14.30</td>
<td>7.81</td>
<td>8.96</td>
<td>7.35</td>
</tr>
<tr>
<td>2008</td>
<td>14.13</td>
<td>7.82</td>
<td>8.81</td>
<td>7.72</td>
<td>13.35</td>
<td>7.92</td>
<td>8.79</td>
<td>7.95</td>
</tr>
<tr>
<td>2009</td>
<td>14.84</td>
<td>8.59</td>
<td>9.07</td>
<td>10.06</td>
<td>12.50</td>
<td>7.46</td>
<td>7.96</td>
<td>8.04</td>
</tr>
</tbody>
</table>

Previous studies use different price-to-income ratio benchmarks to indicate housing bubbles. For example, the price-to-income ratio benchmark is “8” in Ning and Hoon’s (2012) study, “9.1” in Shen’s (2012) study, and more than “10” in Lin, Chang and Chen’s (2014) study. Thus, there is no consensus on which is the best price-to-income ratio benchmark.
<table>
<thead>
<tr>
<th>Year</th>
<th>Beijing</th>
<th>Guangzhou</th>
<th>Changchun</th>
<th>Qingdao</th>
<th>Nanjing</th>
<th>Kunming</th>
<th>Xian</th>
<th>Urumqi</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>13.62</td>
<td>7.83</td>
<td>8.91</td>
<td>9.78</td>
<td>11.91</td>
<td>7.69</td>
<td>9.01</td>
<td>8.80</td>
</tr>
</tbody>
</table>

*Note: The price income ratio is calculated based on equation (5.1) (see section 5.1.1)*

Table 6.1 summarises the annual price-to-income ratios of eight Chinese cities, from 2002 to 2012. The results show the price-to-income ratios of Beijing and Guangzhou are above the benchmark index, for the period 2006 to 2012. The ratios of the other cities are under the benchmark index (Changchun, Qingdao, Nanjing, Kunming, Xian and Urumqi), for the period 2002 to 2012. The results show that a housing bubble exists in Beijing and Guangzhou. The results are consistent with Ning and Hoon’s (2012) estimation, based on the price-to-income ratio, who investigated the housing price bubble in Beijing and Shanghai, for the period 2001 to 2010. The authors’ results show the price-to-income ratio of Beijing is above the benchmark index from 2001 to 2010, and that the ratio reached its peak in 2010. The results reveal the presence of a housing bubble in Beijing from 2001 to 2010, and the housing bubble boom during most of 2010.

Table 6.1 shows a clear upward trend of price-to-income ratios in Beijing and Guangzhou from 2003 to 2010 (the ratio reaches its peak of 17.70 in 2010 in Beijing, and 14.30 in Guangzhou in 2007). In contrast, house prices in Tokyo were 15 times the income, and U.S. house prices were five to six times the income, when the Japanese and U.S. housing bubbles burst in 1990 and 2006, respectively (Fawley & Wen, 2013). However, the conditions in China are quite different with the U.S. and other developed countries because of the following reasons: (1) the substantial unreported income (‘grey’ income) caused the biased of the price-to-income ratio, (2) Chinese commercial banks typically consider 50% as the upper bound for the ratio of monthly debt service to monthly disposable income. Given the current mortgage with a 30 year term, this results in a 30 percent down payment and a 6.55 percent mortgage rate. (3) the lack of proper taxes in China has contributed to the high price-to-income ratio observed in China compared to that in the U.S., whereby homeowners in the U.S. pay one percent to two percent annual property tax of home values to local townships, while homeowners in China do not pay any property tax (Wang & Woo, 2011, Deng, Wei and Wu, 2015, Fang et al., 2015, Wu, Gyourko & Deng, 2015). The high price-to-income ratio in Beijing and Guangzhou is consistent with the standard Chinese underwriting, which presumes continuous high income growth in first tier cities (Fang et al., 2015, Wu, Gyourko & Deng, 2015). Therefore, the price-to-income ratio is an inadequate measurement of house prices in China (Wang, 2012). Income is one of the drivers of house prices; however, population, land prices and mortgage rates should also be included in the analysis (Dreger &

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4 The price-to-income ratio overestimates the share of income in housing; (1) there is large amount of unreported income in China; (2) some households may purchase a house less than 30 square metres (Wu et al., 2012).
Zhang, 2010). According to Mak, Choy and Ho’s (2007) study, the wealth of the Chinese people is obtained from various sources, including income received from primary and secondary jobs, and investing in stocks and private businesses. Fang et al. (2015) studies 120 Chinese cities and find that households from the lower end of the income distribution still are able to access financing and purchase homes, even in cities with high house price appreciation. Hence, salary should not be the sole determinant when testing for housing bubbles. In order to determine the macroeconomic fundamental factors that influence house prices and housing bubbles in China, this current study used other econometric techniques.

6.2.2 Augmented Dickey-Fuller Unit Root Tests

Prior to estimating a regression with time series data, it is necessary to verify that all variables are stationary; if not the empirical results can be spurious. The apparently significant regression results could be obtained from unrelated data when non-stationary series are used in the regression analysis, which means the results may spuriously indicate a significant relationship when there is none. The ADF test is therefore, carried out to eliminate any spurious regression problem in the time series data (Chinese house price index, income, mortgage rates and inflation) and to determine the order of integration of all the data. The lag length is based on the Bartlett criteria $\text{int}(12(T/100)^{1/4})$ where $T$ is the sample size. This current study uses quarterly data from 1999:Q1 to 2013:Q4. Thus, the sample size is 60, and based on the Bartlett criteria a lag length of 10 was obtained by the study. Table 6.2 reports the ADF test results for the levels and for the first differences of the time series data (macroeconomic fundamental variables included in this study). The results show that all the variables are non-stationary in levels, but are stationary in their first differences (integrated of order one), denoted I(1) at the 5% significance level.

<table>
<thead>
<tr>
<th>Variable</th>
<th>LEVELs</th>
<th>FIRST DIFFERENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ADF t-stat</td>
<td>P-value</td>
</tr>
<tr>
<td>Kunming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHPI</td>
<td>-3.837779</td>
<td>0.0004</td>
</tr>
<tr>
<td>Inflation (CPI)</td>
<td>-1.916979</td>
<td>0.6323</td>
</tr>
<tr>
<td>Income</td>
<td>0.145349</td>
<td>0.9970</td>
</tr>
<tr>
<td>Mortgage rate</td>
<td>-2.530264</td>
<td>0.1136</td>
</tr>
<tr>
<td>Xian</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHPI</td>
<td>-4.930294</td>
<td>0.0009</td>
</tr>
<tr>
<td>Inflation (CPI)</td>
<td>-4.270371</td>
<td>0.0067</td>
</tr>
<tr>
<td>Income</td>
<td>-0.228730</td>
<td>0.9908</td>
</tr>
<tr>
<td>Mortgage rate</td>
<td>-2.530264</td>
<td>0.1136</td>
</tr>
<tr>
<td>Urumqi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHPI</td>
<td>-4.096173</td>
<td>0.0108</td>
</tr>
<tr>
<td>Inflation (CPI)</td>
<td>-5.298965</td>
<td>0.0003</td>
</tr>
<tr>
<td>Income</td>
<td>-0.004058</td>
<td>0.9953</td>
</tr>
<tr>
<td>Mortgage rate</td>
<td>-2.530264</td>
<td>0.1136</td>
</tr>
</tbody>
</table>
### 6.2.3 Co-integration Test and Vector Error Correction Model

The unit root test results discussed in section 6.2.2 show all the series are integrated of the same order at the first differences. These stable linear combinations possibly exist between the variables, which reflect the long-term equilibrium relationships between the variables, namely the co-integration relationships (Wu & Duan, 2012). The Johansen and Juselius test (1990) is applied to identify the long-run relationships (co-integration) between the Chinese house price indices and the macroeconomic fundamental variables. The co-integration tests are conducted with the vector autoregressive model (VAR), followed by vector error correction model (VECM) to test for the long-run relationships. The VAR model is used to determine the number of co-integration relationships among the series. If co-integration relationships exist between the macroeconomic fundamental variables and the house price indices, the VECM model is applied to investigate the short-run and long-run relationships. Otherwise, the VAR model is retained to examine the short-run relationships between the macroeconomic fundamental variables and the house price indices.

The choice of lag is important for estimating the VAR model. In choosing the lag length, one must weigh two opposing considerations; the curse of dimensionality and the correct specification of the model (Canova, 1995). This current study chooses two lag-lengths for the VAR model specification. According to Belke et al. (2008) and Wu and Duan (2012, p.16), the two lags for VAR are considered sufficient to
avoid any serial correlation among the residuals. This current study used the Schwarz (SC) and Akaike (AIC) criteria to select the optimal VAR lag length (Campbell & Perron, 1991; Braum & Mittnik, 1993; Diebold et al., 1994; Ventzislar & Lutz, 2005). The results of the lag length criteria for the eight Chinese cities are summarised in Table 6.3.

Table 6.3 The VAR Lag Order Selection Criteria for the Eight Chinese Cities

<table>
<thead>
<tr>
<th>Lag</th>
<th>LogL</th>
<th>LR</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kunming</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>-805.2629</td>
<td>NA</td>
<td>15465492</td>
<td>27.90562</td>
<td>28.04772</td>
<td>27.96097</td>
</tr>
<tr>
<td>1</td>
<td>-656.4083</td>
<td>272.0446*</td>
<td>158677.8*</td>
<td>23.32442*</td>
<td>24.03492*</td>
<td>23.60118*</td>
</tr>
<tr>
<td>2</td>
<td>-643.4615</td>
<td>21.87556</td>
<td>177781.2</td>
<td>23.42971</td>
<td>24.70860</td>
<td>23.92786</td>
</tr>
<tr>
<td>Xian</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>-801.5427</td>
<td>NA</td>
<td>13603531</td>
<td>27.77733</td>
<td>27.91943</td>
<td>27.83269</td>
</tr>
<tr>
<td>1</td>
<td>-648.1221</td>
<td>280.3894</td>
<td>140013.8</td>
<td>23.03869</td>
<td>23.74919</td>
<td>23.31545</td>
</tr>
<tr>
<td>2</td>
<td>-626.2333</td>
<td>36.98450*</td>
<td>98148.15*</td>
<td>22.83563*</td>
<td>23.11453*</td>
<td>23.31269*</td>
</tr>
<tr>
<td>Urumqi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>-799.7440</td>
<td>NA</td>
<td>12785417</td>
<td>27.71531</td>
<td>27.85741</td>
<td>27.77066</td>
</tr>
<tr>
<td>1</td>
<td>-652.7794</td>
<td>268.5905</td>
<td>140013.8</td>
<td>23.19929</td>
<td>23.90979</td>
<td>23.47604</td>
</tr>
<tr>
<td>2</td>
<td>-629.9190</td>
<td>38.62620*</td>
<td>111449.2*</td>
<td>22.96272*</td>
<td>23.24162*</td>
<td>23.46088*</td>
</tr>
<tr>
<td>Qingdao</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>-849.0162</td>
<td>NA</td>
<td>69919632</td>
<td>29.41435</td>
<td>29.55645</td>
<td>29.46970</td>
</tr>
<tr>
<td>1</td>
<td>-670.7820</td>
<td>325.7383*</td>
<td>260479.2*</td>
<td>23.82007*</td>
<td>24.53057*</td>
<td>24.09682*</td>
</tr>
<tr>
<td>2</td>
<td>-657.4950</td>
<td>22.45055</td>
<td>288434.0</td>
<td>23.91362</td>
<td>25.19252</td>
<td>24.41178</td>
</tr>
<tr>
<td>Guangzhou</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>-850.7304</td>
<td>NA</td>
<td>74177149</td>
<td>29.47346</td>
<td>29.61556</td>
<td>29.52881</td>
</tr>
<tr>
<td>1</td>
<td>-715.0929</td>
<td>24.78892*</td>
<td>1200489.*</td>
<td>25.34803*</td>
<td>26.05853*</td>
<td>25.62478*</td>
</tr>
<tr>
<td>2</td>
<td>-699.3777</td>
<td>26.55335</td>
<td>1222553.</td>
<td>25.35785</td>
<td>26.63675</td>
<td>25.85601</td>
</tr>
<tr>
<td>Nanjing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>-858.7484</td>
<td>NA</td>
<td>97801495</td>
<td>29.74995</td>
<td>29.89204</td>
<td>29.80530</td>
</tr>
<tr>
<td>1</td>
<td>-714.1374</td>
<td>26.42891*</td>
<td>1161578.*</td>
<td>25.31508*</td>
<td>26.02558*</td>
<td>25.59184*</td>
</tr>
<tr>
<td>2</td>
<td>-698.4845</td>
<td>26.44804</td>
<td>1185472.</td>
<td>25.32705</td>
<td>26.60595</td>
<td>25.82521</td>
</tr>
<tr>
<td>Changchun</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>-812.7606</td>
<td>NA</td>
<td>20028476</td>
<td>28.16416</td>
<td>28.30626</td>
<td>28.21951</td>
</tr>
<tr>
<td>1</td>
<td>-626.0805</td>
<td>34.11741</td>
<td>55761.82</td>
<td>22.27864</td>
<td>22.98913</td>
<td>22.5539</td>
</tr>
<tr>
<td>2</td>
<td>-604.9420</td>
<td>35.71670*</td>
<td>47101.04*</td>
<td>22.10145*</td>
<td>22.38034*</td>
<td>22.53271*</td>
</tr>
<tr>
<td>Beijing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>-871.7905</td>
<td>NA</td>
<td>1.53e+08</td>
<td>30.19967</td>
<td>30.34177</td>
<td>30.25502</td>
</tr>
<tr>
<td>1</td>
<td>-681.6908</td>
<td>347.4236</td>
<td>379436.4</td>
<td>24.19623</td>
<td>25.90673</td>
<td>24.47299</td>
</tr>
<tr>
<td>2</td>
<td>-663.4172</td>
<td>30.87605*</td>
<td>353782.2*</td>
<td>24.11784*</td>
<td>25.39673*</td>
<td>24.13267*</td>
</tr>
</tbody>
</table>

Note: *indicates the identified lag number by different criteria

The results in Table 6.3 report that both SC and AIC criteria suggest the inclusion of one lag for Kunming, Qingdao, Guangzhou and Nanjing, and two lags for Xian, Urumqi, Changchun and Beijing. This current study chose one lag length for the VECM model specification for Kunming, Qingdao, Guangzhou and Nanjing, and two lag lengths for Xian, Urumqi, Changchun and Beijing.

In this current study, the restriction imposed in the VAR model led to the formation of a VECM model. The VECM model is a VAR model in the first difference with a vector of co-integrating residuals. Prior
to estimating the VECM model, this current study employed the Johansen and Juselius (1990) procedure and the Trace Test ($\lambda_{\text{Trace}}$) to select an appropriate model and to select lags. Table 6.4 shows that the trace statistics tests reveal the existence of co-integration relationships between the variables for the eight Chinese cities (with no trend included in the co-integration and in the VAR model). The trace test suggests one co-integration relationship in six cities and no co-integration relationships between the house price indices and macroeconomic fundamental variables in Qingdao and Nanjing.

Table 6.4 Model Selection for VECM of Eight Chinese Cities

<table>
<thead>
<tr>
<th>City</th>
<th>$H_0$</th>
<th>Eigenvalue</th>
<th>Trace Statistic</th>
<th>5% Critical Value</th>
<th>5% P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kunming</td>
<td>$r = 0$</td>
<td>0.357745</td>
<td>51.59579</td>
<td>47.85613</td>
<td>0.0214**</td>
</tr>
<tr>
<td></td>
<td>$r \leq 1$</td>
<td>0.239455</td>
<td>25.91517</td>
<td>29.79707</td>
<td>0.1313</td>
</tr>
<tr>
<td></td>
<td>$r \leq 2$</td>
<td>0.148761</td>
<td>10.03944</td>
<td>15.49471</td>
<td>0.2777</td>
</tr>
<tr>
<td>Xian</td>
<td>$r = 0$</td>
<td>0.382789</td>
<td>53.96778</td>
<td>47.85613</td>
<td>0.0120**</td>
</tr>
<tr>
<td></td>
<td>$r \leq 1$</td>
<td>0.299653</td>
<td>26.46273</td>
<td>29.79707</td>
<td>0.1155</td>
</tr>
<tr>
<td></td>
<td>$r \leq 2$</td>
<td>0.099131</td>
<td>6.160515</td>
<td>15.49471</td>
<td>0.6766</td>
</tr>
<tr>
<td>Urumqi</td>
<td>$r = 0$</td>
<td>0.382524</td>
<td>55.50255</td>
<td>47.85613</td>
<td>0.0081***</td>
</tr>
<tr>
<td></td>
<td>$r \leq 1$</td>
<td>0.241392</td>
<td>28.02197</td>
<td>29.79707</td>
<td>0.0790</td>
</tr>
<tr>
<td></td>
<td>$r \leq 2$</td>
<td>0.128597</td>
<td>12.27461</td>
<td>15.49471</td>
<td>0.1442</td>
</tr>
<tr>
<td>Qingdao</td>
<td>$r = 0$</td>
<td>0.352730</td>
<td>46.21742</td>
<td>47.85613</td>
<td>0.0707</td>
</tr>
<tr>
<td></td>
<td>$r \leq 1$</td>
<td>0.214591</td>
<td>20.98789</td>
<td>29.79707</td>
<td>0.3584</td>
</tr>
<tr>
<td></td>
<td>$r \leq 2$</td>
<td>0.087580</td>
<td>6.977967</td>
<td>15.49471</td>
<td>0.5802</td>
</tr>
<tr>
<td>Guangzhou</td>
<td>$r = 0$</td>
<td>0.495715</td>
<td>59.95551</td>
<td>47.85613</td>
<td>0.0025***</td>
</tr>
<tr>
<td></td>
<td>$r \leq 1$</td>
<td>0.214062</td>
<td>20.24786</td>
<td>29.79707</td>
<td>0.4062</td>
</tr>
<tr>
<td></td>
<td>$r \leq 2$</td>
<td>0.101274</td>
<td>6.276949</td>
<td>15.49471</td>
<td>0.6628</td>
</tr>
<tr>
<td>Nanjing</td>
<td>$r = 0$</td>
<td>0.330723</td>
<td>43.63451</td>
<td>47.85613</td>
<td>0.1179</td>
</tr>
<tr>
<td></td>
<td>$r \leq 1$</td>
<td>0.221809</td>
<td>20.34415</td>
<td>29.79707</td>
<td>0.3998</td>
</tr>
<tr>
<td></td>
<td>$r \leq 2$</td>
<td>0.090557</td>
<td>5.798757</td>
<td>15.49471</td>
<td>0.7192</td>
</tr>
<tr>
<td>Changchun</td>
<td>$r = 0$</td>
<td>0.459706</td>
<td>63.00485</td>
<td>47.85613</td>
<td>0.0010***</td>
</tr>
<tr>
<td></td>
<td>$r \leq 1$</td>
<td>0.293894</td>
<td>27.91330</td>
<td>29.79707</td>
<td>0.0812</td>
</tr>
<tr>
<td></td>
<td>$r \leq 2$</td>
<td>0.091654</td>
<td>8.077895</td>
<td>15.49471</td>
<td>0.4571</td>
</tr>
<tr>
<td>Beijing</td>
<td>$r = 0$</td>
<td>0.476176</td>
<td>58.01238</td>
<td>47.85613</td>
<td>0.0042***</td>
</tr>
<tr>
<td></td>
<td>$r \leq 1$</td>
<td>0.203789</td>
<td>21.15617</td>
<td>29.79707</td>
<td>0.3480</td>
</tr>
<tr>
<td></td>
<td>$r \leq 2$</td>
<td>0.094260</td>
<td>8.166373</td>
<td>15.49471</td>
<td>0.4478</td>
</tr>
</tbody>
</table>

Note: ** and *** indicate significant at the 5% level, and at the 1% level. Mackinnon-Haug-Michelis (1999) p-values
Based on the co-integration test criteria results, the VAR model was determined to no longer be appropriate to test the relationships among the variables for Kunming, Xian, Urumqi, Guangzhou, Changchun and Beijing. Thus, the VECM model was computed to determine if the house price indices deviates from the actual house price indices. The results in Table 6.4 show no co-integration relationships among the variables in Nanjing and Qingdao, which indicates there are no long-run co-integration relationships between the house price indices and the macroeconomic fundamental variables of the two cities. Thus, the VAR model is retained to estimate the short-run relationships between the macroeconomic fundamental variables and the house price indices in Qingdao and Nanjing.

A further restricted VECM test was conducted to test for the weak exogeneity on income, mortgage rates and inflation. These restrictions on the variables in the restricted VECM model are jointly estimated against the variables in the unrestricted VECM model with the \( \chi^2 \) test statistic. A non-rejection of these restrictions if the p-value of \( \chi^2 \) is more than the 5% significance level, implies that the null hypothesis of weak exogeneity is accepted in this study, and the restricted VECM model is therefore used. Otherwise the unrestricted model is retained.

Table 6.5 reports the summary of the results of \( \chi^2 \) obtained from the restricted VECM model via Eviews 8.0 software. The results show the P-values are less than 5% in most of the cities except for Xian, which implies rejection of the null hypothesis of weak exogeneity in Kunming, Urumqi, Guangzhou, Changchun and Beijing, but acceptance of the null hypothesis of weak exogeneity in Xian. Thus, this current study applied the restricted VECM model for Xian and retained the unrestricted VECM model for the other five cities.

<table>
<thead>
<tr>
<th></th>
<th>Kunming</th>
<th>Xian</th>
<th>Urumqi</th>
<th>Guangzhou</th>
<th>Changchun</th>
<th>Beijing</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \chi^2 )</td>
<td>1.762</td>
<td>5.872</td>
<td>8.0701</td>
<td>27.5924</td>
<td>10.6482</td>
<td>12.5527</td>
</tr>
<tr>
<td>P-value</td>
<td>0.023</td>
<td>0.118</td>
<td>0.0446</td>
<td>0.0004</td>
<td>0.0138</td>
<td>0.0057</td>
</tr>
</tbody>
</table>

6.2.4 Short-run Relationships between House Price Indices and Macroeconomic Fundamentals

The results of the short-run relationships between the macroeconomic fundamental variables and the house price indices of the eight Chinese cities estimated by the VAR model, and the unrestricted and restricted VECM model, are reported in Appendix One. These estimated results confirm that the Chinese housing markets are regional specific. The short-run relationships between the
macroeconomic fundamental variables and the house price indices are different among the eight cities. The results further show that different cities’ house prices respond differently to the changes in macroeconomic fundamental factors.

The results shown in Appendix One reveal that in the short-run, inflation and the house price indices are significant and positively correlated in Xian, Changchun and Qingdao. The coefficients of inflation are negative and insignificant in Guangzhou, Beijing and Nanjing. The significant and positive relationships between inflation and house prices can be explained in the short-run, where the house buyers are over-optimistic and expect the asset price to grow rapidly along with the land price and construction costs. House buyers expect to gain profits from the houses they invest in. The results are consistent with Qiu’s (2011) study, which shows positive relationships between inflation and the house price indices. The author’s study examines the relationships between house price dynamics and inflation in China using the autoregressive distribution lag model, with data covering the period from 2004 to 2010. The study investigated the relationships between inflation and house price indices in the short-run.

This current study results show that Chinese house prices are not sensitive to changes in income and mortgage rates in the short-run. The income and mortgage rate coefficients are insignificant in seven cities, except there is a significant and positive relationship between the mortgage rate and the house price index in Kunming. The mixed relationship between disposable income and house price is insignificant among the eight cities in the short-run. These results imply that the magnitude of income that influences house prices could be relatively small in China. According to Huang’s (2004) study, the average Chinese household’s income is much lower than the house price, thus income is not a major determinant of housing demand. Further, Yang and Shen (2008) and Ahujia et al. (2010) point out that house prices in Beijing increased at an average rate of 25 percent per year since 2004, while the average household disposable income has increased at a stable annual rate of 12 percent per year in the same period.

In the short-run, mortgage rates exhibit mixed effects on the house price index. The result shows a positive and statistically significant relationship between mortgage rates and the house price index in Kunming, but negative and insignificant in Qingdao. The mortgage rate has been two percent below the inflation rate since 2005, and coupled with low interest, high savings, and a lack of alternative investment opportunities has led to the positive relationship between house prices and mortgage rates (Ahuja et al., 2010). In China, the increase in mortgage rates and house prices is due to the irrational behaviour of house buyers, because when mortgage rates rise, house buyers increase their demand for houses, thereby pushing up house prices. This is because the real estate market is considered to be an investment channel and homebuyers in China are optimistic about housing market growth (Ahuja
et al., 2010). On the other hand, the interest rate variable not only negatively impacts on the house price index by increasing the borrowing costs for buyers, but also positively affects house prices with an increase in costs for developers (Huang & Wang, 2007). This pushes up future house prices and enlarges the profit in real estate investment.

6.2.5 The Co-integration Relationships between the House Price Index and Macroeconomic Fundamentals

Table 6.6 shows the long-run equilibrium equations, based on the co-integration model results from the unrestricted and restricted VECM model shown in Appendix One. Both the short-run and long-run results confirm that regional development in China is unbalanced; thus, the macroeconomic fundamental variables have different signs and levels of influence on the house price indices (Ren, Xiong & Yuan, 2012). Housing market reform in China is decentralized; that is, local governments design the actual reform programmes and determine the degrees of reform. With large regional differences in China, it is likely that housing reform will be carried out differently across cities, which may lead to different patterns of housing behaviour (Huang, 2004). Peng, Tam and Yiu (2005) applied the generalized least squares (GLS) method to estimate the effect of the macro economy of China’s property market, for the period 1998 to 2004. Their study reveals that land price is a significant variable in explaining differences in property prices across the provinces. The effect of land price increases on property prices is much larger in coastal cities than in other parts of the country.

### Table 6.6 The Long-Run Equilibrium Coefficients Derived from VECM Model

<table>
<thead>
<tr>
<th>City</th>
<th>HPI&lt;sub&gt;i,t&lt;/sub&gt; =</th>
<th>HPI&lt;sub&gt;i,t&lt;/sub&gt; =</th>
<th>HPI&lt;sub&gt;i,t&lt;/sub&gt; =</th>
<th>HPI&lt;sub&gt;i,t&lt;/sub&gt; =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kunming</td>
<td>66.975 + 0.380Infl + 0.0007Inc&lt;sub&gt;i&lt;/sub&gt; - 0.946Mtr&lt;sub&gt;i&lt;/sub&gt;</td>
<td>(2.350)</td>
<td>(1.993)</td>
<td>(-1.267)</td>
</tr>
<tr>
<td>Xian</td>
<td>95.281 - 0.024Infl + 0.0007Inc&lt;sub&gt;i&lt;/sub&gt; + 1.351Mtr&lt;sub&gt;i&lt;/sub&gt;</td>
<td>(-0.078)</td>
<td>(1.703)</td>
<td>(1.231)</td>
</tr>
<tr>
<td>Urumqi</td>
<td>87.127 - 0.103Infl + 0.0009Inc&lt;sub&gt;i&lt;/sub&gt; + 3.837Mtr&lt;sub&gt;i&lt;/sub&gt;</td>
<td>(-0.305)</td>
<td>(1.459)</td>
<td>(2.680)</td>
</tr>
<tr>
<td>Guangzhou</td>
<td>451.315 - 4.390Infl + 0.002Inc&lt;sub&gt;i&lt;/sub&gt; + 13.642Mtr&lt;sub&gt;i&lt;/sub&gt;</td>
<td>(-5.887)</td>
<td>(2.442)</td>
<td>(4.751)</td>
</tr>
<tr>
<td>Changchun</td>
<td>235.051 - 1.606Infl + 0.0009Inc&lt;sub&gt;i&lt;/sub&gt; + 4.517Mtr&lt;sub&gt;i&lt;/sub&gt;</td>
<td>(-4.708)</td>
<td>(1.825)</td>
<td>(4.081)</td>
</tr>
<tr>
<td>Beijing</td>
<td>331.664 - 2.698Infl + 0.0016Inc&lt;sub&gt;i&lt;/sub&gt; + 6.209Mtr&lt;sub&gt;i&lt;/sub&gt;</td>
<td>(-5.043)</td>
<td>(3.523)</td>
<td>(3.052)</td>
</tr>
</tbody>
</table>

Source: Author’s calculations
Table 6.6 results report that the inflation coefficients display significant and negative relationships with the Chinese house price indices (CHPI) in Guangzhou, Changchun and Beijing (-4.39, -1.61 and -2.70, respectively). However, there is no statistically significant relationship between CHPI and inflation in Xian and Urumqi. The relationship is positive and significant in Kunming (0.38), but the magnitude of the relationship is small which indicates that the influence of inflation on the house price index in Kunming is small. Inflation measures the price factor that impacts house prices, such as the price of raw materials and labour. Raw materials and labour are an estimator for the cost of housing supply. For example, Coleman et al. (2008) used inflation (CPI) to model the changes in construction cost in their VECM model. In the authors’ model, CPI was treated as a proxy for the cost of housing supply. Housing developers tend to use CPI to estimate the total costs of housing supply, and focus on the supply cost (construction costs) to make their decisions about house prices (Chen, Gan, Hu & Cohen, 2013). According to the National Bureau of Statistics of China, the raw materials and labour for house building and rent count for 13 percent of the total CPI. Thus, increasing CPI pushes up the costs of real estate projects. In the long-run, a rise in house prices will lead to lower housing demand, thereby causing house prices to decline. Chen, Gan, Hu and Cohen’s (2013) study found the cost of house supply (construction costs and operating costs) significantly impact house prices in the long-run. Peng, Tam and Yiu’s (2005) study applied the generalized least squares estimation to test the macroeconomic factors (GDP, CPI and interest rates) that influence the growth of house prices in major cities (Beijing, Shanghai, Guangzhou) and 31 provinces in China, for the period 1998 to 2004. The study found a negative relationship between property prices and CPI in the coastal provinces of China (e.g. Zhejiang and Jiangsu).

Land price is also a major factor that significantly influences the house prices in China (Yu, 2010). Land in China’s cities and towns is state-owned while rural area land is collectively owned. Further, land ownership cannot be transferred and circulated. Someone wanting to purchase land can only purchase the land-use rights for a certain number of years (Yu, 2010). According to Zhang, Hua and Zhao’s (2011) study, the house price boom in China occurred because the local governments have strong incentives and capabilities to generate significant revenue from the sale of ‘land-use rights’. The soaring land prices push up house prices. For instance, Chinese land value increased eight fold for the period 2003 to 2010. From 2003 to 2009, the ratio of land to house values hovered between 30 percent and 40 percent. Beijing’s land price nearly tripled subsequent to the end of the 2008 Olympic Games (Wu, Gyourko & Deng, 2012). Thus, the house price index increases while inflation decreases.

Income measures households’ affordability to buy houses. This current study’s results show that the income variables are positively related to CHPI in six cities. Prevalent literature confirms income to be positively related to house prices in a stable long-run relationship (Abraham & Hendershott, 1996; Malpezzi, 1999; Capozza et al., 2002; Meen, 2002; Gallin, 2003). The growth of income will increase
housing affordability, which will positively impact the demand for houses. Zhang et al. (2007) show that per capita disposable personal income has a significant positive impact on the estimated equilibrium house prices from 2000 to 2004 in China. Yang and Shen (2008) investigated the factors that influence house prices in the Beijing housing market, for the period 1990 to 2005. The authors report that income is one of the most important determinants of housing affordability in Beijing. Yang and Shen’s (2008) study discovered that the impact of income on housing affordability is very large, especially for first-time house buyers. An increase in income does not necessarily cause an instant increase in housing demand because the timing of a house purchase is a long-term decision (Chen, Tsai & Chang, 2007). House prices and income are linked in the long-run with housing affordability and tend to return to their long-run equilibrium relationship eventually (Gallin, 2003).

These income coefficients are the smallest values among the other macroeconomic fundamental variables in this current study. This implies that the income variable has marginal influence in determining the house price index in China. This is because the Chinese average household income is much lower than the housing market price, thus income has limited power to determine house demand (Huang, 2004). For example, according to data from the Statistics Bureau of China, the national average annual income for a couple is 22,304 RMB in 2003; the duration for a couple to purchase a house valued 300,000 RMB with 30 percent of their annual earnings is 44.7 years (Burell, 2006). Thus, there is a large disparity between household income and house price (Yang & Shen, 2008; Ahuja et al., 2010). The majority of homebuyers still rely heavily on personal savings and parental contributions to purchase their homes (Li, 2010).

The estimated mortgage rate coefficients are statistically significant and positively related to house price indices in Urumqi, Guangzhou, Changchun and Beijing. However, the mortgage rate negatively influences the house price index in Kunming. The general expectation is that house prices should react negatively to an increase in the mortgage rate. Such an expectation implies that an increase in mortgage rates increases the costs of house purchasing. This finding is consistent with Iacoviello and Minetti’s (2003) study which focuses on factors that influence house prices in Finland, Sweden and the U.K. The authors’ results show an instant and significant decrease in real house prices (about 0.75 percent to 2 percent) following a rise in mortgage rates. Similarly, Negro and Otrok (2005), Sliva (2008) and Carstensen et al. (2009) studies exhibit similar results for the U.S. housing market although the fall in house prices has been as large as 13 percent following an increase in the mortgage rate.

In China, the irrational behaviour of house buyers causes simultaneous increases in mortgage rates and house prices, which further fuels house buyers to buy houses even when the mortgage rate increases. This behaviour pushes house prices up further (Yao, Luo & Loh, 2011). Empirical results show that mortgage rate movements have little immediate effect on house prices, which suggests that
Chinese investors could be ‘irrational’ and ‘speculative’. Instead of running away from the market, investors rush to buy houses or shares when monetary policy-makers announce restrictive policy actions. This irrational behaviour can be explained by market imperfections, lack of investment channels, cultural traditions, urbanization and demographic changes (Yao, Luo & Loh, 2011).

Mortgage rates in China are not determined by the market but by the People’s Bank of China (PBC). The PBC predominantly decides deposit rates, loan rates and mortgage loan rates. The interest rate policy can be used as a monetary policy tool by the central government to influence house prices (Allen & Carletti, 2010). The PBC tends to increase mortgage rates when the economy is “hot”. In other words, an increase in the mortgage rate simply represents an underlying strong demand for housing (Leung, Chow, Yu & Tam, 2010). Mortgage rates are the major monetary tool used by the Chinese government to eliminate house price bubbles (Allen & Carletti, 2010).

According to Chinese culture and traditions, a house is not just a place to live in but a symbol of social status. In most parts of the country, having a house is a pre-requisite for a man to get married (Jia & Liu, 2007). Consequently, the purchasing of a house by young people is determined by the timing of marriage, not by changes in interest rates. Many Chinese families tend to buy houses for their children who are moving to cities, by taking out savings from three generations. When mortgage rates go up, families are more likely to bring forward their planned purchase, rather than suspend or postpone it until interest rates come down (Jia & Liu, 2007). The positive relationship between mortgage rates and house prices is consistent with previous studies (Wong, Hui & Seabrook, 2003; Gao & Wang, 2009; Wang & Zhao, 2010 and Chen et al., 2013). Wong, Hui and Seabrook (2003) investigated the role of interest rates on house prices from 1981 to 2001 in Hong Kong. The authors’ study shows a positive relationship between house prices and interest rates in the Hong Kong housing market. Chen et al. (2013) study applied the vector error correction model to examine the long-run and short-run dynamics of Beijing house prices for the period 1998 to 2010, and found a positive relationship between interest rates and house prices. Interest rates positively affect house prices because an increase in interest rates leads to an increase in the borrowing costs for real estate developers. Thus, house prices rise with an increase on interest rates (Huang and Wang, 2007).

6.2.6 Efficiency in the Housing Market

The error correction mechanism of the VECM model reveals a significant adjustment speed by the error correction term (Adams & Fuss, 2010). In this current study, the efficiency of the Chinese housing market is analyzed by observing the speed of the adjustment factors obtained from the VECM estimation result (see Appendix One). The coefficient value of $\alpha$ (equation 5.8) which determines the speed of adjustment are -0.509 for Kunming; -0.383 for Xian; -0.473 for Urumqi; -0.083 for Guangzhou; -0.476 for Changchun; and -0.270 for Beijing. For example, the house price in Guangzhou
adjusts slowly to the equilibrium price by 8.3 percent, which means that an economic disequilibrium in the Guangzhou market will be resolved after 12 quarters (3 years). The slow adjustment indicates the housing market in Guangzhou is not efficient due to the slow adjustment towards the market equilibrium price. The efficient markets are Kunming, Xian, Urumqi, Changchun and Beijing, where housing markets respond faster to changes in economic conditions such as expansion or recession. For example, an economic disequilibrium in the Kunming housing market will be resolved in almost two quarters (0.5 year).

Expectation could be a possible factor that contributes to the slow adjustment of Chinese house prices to real economic conditions. Glaeser et al. (2008) suggest that any over-optimism about future appreciation by home buyers is more likely to be sustained in inefficient markets. Any positive demand shock will lead to greater price increases that validate the over-optimism behaviour of house buyers. Fluctuations in house prices will not influence optimistic house buyers to adjust their expectations downward (Wu, Gyourko & Deng, 2012). Experienced buyers and sellers tend to follow the market trend with knowledge and understanding of the real conditions of the housing market, which are the rapid adjustments of house prices to real economic conditions.

In conclusion, Johansen and Juseliu’s (1990) co-integration test determines the co-integration relationships between China’s house price index (CHPI), inflation, income and mortgage rates. In addition, the VECM model results show that CHPI is positively related to inflation, income and mortgage rates in Kunming. CHPI is negatively related to inflation, and positively related to income and mortgage rates in Xian, Urumqi, Guangzhou, Changchun and Beijing. In this current study the speed of adjustment of the Chinese house price index represented in the error correction term is negative. The housing market of Guangzhou is found to be inefficient which means the adjustment of house prices to equilibrium is slow. The housing markets in Kunming, Xian, Urumqi, Changchun and Beijing are efficient, due to the fast speed of adjustment towards market equilibrium house prices, which reveals that buyers and sellers response faster to changes in economic conditions such as an expansion or a recession.

6.2.7 Evidence of Housing Bubble and Size of House Price Bubbles

Hott and Monnin (2008) suggest that to test the existence of a housing bubble one should address the deviation (gap) between real house prices and fundamental house prices. The deviation of the movement between these two factors can be used to test for the presence of housing bubbles in a housing market. The measure of price deviation from fundamental factors should give us an early warning indicator of an over-booming house market (Dreger & Zhang, 2010).
Based on the unrestricted VECM results, the estimated coefficients were inserted into equation (5.9) to estimate the long-run equilibrium Chinese house price indices of six cities (Kunming, Xian, Urumqi, Guangzhou, Changchun and Beijing). According to Blanchard and Watson (1982) if house prices deviate considerably from their fundamental values or expected prices, it is very likely that a bubble exists. The larger the deviation, the bigger the bubble becomes. Thomsett and Kahr (2007) theoretically analyzed the sub-prime loan crisis in the U.S. and suggested that the larger the gap between house prices and the equilibrium price, then the more important is the signal of the existence of a house price bubble.

As discussed in Chapter 5, this current study uses a 22 percent deviation or overvaluation of CHPI from its long-run equilibrium price as an indicator for the existence of a housing bubble in China’s housing market. This figure is consistent with previous studies (Shen et al., 2005; Hui & Yue, 2006; Dreger & Zhang, 2010), which use a 22 percent deviation from the actual house price index and the predicted house price index, as a sign for a housing bubble.

Table 6.7 Percentage Deviation of the House Price Index of Six Cities from their Long-Run Equilibrium Price

<table>
<thead>
<tr>
<th>Period</th>
<th>% of deviation (Kunming)</th>
<th>% of deviation (Xian)</th>
<th>% of deviation (Urumqi)</th>
<th>% of deviation (Guangzhou)</th>
<th>% of deviation (Changchun)</th>
<th>% of deviation (Beijing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999Q1</td>
<td>3.51</td>
<td>-4.60</td>
<td>-4.00</td>
<td>-7.80</td>
<td>-10.85</td>
<td>-9.04</td>
</tr>
<tr>
<td>1999Q2</td>
<td>6.90</td>
<td>-4.16</td>
<td>-6.22</td>
<td>-15.50</td>
<td>-10.23</td>
<td>-11.70</td>
</tr>
<tr>
<td>1999Q3</td>
<td>1.76</td>
<td>-1.21</td>
<td>-1.58</td>
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<td>-3.64</td>
</tr>
<tr>
<td>1999Q4</td>
<td>0.57</td>
<td>-0.84</td>
<td>-0.82</td>
<td>-2.63</td>
<td>6.55</td>
<td>-5.35</td>
</tr>
<tr>
<td>2000Q1</td>
<td>0.48</td>
<td>-0.46</td>
<td>-0.19</td>
<td>2.42</td>
<td>-5.77</td>
<td>-1.80</td>
</tr>
<tr>
<td>2000Q2</td>
<td>0.28</td>
<td>-0.42</td>
<td>0.63</td>
<td>5.74</td>
<td>-1.78</td>
<td>0.68</td>
</tr>
<tr>
<td>2000Q3</td>
<td>2.90</td>
<td>-0.80</td>
<td>0.66</td>
<td>15.56</td>
<td>-2.01</td>
<td>13.23</td>
</tr>
<tr>
<td>2000Q4</td>
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<td>1.03</td>
<td>2.39</td>
<td>5.54</td>
<td>12.42</td>
</tr>
<tr>
<td>2001Q1</td>
<td>-0.46</td>
<td>-1.10</td>
<td>-0.46</td>
<td>-8.21</td>
<td>4.18</td>
<td>10.99</td>
</tr>
<tr>
<td>2001Q2</td>
<td>-2.26</td>
<td>-0.53</td>
<td>0.01</td>
<td>-0.83</td>
<td>5.74</td>
<td>9.69</td>
</tr>
<tr>
<td>2001Q3</td>
<td>0.84</td>
<td>1.12</td>
<td>-1.04</td>
<td>-9.57</td>
<td>3.73</td>
<td>-3.73</td>
</tr>
<tr>
<td>2001Q4</td>
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<td>-0.98</td>
<td>-1.17</td>
<td>-11.90</td>
<td>-3.17</td>
<td>-8.29</td>
</tr>
<tr>
<td>2002Q1</td>
<td>1.16</td>
<td>-0.77</td>
<td>-1.95</td>
<td>-3.49</td>
<td>-1.72</td>
<td>-10.00</td>
</tr>
<tr>
<td>2002Q2</td>
<td>-1.02</td>
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<td>-1.36</td>
<td>-14.44</td>
<td>-1.75</td>
<td>-4.19</td>
</tr>
<tr>
<td>2002Q3</td>
<td>-2.02</td>
<td>-0.64</td>
<td>-0.92</td>
<td>-8.09</td>
<td>-6.09</td>
<td>-6.75</td>
</tr>
<tr>
<td>2002Q4</td>
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<td>-0.60</td>
<td>-1.73</td>
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<td>-2.83</td>
<td>-0.60</td>
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</tr>
<tr>
<td>2003Q2</td>
<td>-2.11</td>
<td>-0.71</td>
<td>-0.69</td>
<td>5.84</td>
<td>-0.48</td>
<td>-4.80</td>
</tr>
<tr>
<td>2003Q3</td>
<td>-2.86</td>
<td>-0.45</td>
<td>-0.73</td>
<td>4.45</td>
<td>-2.56</td>
<td>-3.55</td>
</tr>
<tr>
<td>2003Q4</td>
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<td>-0.10</td>
<td>0.11</td>
<td>2.90</td>
<td>0.07</td>
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</tr>
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<td>2004Q1</td>
<td>-2.68</td>
<td>2.33</td>
<td>-0.31</td>
<td>3.61</td>
<td>-2.09</td>
<td>-3.49</td>
</tr>
<tr>
<td>2004Q2</td>
<td>-3.08</td>
<td>2.25</td>
<td>0.76</td>
<td>10.57</td>
<td>6.22</td>
<td>2.52</td>
</tr>
<tr>
<td>2004Q3</td>
<td>0.82</td>
<td>4.21</td>
<td>-0.73</td>
<td>10.84</td>
<td>8.51</td>
<td>4.82</td>
</tr>
<tr>
<td>2004Q4</td>
<td>0.54</td>
<td>2.46</td>
<td>-1.71</td>
<td>9.46</td>
<td>2.04</td>
<td>6.66</td>
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<tr>
<td>2005Q1</td>
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<td>-0.25</td>
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<td>2005Q2</td>
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<td>2005Q3</td>
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<td>6.95</td>
<td>-0.63</td>
<td>3.35</td>
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</tbody>
</table>
Table 6.7 summarizes the percentage deviation of the house price index of the six cities, from their long-run equilibrium prices. The results show no evidence of house price bubbles in the six cities. As discussed previously, a house price bubble in China exists when the deviation of the real house price index is more than 22 percent from its long-run equilibrium price. Therefore, there is no evidence of a house price bubble in the real estate market of the six cities. Although the results indicate these six housing markets have not reached the bubble level, there are nevertheless some periods when the deviations are close to the critical value (see Table 6.7). For example, the deviation of the house price index from its equilibrium value is 15.88 in 2008:Q1 in Urumqi; 14.86 in 2006:Q2 in Guangzhou; 14.84 in 2013:Q3 also in Guangzhou; and 18.69 in 2010:Q4 in Beijing. Thus, potential housing bubbles still exist, as the house price indices of the six cities are greater than the equilibrium house price indices in some periods. The overpriced real estate market could easily produce a bubble (Guo & Huang, 2010).

<table>
<thead>
<tr>
<th>Year</th>
<th>Deviation</th>
<th>Price</th>
<th>Deviation</th>
<th>Price</th>
<th>Deviation</th>
<th>Price</th>
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<tbody>
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<td>1.69</td>
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</tr>
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<td>-2.10</td>
<td>3.59</td>
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<td></td>
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<td>-5.52</td>
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<tr>
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<td>2.24</td>
<td>2.97</td>
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<td></td>
</tr>
<tr>
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<td>-0.37</td>
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<td>2012Q2</td>
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</tbody>
</table>
The results are similar to previous housing affordability measures (price-to-income ratio) (see section 6.2.1). Housing affordability measures show that only Beijing and Guangzhou exhibit signs of house price bubbles for the period 2006 to 2012, based on the price-to-income ratio results; the other cities are free of a housing bubble. Previous studies confirm that the Chinese housing markets are free of housing bubbles. Xie (2004) analysed market irrational behaviour in Beijing based on local price rent ratios. The author’s study reveals the housing market in Beijing does not exhibit a strong speculative mode. Hui and Yue (2006) applied a combination of econometric estimation methods, such as the Granger causality tests and generalized impulse response analysis, to investigate whether there was a house price bubble in Beijing in 2003. The authors’ results show that Beijing exhibited no sign of a bubble in 2003. Also, Ahuja et al. (2010) believe that there is no evidence of a national level house price bubble in China. The Chinese government intervention policies in 2010 may have eliminated the overheating real estate market. Seki (2012) reviewed the Chinese real estate market for the decade to 2012, and analysed the risk factors, such as the deposit reserve ratio that is associated with the collapse of a housing bubble. Seki’s study shows no clear sign of a housing bubble in China’s housing market, especially for the small and medium size cities. Chen and Funke (2013) employed the newly developed recursive unit root tests aimed at identifying explosive bubbles in China for the period 2003:Q1 to 2011:Q4. Their results reveal the Chinese housing market does not display significant signs of a housing bubble.

Although China has experienced a sharp increase in house prices in the past decade, the causes of China’s house price dynamics are not the same as those of other countries. On the surface, the increase in China’s house prices seems to share many features of the house price bubble of Japan in the 1980s. However, China has abundant room for driving its maturing export-driven economy into a more consumption driven economy. Furthermore, most Chinese banks are state owned and thus, government policies aimed at deflating a bubble are more effective in China than they would be in Japan (Chen & Funke, 2013). The following sections explain why the fears about China’s real estate market are most likely overblown.

First, Chinese households’ average leverage ratio remains low. For example, the total urban real estate asset is five times the size of the equity market and 16.9 times the equity market assets held by households. However, China’s urban housing stock is only 2.6 times the value of household bank deposits. Thus, there is little debt carried by households in China (Liu, 2014). Moreover, Chinese home buyers are required to pay at least a 30 percent down payment to qualify for a mortgage loan. Mortgage loans account for only 14 percent of total bank loans (Liu, 2014). Therefore, banks are well cushioned from the effects of large property market corrections. Gan, Li, Wang and Kao’s (2012) study confirm the Chinese banks do not heavily rely on the mortgage loan business. Their study employs the credit scoring model to investigate the determinants of default mortgage in China, and found the
significant relationship between the borrower’s rating, mortgage rate, mortgage duration, mortgage amount and the borrower’s default rate. These findings suggest that Chinese banks’ mortgage lending are based on commercial basis.

Second, urbanization accelerates house price increases in China, which fuels the demand for housing in China’s major cities. This in turn accelerates house prices in urban cities. For example, between 1996 and 2005, the urban population increased by over 50 percent from 373 million to just over 562 million. The urbanization rate has been growing by about 1.4 percent annually since 1996, which means more than 15 million new people enter urban areas each year (Wu, Gyourko & Deng, 2010). Strong urbanization will continue to drive the expansion of new demand for housing. China is reforming its residential registration system. There has been substantial migration from rural to urban areas and large numbers of people without urban residential registration now live in major Chinese cities. Between 2006 and 2009, China’s urban population grew by 44.8 million as a result of migration from rural to urban areas (Seki, 2012). The rapid urbanization process could fuel a large demand for housing. For example, Figure 6.4 shows the housing floor space sold, is greater than the floor space completed, in eight Chinese cities from 2005 (Kunming, Xian, Urumqi, Qingdao, Guangzhou, Nanjing, Changchun and Beijing). The demand for housing has outstripped supply by over 20 million square metres each year with regard to rapid urbanisation (except 2008 and 2012), which drove house prices higher (Liu, 2014).

Figure 6.4 Average Floor Space Completed versus Floor Space Sold (in Eight Chinese Cities)

![Figure 6.4](image)

Source: Author’s calculations based on data from the National Bureau of Statistics of China

Finally, China’s house prices are impacted heavily by government real estate policies. In response to rapid house price growth, the Chinese government carefully crafts and closely monitors its monetary policies to prevent real estate bubbles (Yurichuk, 2011). The Chinese economy has been transformed
from a state planned economy to a market oriented economy over the past three decades, but commercial banks are still primarily state owned or are state holdings. Thus, monetary policy plays a pivotal role in controlling the credit supply to the real estate sector (Xu & Chen, 2012). Government interventions give China the upper hand in engineering a gradual, controlled slowdown of the market economy so as not to burst the real estate bubble (Yurichuk, 2011). For example, on January 12, 2010, the People’s Bank of China announced that it would raise the deposit reserve requirement ratio by one half of a percent. This policy has been well regarded for cooling down the property market (Gao, 2010). Therefore, the dynamics of Chinese house prices are likely to be the result of both the macroeconomic fundamental variables and government policies.

6.2.8 The Impulse Response Function and Variance Decomposition

The impulse response function traces the response of current and future values for each of the variables, to a one unit increase in the current value of one of the VAR errors. It assumes that errors return to zero in subsequent periods and that all other errors are equal to zero (Stock & Watson, 2001; Sun, Gan & Hu, 2012). An impulse response function provides a different method for depicting the system dynamics by tracing the effects of the shock of an endogenous variable on the variables in the VAR. Compared with the Granger causality test, the impulse response function offers an advantage in that it can indicate whether the shock impacts are positive or negative, and whether the shock is temporary or for the long-run (Shen, Hui & Liu, 2005). The interpretation of the impulse response requires that the innovations in a VAR are correlated and may be viewed as having a common component that cannot be associated with a specific variable. Thus, this current study uses the inverse of the Cholesky factor of the residual covariance matrix to orthogonalize the impulses.

The figures in Appendix Three present the impulse response function that documents the impact of a unit rise in the Chinese house price index, inflation, income, and mortgage rates, on CHPI. The dotted lines show the impact of a unit rise in the CHPI, inflation, income, and mortgage rates, on CHPI at a 95% confidence levels.

The VECM test determines the short-term and long-term relationships between house prices and fundamental variables; unfortunately this study is unable to trace the time paths of the effects of various economic shocks on house prices and other fundamental variables. Therefore, the generalized impulse response function is applied to trace the paths of different variables, whether they return to equilibrium after a shock is injected into the system (Guo & Huang, 2010). The shock to each equation is equal to one standard deviation of the equation residual, and the impulse response of all the variables to the shock are traced out for a period of three years (12 quarters).
The figures in Appendix Three display the multiple graphs of the impulse response function between house prices and three macroeconomic fundamental variables in the six cities. The CHPI responds similarly to its own shock in all eight cities. For example, a one standard deviation of the house price index itself decreases the future house price index in the first seven quarters; reaches the lowest point, negative 0.3 percent by the seventh quarter; and vanishes completely by the tenth quarter. This indicates that current changes in house prices do affect people’s expectations in the short-term in the eight cities. The response of house prices to one standard deviation of the three fundamental variables differs greatly. The increase in disposable income has a positive effect on house prices in six cities, but the impact from the shock of the income to house price index is relatively small. The findings suggest that the fluctuation in the response of CHPI to the shock of income, are between zero percent and 0.2 percent for the 12 quarters, except the fluctuation is larger in Guangzhou which is between zero percent and one percent. The response of the house price index to the disposable income shock in Changchun and Qingdao appears to be insignificant.

The response functions of CHPI to the shock of inflation (CPI) and mortgage rates are similar and consistent with what this current study expects to be the effects of house prices. The CHPI response is similar to the CPI shock in Kunming, Xian and Urumqi; the CHPI response fluctuated between zero percent and 0.5 percent, and peaked at 0.5 percent in the third quarter in Kunming and Xian, and peaked at one percent in Urumqi. The response of CHPI to CPI shocks decreases to below 0.2 percent by the sixth quarter in Kunming and Xian. The response of CHPI to the shock of CPI decreases and reaches the lowest point of 1.5 percent by the fifth quarter in Beijing, Guangzhou, Qingdao and Nanjing. The response of CHPI to the CPI shock does not last long since the effects vanish completely in all six cities by the 12th quarter.

The response of CHPI to mortgage rate shocks are similar to Kunming, Xian, Guangzhou and Beijing. The response of CHPI to mortgage rate shocks increases to 0.3 percent in about two quarters, after which it trails off with a downward trend to its long-run equilibrium level in another three quarters, and decreases to below negative 0.1 percent in Kunming, Xian, Beijing, Qingdao and Nanjing; decreasing to negative one percent in Guangzhou, Qingdao and Nanjing by the sixth quarter. The response of CHPI to mortgage rate shocks is longer in Urumqi, Qingdao and Nanjing (11 quarters). The response of CHPI to mortgage rates vanishes completely by the 12th quarter in all six cities. The impulse response function results indicate that there is only a short-term (about two quarters) impact from mortgage rate shocks to CHPI in Kunming, Xian, Guangzhou and Beijing, which reveals that the change in mortgage rates will only influence the house prices of these four cities in the short-run. The impact of the standard deviation of the mortgage rates to house prices is longer in Urumqi, Qingdao and Nanjing, and is 11 quarters.
6.2.9 Variance Decomposition

The analysis of the forecast error variance decompositions, dissects the relative strengths of various shocks, to the innovations of house prices in China. The variance decomposition measures the relative importance of the fluctuation of Chinese house price indices in the macroeconomic fundamental variables. The forecast error decomposition is the percentage of the variance of the error obtained from the forecasting variables, due to a specific shock in a given horizon (Stock & Watson, 2001). Table 6.8 reports the variance decomposition of the Chinese house price index covering 12 quarters. The second column in Table 6.8 shows the forecast errors of the variable for each forecast horizon. The remaining columns present the percentages of the variances that are due to the shocks of the variables (with each row adding up to 100).

Table 6.8 Variance Decomposition (CHPI)

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<th>Period</th>
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Source: Author’s calculations

The results show that in the short-run (4 quarters), the innovations in the previous house price index account for around 80 percent variance of the fluctuation in CHPI (own shock) in all six cities (Kunming, Xian, Urumqi, Guangzhou, Changchun and Beijing), which is caused by its own shock in the short-run. In the long-run (12 quarters), the shock to CHPI contributes to the fluctuations in the CHPI, which decreases from 100 percent to 54 percent in Kunming, 61 percent in Urumqi, 52 percent in Guangzhou and 46 percent in Nanjing. This means that in all six cities the fluctuations of CHPI are no longer solely caused by its own shock. Inflation (CPI) and income could also be dominant factors that cause fluctuations in the CHPI; such as the shock to CPI increases fluctuation in CHPI by 41 percent in Kunming and 39 percent in Nanjing. The shock to income contributes 34 percent fluctuation in the variance in CHPI in Guangzhou.
Chapter 7
Conclusion and Policy Implication

7.0 Introduction

This chapter presents a summary of the thesis findings, including discussion of the empirical results. Section 7.1 summarizes the main empirical results of the research. Section 7.2 discusses the policy implications from the research findings. Section 7.3 discusses the contributions of the study. Section 7.4 identifies limitations of the study and makes suggestions for future research.

7.1 Summary and Main Empirical Findings

Over the past two decades, house prices have risen rapidly in China. From 2003 to 2007, the house price growth rate in China has reached as high as 14 percent annually on average, among the major cities. The first tier cities such as Beijing have exhibited a 22 percent annual price growth rate (Ren, Xiong & Yuan, 2012). The fast growth of Chinese house prices signals the possible existence of house price bubbles. Housing market bubbles also became a major concern for policymakers, as housing bubble busts would have serious consequences for China’s economy (Ren, Xiong & Yuan, 2012). The house asset constitutes the largest single source of a household’s wealth in China. By the end of 2009, the total market value of China’s residential house market had reached 91.5 trillion RMB, occupying about three times China’s GDP (Zhang, Hua & Zhao, 2012).

The main objective of this current study is to investigate whether a house price bubble exists in China’s housing market and to identify the size of the housing bubble. This study uses several methods, such as price-to-income ratio, VAR and VECM models to investigate any housing bubbles in China’s housing market. Further, the VAR and VECM models are used to estimate the short-run and long-run relationships between the macroeconomic fundamental variables (inflation, disposable income and mortgage rates) and the house price indices of the eight Chinese cities (Kunming, Xian, Urumqi, Guangzhou, Changchun, Beijing, Qingdao and Nanjing). This study estimates the housing market separately among the eight cities because of differences in culture, economic development and infrastructure among the cities. For example, Peng, Tam and Yiu’s (2005) study reveals that land price is a significant variable in explaining differences in property prices across most of China’s provinces. The study found that the effects of land prices on property prices are much larger in coastal cities than in other parts of the country. For example, the estimated coefficients suggest that the elasticity of property prices with respect to land prices in China’s coastal cities (e.g. Hangzhou) is more than twice
that of the interior cities (e.g. Xian). With large regional differences in China, it is likely that housing reform is carried out differently across cities, which may lead to different patterns of housing behaviour (Huang, 2004). By testing eight cities separately, this current study allows the house prices and the macroeconomic fundamental variables to vary across the different cities.

In this current study, three macroeconomic fundamental variables are used in the VAR and VECM models, namely, income, mortgage rates and inflation. The scope of this current study focuses on eight Chinese cities (Kunming, Xian, Urumqi, Guangzhou, Changchun, Beijing, Qingdao and Nanjing) from three different house price growth rate groups, and covers three tiers of Chinese cities. The tier levels of the eight Chinese cities are differentiated by their GDP level and population size based on Jone Lang LaSalle’s (2009) report. The main findings of this current study are discussed as below.

First, the price-to-income ratio is calculated based on equation (5.1), and compared to a benchmark index of “11” for the period 2002 to 2012. The results show the price-to-income ratio of Beijing and Guangzhou are above the benchmark indices for the period 2006 to 2012. Other cities exhibited below the benchmark index (Changchun, Qingdao, Nanjing, Kunming, Xian and Urumqi) for the same period. Thus, there are signs of house price bubbles in Beijing and Guangzhou for the period 2006 to 2012. As discussed in chapters five and six, Chinese people obtain a large amount of unreported income, making a direct comparison of the price-to-income ratio for investigating the housing bubble is inconclusive; meaning that income should not be the sole determinants for testing housing bubbles particularly in China’s housing market. This current study uses other econometric techniques to test if the macroeconomic fundamental variables have any influence on house prices and if housing bubbles prevail in China’s housing market.

Second, the study examines the effect of the macroeconomic fundamental variables on the house price index in China’s housing market. Prior to estimating regression with time series data, this current study examined the integration properties of the data using the ADF test to eliminate the spurious regression problem. The test results show that all the variables are non-stationary in levels, but are stationary in their first differences or are integrated of order one. Next the VAR and VECM models were applied to test the short-run relationship between the three macroeconomic fundamental variables (inflation, income and mortgage rates) and house price indices in eight Chinese cities from 1999:Q1 to 2013:Q4. Table 7.1 shows a summary of the short-run estimated coefficients of inflation, income and mortgage rates from the VAR and VECM models.

| Table 7.1 Summary Results of Inflation, Income and Mortgage Rate Effects on the CHPI (Short-run) |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Model                          | Kunming         | Xian            | Urumqi          | Guangzhou       | Changchun       | Beijing         | Qingdao         | Nanjing         |
| Inflation                      | (+)             | (+)*            | (+)             | (-)             | (+)**           | (-)             | (+)**           | (-)             |
The results in Table 7.1 show that Chinese house prices are not sensitive to changes in macroeconomic fundamental variables in the short-run, since most of the macroeconomic fundamental variables are statistically insignificant to the house price indices. However, the results confirm that the Chinese housing market has regional specifics. The inflation, income and mortgage rates coefficients are region specific and affect the house price indices differently among the eight cities. The inflation coefficients are positive and statistically significant in Xian, Changchun and Qingdao. The results imply that higher inflation increased house price indices in the three cities. Income exhibits an insignificant relationship with the house price index among the eight cities. The result implies that the magnitude that income influences on house prices is relatively small in China. Income is not a major determinant for housing demand in the short-run, due to the large disparity between house price growth and income growth. It is very difficult for individuals to accumulate enough income (savings) to purchase a house in China (Deng, Shen & Wang, 2011). In the short-run, the mortgage rate coefficients exhibit a significant and positive relationship with the house price index of Kunming.

Third, the VECM model is used to test the long-run relationship between the three macroeconomic fundamental variables and house price indices of the eight Chinese cities from 1999:Q1 to 2013:Q4. However, the Johansen and Juselius (1990) co-integration tests showed no co-integration relationships between the macroeconomic fundamental variables and house price indices in Qingdao and Nanjing, therefore the VECM model does not apply between these two cities. The VECM model is used to test the long-run relationship between the macroeconomic fundamental variables and house price indices in Kunming, Xian, Urumqi, Guangzhou, Changchun and Beijing. The restricted VECM model is jointly estimated against the unrestricted VECM model to test for the weak exogeneity on income, mortgage rates and inflation. The results reject the weak exogeneity in Kunming, Urumqi, Guangzhou, Changchun and Beijing, but support weak exogeneity in Xian. Thus, this current study retained the restricted VECM model for Xian and the unrestricted VECM model for the other five cities.

Table 7.2 Summary Results of Inflation, Income and Mortgage Rates Effects on the CHPI (long-run)

<table>
<thead>
<tr>
<th>Model</th>
<th>Kunming</th>
<th>Xian</th>
<th>Urumqi</th>
<th>Guangzhou</th>
<th>Changchun</th>
<th>Beijing</th>
</tr>
</thead>
<tbody>
<tr>
<td>VECM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>(+)**</td>
<td>(-)</td>
<td>(-)</td>
<td>(-)**</td>
<td>(-)**</td>
<td>(-)**</td>
</tr>
<tr>
<td>Income</td>
<td>(+)**</td>
<td>(+)*</td>
<td>(+)</td>
<td>(+)**</td>
<td>(+)*</td>
<td>(+)**</td>
</tr>
<tr>
<td>Mortgage Rate</td>
<td>(-)</td>
<td>(+)</td>
<td>(+)**</td>
<td>(+)**</td>
<td>(+)**</td>
<td>(+)**</td>
</tr>
</tbody>
</table>

Note: * statistically significant at 0.1 level, ** statistically significant at 0.05 level, *** statistically significant at 0.01 level.
The results in Table 7.2 show house prices in China’s housing markets are more sensitive to the changes in macroeconomic fundamental variables in the long-run. The inflation coefficient is positive and significantly increases the house price index in Kunming, and significantly decreases the house price indices in Guangzhou, Changchun and Beijing. Inflation is a region-specific variable, whereby the variations in the inflation coefficients are different with regional markets (Wang & Liu, 2007). The rise in inflation does not only increases the nominal interest rate, but also increases the construction raw material costs. Thus, increase in inflation pushes up the costs of real estate projects, rise in house prices and lower the housing demand in the long-run. Land price appreciation is another major factor that significantly influences the house prices in China (Yu, 2010). However, there is heterogeneity in the land price growth across markets. For example, Beijing and Guangzhou experienced land price annual growth rate above 20 percent in 2011 and the annual land price growth rate of Kunming is less than 10% for the same period (Deng, Gyourko & Wu, 2012). The inflation rise the costs of housing supply, however, the lower land price could maintain the house prices at a lower level compare with cities have fast land price growth rates. Thus, the demand for housing can still remain high in the long-run. The estimated income coefficients positively influence the house price indices in six cities. The relationships between income and house price indices are statistically significant in Kunming, Guangzhou, Changchun and Beijing but insignificant in Urumqi. The mortgage rate coefficient is positive and significantly influences the house price indices in Urumqi, Guangzhou, Changchun and Beijing. The mortgage rate has been one of the dominant tool used by the Chinese central government to stabilise the house price boom. For example, the average house price rose by 12.4 percent in 70 Chinese cities during the period of 2009 to 2011 (Yurichuk, 2011). The Chinese government increases the mortgage rate from 5.94 percent to 7.05 percent from the first quarter of 2009 to the first quarter of 2012 to cool down the housing market (Bank of China, 2012). Thus, an increase in the mortgage rate represents an underlying strong demand for housing because both homebuyers and investors expect house prices to rise further in the future. Furthermore, with China’s increasing urbanisation rate and continue population growth, housing demand will continue to increase in most Chinese cities. Therefore, the irrational behaviour of Chinese homebuyers (for investment purposes) and increasing in housing demand simultaneously increases in mortgages and house prices in China (Wang & Liu 2007).

Fourth, the estimated coefficients from the VECM model are inserted into equation (5.9) to calculate the long-run equilibrium house price indices of Kunming, Xian, Urumqi, Guangzhou, Changchun and Beijing. The presence of a housing bubble can be determined by comparing the deviation between the equilibrium house price indices and the actual house price indices. This current study used a 22 percent deviation of house price index from its long-run equilibrium price as a benchmark to test for the presence of housing bubbles in China’s housing market. The larger the deviation, the bigger the
bubbles (Blanchard and Watson, 1982). This current study’s results show no evidence of house price bubbles in six Chinese cities (Kunming, Xian, Urumqi, Guangzhou, Changchun and Beijing). Unlike housing crises that took place in developed countries (e.g. U.S. subprime crisis in 2007), China’s housing market is still less leveraged. For example, Chinese banks required a 30 percent down-payment for mortgage loans. This high down-payment substantially alleviates the household default risk and makes credit expansion to households an unlikely cause of Chinese house price bubbles. Furthermore, most Chinese banks are state owned. Thus, the government policies aimed at deflating a housing bubble are more effective in China than in developed countries (such as in Japan and the U.S.).

The impulse response function figures show that the CHPI responds similarly to its own shock in all eight cities, and that current changes in housing prices do affect people’s expectations in the short-term in the eight cities. The increase in disposable income has a positive effect on house prices in six cities, but the impact from the shock of the income to house price index is relatively small. The response of the house price index to disposable income shock in Changchun and Qingdao appears to be insignificant. The CHPI response is similar to the inflation (CPI) shock in Kunming, Xian and Urumqi, which fluctuated between zero and 0.5 percent. The response of CHPI to CPI shock fluctuated from zero to 1.5 percent in Beijing, Guangzhou, Qingdao and Nanjing. The response of CHPI to CPI did not last long and the effects vanished completely in all eight cities by the 12th quarter. The impulse response function results indicate a short-term impact (two quarters) from the mortgage rate shock to CHPI in Kunming, Xian, Guangzhou and Beijing. The impact of the standard deviation of the mortgage rates to house prices is longer in Urumqi, Qingdao and Nanjing (11 quarters).

The variance decomposition results show that the fluctuations in CHPI are mainly caused by its own shocks in all eight cities (Kunming, Xian, Urumqi, Guangzhou, Changchun, Beijjng, Qingdao and Nanjing) in the short-run (4 quarters). In the long-run (12 quarters), the fluctuations in CHPI are no longer solely caused by its own shock in eight cities. CPI and income could also be the dominant factors that cause the fluctuations in CHPI. For example, the shock to inflation (CPI) increases the fluctuations in CHPI by 41 percent in Kunming and the shock to income contributes 34 percent of the fluctuation in the variance in the CHPI in Guangzhou.

Fifth, the error correction term of the VECM model shows the speed of the market house price index adjustment back to economic equilibrium price (Adam & Fuss, 2010). In this current study, the efficiency of the Chinese housing market is analysed by observing the speed of adjustment factors obtained from the VECM estimated results (equation 5.8). The results show the speed of adjustments are -0.509 for Kunming, -0.383 for Xian; -0.473 for Urumqi, -0.083 for Guangzhou, -0.476 for Changchun and -0.270 for Beijing. The results imply that the housing markets are efficient in Kunming, Xian, Urumqi, Changchun and Beijing but inefficient in Guangzhou.
7.2 Policy Implications

The Chinese government has used various policy tools to control house prices, such as larger down payments and higher mortgage interest rates to control the demand for houses. This current study identified several policy implications relevant to policy-makers based on the study findings for maintaining a balanced and sustainable housing market.

First, this current study’s results show the house price indices respond differently to the changes in the macroeconomic fundamental variables in the eight Chinese cities. For example, the study’s results show inflation is positively and significantly related to house price indices of Xian, Changchun and Qingdao. However, the inflation coefficient is negative but insignificant in explaining house prices in Guangzhou, Beijing and Nanjing. This implies the Chinese housing market has regional differences. However, since 1999, the Chinese central government has announced many unified housing market policies in order to maintain a stable housing market. Under these unified housing policies, the central government heavily regulated interest rates, heavily regulated the state-influenced credit allocation, and frequently adjusted the reserve requirement to regulate the Chinese housing market (Huang & Wang, 2011). For example, in April 2010, the central government increased the down-payment requirement on a first home larger than 90 square metres to 30 percent from 20 percent, and increased the down-payment requirement on a second home to 50 percent from 40 percent. The policy aims to curb the rapid growing housing market. However, this housing market policy did not apply well to all Chinese cities. The house prices of some central and western cities (e.g. Kunming and Xian) were low and affordable. For example, in 2010, the price-to-income ratio of Beijing was 17.70 which is much higher than the benchmark value (11), and indicates that housing affordability is low in Beijing. However, in the same period, the price-to-income ratio was only 6.36 in Kunming which is much less than the benchmark value (11).

This current study’s results suggest that the regulatory policies for the housing market in China should be more decentralised, and that local governments should have more freedom to adjust the housing policies to adapt them better to the local housing market environment. This finding is consistent with previous studies such as Yang et al. (2010) which measured the effects of monetary policy on regional house prices in Sweden from 1991 to 2002. The authors’ results show significant effects of the regional monetary policy on the Swiss housing market. Fratantoni and Schuh (2003) studied the effects of monetary policy in the U.S. for the period 1966 to 1998. The study reported the response of housing investment to monetary policy varies by region.

Second, the high price-to-income ratios show that housing affordability is low in Beijing and Guangzhou (first tier cities). The price-to-income ratios in Beijing and Guangzhou from 2006 to 2012 are higher than the benchmark value (11). For example, the highest price-to-income ratio is 17.70 in Beijing in
2010. The large price-to-income ratio suggests the possibility of a housing bubble. Policymakers should monitor closely the movements of the house price indices, and also the buying and selling activities in Beijing and Guangzhou.

Third, the VECM results indicate that the housing market in Guangzhou is not efficient due to the slow adjustment towards market equilibrium price. Case and Shiller (1989) explain that the inefficiency of the housing market is due to the illiquidity characteristic caused by the high transaction costs. Financial institutions and banks can increase homebuyers’ liquidity and reduce housing transaction costs, by introducing the electronic trading system to the housing market, which is similar to the stock market. The transaction costs of purchasing a house can be reduced by using the internet to list and search for a house, avoiding traditional real estate agents’ costs (Fletcher, 1997c). For example, according to IBIS World (2015) report, there are about 36,790 real estate agents nationwide, which employed 464,327 workers. Over the five years through 2014, the real estate agents in China made about U.S. $18.2 billion in revenue and the annual growth rate is 2.4 percent. These real estate agencies charge one percent to three percent of the traded house price as commission.

Furthermore, the source fund for real estate developers can be diversified and therefore reduce the reliance on the Chinese banking system. For example, real estate investment trusts (REIT) can be introduced to real estate developers. A REIT is similar to mutual funds that invests in stocks (Liu, 2014), and which can help real estate developers create liquidity by unlocking their capital that is tied up in the properties they hold, and the redeploy the capital to other high-yielding investments. The real estate electronic trading system and the real estate investment trust increase market liquidity and improve the financial stability in the Chinese financial market. These initiatives can also increase transparency of information to housing market players and policymakers, which can lead to higher efficiency in China’s housing market.

7.3 Contributions of the study

The findings of the VECM model show no house price bubble exists in six Chinese housing markets (Kunming, Xian, Urumqi, Guangzhou, Changchun and Beijing). It is worth noting that the macroeconomic fundamental variables can significantly capture any house price bubble. This current study’s results are important for economists, homebuyers, and banks and financial institutions in China.

First, the use of the price-to-income ratio and the VECM model to investigate the existence of housing bubbles in the Chinese housing markets, differentiate this current study from previous studies which use only the ordinary least squares model (OLS) and the price-to-income ratio technique. For example, Chung and Kim (2004) applied the ordinary least squares regression (OLS) to test the relationships
between house prices and macroeconomic fundamental variables (GDP and land prices) and the expected house prices, for the period 2000 to 2009 in South Korea. The authors’ result shows that land prices and expected house prices significantly and positively influence house prices in South Korea. However, their OLS model fails to capture the long-run effects of each of the variables on South Korea’s house price index (Hill, Griffiths & Lim, 2011). The OLS method also lacks the ability to indicate the economic equilibrium relationship and the speed of the adjustment, until the equilibrium is reached. Shen (2012) used the price-to-permanent income ratio to test the housing affordability in China for the period 2006 to 2010. The author found that the Chinese housing affordable rate closely resembled those of developed economies, such as Australia, New Zealand and the U.K. The study also reports that Chinese housing is still affordable compared to New Zealand and Australia, as the price-to-permanent-income ratio is 0.21 in Australia, 0.26 in New Zealand and 0.097 in China. The price-to-income ratio approach fails to determine the relationships between house prices and other macroeconomic fundamental variables (e.g. inflation, GDP and mortgage rates) (Cameron et al., 2006). In addition, unreported income can cause the price-to-income ratio to overstate the share of income in housing, and lead to biased results. According to Credit Suisse’s (2010) research, unreported income in China amounts to 30 percent of the country’s GDP.

This current study applied the price-to-income ratio approach and the VAR and VECM models, to test for the existence of house price bubbles, as well as to identify the size of any bubbles. This study provides an improved result compared to the previous studies discussed above. The estimated results help economists, homebuyers, banks and financial institutions to understand the existence of regional housing market bubbles and to clarify the size of any bubble in three different tier levels of Chinese cities. This current study’s results also identify the macroeconomic factors that influence house prices in the short-run and the long-run. Such information could help housing market players to adjust their expectations about house prices, and balance housing demand with housing supply. Furthermore, the long equilibrium prices which are calculated by the long-run equilibrium coefficients of the VECM model, can be used by the housing authorities and local government officers to monitor the future house price movements in China. The deviation (gap) between real house prices and long-run equilibrium house prices can give an early warning indicator to government officers, house-sellers, and house-buyers, of an over-booming housing market.

Second, the study results show that most of the short-term macroeconomic fundamental variables have no significant influence on house prices. The results suggest that Chinese homebuyers did not consider inflation, mortgage rates and income in their purchase decisions in the short-term. The Chinese central bank should focus on the middle-term and long-term interest rates to stabilize house prices in China during housing price boom periods. Long-term mortgage rates significantly influence house prices, which implies that Chinese homebuyers’ borrowing decisions are influenced by medium-
term and longer-term mortgage rates. The banks and financial institutions can use this information when designing mortgage financing packages for homebuyers.

Third, this current study’s results show the significant long-run relationships between the macroeconomic fundamental variables and China’s house prices. Such information could enable homebuyers to make rational house purchasing decisions. “Rational” implies homebuyers use the available information to estimate future events or future economic conditions (Muth, 1960). For banks and financial institutions, the rational decisions of their customers could potentially reduce the mortgage loan default rate, and decrease their over-exposure to the real estate sector. Furthermore, the housing market would become more efficient with rational investment behaviour from homebuyers. In addition, it would be less possible to earn excess investment profits from an efficient housing market (Malpezzi & Wachter, 2002). Thus, speculation in the Chinese housing market would be reduced.

7.4 Limitations and Suggestions for Future Research

The following section discusses the limitations of this research and offers suggestions for future research.

First, the duration of this current study is from 1999:Q1 to 2013:Q4 (15 years), but a suggested complete real estate cycle is about 18 years: seven years slow increase (recovery from last recession); five years rapid increase; winner’s curse (2 years of madness increases in house prices); and four years collapse in the housing market (Harrison, 2005; Chen, Gan, Hu & Cohen, 2013). However, the liberalization of the Chinese housing market to a private market with competitive bidding pricing of properties only started in 1998. Before 1998, private housing was treated as a social asset in China, produced, allocated and administrated by the state through work units. The short data duration is not long enough to capture house price movements in a complete real estate cycle. Effectively, the available time series is one of a boom period in the Chinese real estate cycle (Wu, Gyourko & Deng, 2010).

Second, this current study applied the Choleski decomposition method to investigate the effectiveness of the macroeconomic fundamental variables on the house price index, due to the innovation on the error term. However, innovation does require an ordering of the variables in the Choleski decomposition, but the ordering is not likely to be important if the correlation coefficients among the residuals are low. It is improbable that all correlations will be small in the VAR model. In some instances, innovation derived based on the Choleski decomposition method, is not a reasonable interpretation of the related economics relationships (Ender, 2010).
Third, this current study did not consider the effects of psychological variables in the house price bubble model. According to Keynes and Shiller theory (see Chapter Three), housing bubbles are fundamentally influenced by psychological factors, such as whether a buyer’s expectations are optimistic or pessimistic about the future direction of house prices. If homebuyers emotionally believe that house prices will continue to rise, then they will be willing to spend even more, and this drives house prices higher (Shiller, 2004). Shiller’s (2004) study explains that once homebuyers form a speculative expectation on house prices in one city, then this expectation tends to spread to other cities, creating a contagious effect in the housing market. This is consistent with Case and Shiller’s (2003) study which shows positive relationships between housing bubbles and consumer psychological factors. The study discovered a housing bubble occurs when there is a sharp rise in housing prices and an expectation of future house price rises, which attracts new buyers (generally speculators) who are more interested in profits from trading than living in the house (Sun & Zhang, 2008). Roehner’s (1999) study also found that this speculative behaviour results in an increase in house prices in Paris.

Future research should consider to study Chinese behaviour and attitudes such as herding behaviour toward housing purchase since the economic fundamentals yield inconclusive results. Herding behaviour is a psychological variable that can potentially explain the fluctuation of Chinese housing market. Herding behaviour refers to the investors’ irrational behaviour under the influence of other investors’ behaviour, imitating others’ decision, or excessive relying on public opinions without considering their own information (Wang, 2013). Wang’s (2013) study applied the Generalised Capital Asset Pricing Model to measure the herding behaviour in Chinese housing market for the period of 2002 to 2011. The study found herding behaviour exists in Chinese housing market and influences the housing price fluctuation.

7.4.1 Recommendations for Future Research

The qualitative data of homebuyers’ behavioural and psychological factors can be examined in future housing bubble studies. These factors are directly related to homebuyers’ expectations on future house price growth rates, and homebuyers’ expectations on price increases, which is one of the factors that causes housing bubbles. Furthermore, an analysis of the causality relationship between house prices and stock prices would be useful to better understand the household’s investment decisions, as the housing and stock markets are the two major investment vehicles for Chinese people.

Future studies could include more macroeconomic fundamental variables in the empirical model, such as short-term factors (international hot money), institutional factors (tax policy) and long-term factors (regional economic growth) (Berry & Dalton, 2004). Furthermore, it would be interesting to apply the method and framework used in this study to other housing markets, which exhibit similar economic and housing market development characteristics, such as Hong Kong and Taiwan. The cross regional
research between these cities could further enhance understanding of the behaviour of house prices and bubbles in the region.

The spill-over effects could be estimated in a future study, which means that there is the possibility that house prices within the same potential contagion region could be co-integrated together. Costello, Fraser and Groenewold (2011) suggest that actual house prices often do not reflect the macroeconomic fundamental determinants; their study explored the spill-over effects of speculative activity in six Australian states. Their results show that New South Wales is relatively more susceptible to spill-over transmitted from other states, and that Western Australia is the most isolated from the other states of the country. Spill-over effects may exist in China due to housing purchase restrictions for high price regions, which may stimulate the flow of cash from rich regions to poor regions (Riddle, 2011). Shih, Li and Qin’s (2014) study found that Beijing and Shanghai are contagion regions, and that house prices in these two cities can exogenously influence the house price long-term equilibrium systems of neighbouring provinces.
### A.1 Error Correction Model and VAR Model Results (Eight cities)

<table>
<thead>
<tr>
<th>Method</th>
<th>Kunming</th>
<th>Xian</th>
<th>Urumqi</th>
<th>Guangzhou</th>
<th>Changchun</th>
<th>Beijing</th>
<th>Qingdao</th>
<th>Nanjing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient (t-ratio)</td>
<td>Coefficient (t-ratio)</td>
<td>Coefficient (t-ratio)</td>
<td>Coefficient (t-ratio)</td>
<td>Coefficient (t-ratio)</td>
<td>Coefficient (t-ratio)</td>
<td>Coefficient (t-ratio)</td>
<td>Coefficient (t-ratio)</td>
</tr>
<tr>
<td>Error correction</td>
<td>-0.5087 (-4.947)***</td>
<td>-0.3830 (-4.709)***</td>
<td>-0.4728 (-4.681)***</td>
<td>-0.0834 (-2.305)**</td>
<td>-0.4763 (-4.654)***</td>
<td>-0.2702 (-4.283)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCPI(-1)</td>
<td>0.0249 (0.260)</td>
<td>0.2016 (1.777)*</td>
<td>0.0400 (0.249)</td>
<td>-0.0785 (-0.326)</td>
<td>0.6764 (3.371)***</td>
<td>-0.1892 (-0.665)</td>
<td>0.5671 (2.569)**</td>
<td>-0.1084 (-0.392)</td>
</tr>
<tr>
<td>DINCOME(-1)</td>
<td>-0.0007 (-1.019)</td>
<td>-0.0003 (-0.582)</td>
<td>0.0003 (0.234)</td>
<td>0.0003 (0.091)</td>
<td>-0.0023 (-0.926)</td>
<td>0.0002 (0.189)</td>
<td>-0.0009 (-0.626)</td>
<td>0.0002 (0.388)</td>
</tr>
<tr>
<td>DMORTGAGE RATE(-1)</td>
<td>1.073 (1.90)**</td>
<td>0.2502 (0.419)</td>
<td>1.3051 (1.208)</td>
<td>1.3911 (1.297)</td>
<td>1.6879 (1.538)</td>
<td>0.4725 (0.402)</td>
<td>-0.0015 (-0.001)</td>
<td>0.1149 (0.099)</td>
</tr>
<tr>
<td>C</td>
<td>0.0617 (0.284)</td>
<td>0.0324 (0.164)</td>
<td>0.1232 (0.392)</td>
<td>0.4417 (1.251)</td>
<td>0.3842 (0.825)</td>
<td>0.0248 (0.062)</td>
<td>0.2142 (0.494)</td>
<td>0.1134 (0.304)</td>
</tr>
</tbody>
</table>

Note: *statistically significant at the 0.1 level of significance
** statistically significant at the 0.05 level of significance
***statistically significant at the 0.01 level of significance
### A.2 Co-integration Model Results (Six Cities)

<table>
<thead>
<tr>
<th></th>
<th>Kunming</th>
<th>Xian</th>
<th>Urumqi</th>
<th>Guangzhou</th>
<th>Changchun</th>
<th>Beijing</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI(-1)</td>
<td>Coefficient</td>
<td>t-ratio</td>
<td>Coefficient</td>
<td>t-ratio</td>
<td>Coefficient</td>
<td>t-ratio</td>
</tr>
<tr>
<td></td>
<td>0.3801</td>
<td>2.350**</td>
<td>-0.0237</td>
<td>-0.078</td>
<td>-0.1030</td>
<td>-0.305</td>
</tr>
<tr>
<td>INCOME(-1)</td>
<td>0.0007</td>
<td>1.993**</td>
<td>0.0007</td>
<td>1.703*</td>
<td>0.0009</td>
<td>1.459</td>
</tr>
<tr>
<td>MORTGAGE RATE(-1)</td>
<td>-0.9460</td>
<td>-1.267</td>
<td>1.3511</td>
<td>1.231</td>
<td>3.8374</td>
<td>2.680***</td>
</tr>
<tr>
<td>C</td>
<td>66.9754</td>
<td>95.2818</td>
<td>87.1269</td>
<td>451.3146</td>
<td>235.0507</td>
<td>331.6638</td>
</tr>
</tbody>
</table>

Note: *statistically significant at the 0.1 level of significance  
** statistically significant at the 0.05 level of significance  
***statistically significant at the 0.01 level of significance
A.3 Impulse Response Functions of Eight Cities

**Kunming**

- Response of CHPI to CHPI
- Response of CHPI to CPI
- Response of CHPI to INCOME
- Response of CHPI to MORTGAGE

**Xian**

- Response of CHPI to CHPI
- Response of CHPI to CPI
- Response of CHPI to INCOME
- Response of CHPI to MORTGAGE

**Urumqi**

- Response of CHPI to CHPI
- Response of CHPI to CPI
- Response of CHPI to INCOME
- Response of CHPI to MORTGAGE
References


Gu, Y. (2005), “China’s Real Estate Market in Rapid Development”, *China Real Estate Association,* memo


