House Price Dynamics and Property Bubble Analysis in Australia and China

JingJing (Justine) Wang

A Thesis Submitted in Fulfilment of the Requirements for the Degree of Doctor of Philosophy (PhD)

Macquarie Graduate School of Management
Macquarie University
Sydney, Australia
June 2017

ABSTRACT

Research questions

This research presents empirical evidence regarding house price dynamics and the risk of housing bubbles within the Australian and Chinese housing markets. Specifically, it explores the spillover effects which affect house prices and the risk of housing bubbles in both contexts. Additionally, it offers empirical evidence of regional house prices dynamics, citing the various influences of macroeconomic factors and ripple effects on house prices in Australia's four largest cities (Sydney, Melbourne, Brisbane and Perth). Finally, the research offers a unique exploration of the macroeconomic impacts on house prices in the five first-tier cities and top eight second-tier cities in China, as well as explaining the spillover effects from house prices between major cities in both these major segments of the housing market in China.

Econometric techniques

Using a broad range of house price indexes and various macroeconomic data for the period from 1995Q4 to 2015Q3 in Australia and the period from Q22007 to Q32015 in China, a combination of advanced time series methods was employed to perform econometric estimates. These methods included Ordinary Least Squares (OLS), principal components technique, Vector Error Correction Model (VECM), Johansen co-integration, variance decomposition, generalised impulse response and the Granger causality test.

Findings

The thesis suggests Australian house prices are driven by four key factors: mortgage interest rates (IR), consumer sentiment (CS), the Australian S&P/ASX 200 stock market index (AUSHARE), and unemployment rate (UNEMPLOY). These four key drivers are found to exhibit long-term relationships with house prices, such that short-term disequilibria are always corrected by economic forces; thus, no bubbles are identified in Australia (see Chapter 8). Similarly, in the Chinese context, short-term disequilibria are always corrected by economic forces to achieve a balanced house price equilibrium, leading to the conclusion that there is no housing bubble in China either (see Chapter 7).

Both countries' housing price performance react strongly to mortgage interest rates and share market performance, reflecting both the importance of house financing and the close relationship between the share market and the real estate market. Moreover, a further main driver of Chinese house prices was determined to be GDP performance. Heterogeneity in terms of the relationship between house prices and macroeconomic variables was identified.

Turning attention to the spillover effects between China house prices and Australian house prices, the reported finding suggests the house price in China Granger causes Australian house prices; however, this is not significant. The finding suggested that Chinese buyers' large purchase activities were not drivers of Australian house prices during the most recent housing boom. Furthermore, the general impulse response test suggests that Australian house prices had a significant positive impact on China's house prices over the 10 quarters tested. This result is further confirmed by the variance decomposition test.

The results may relate to the close business relationships between the Australian and Chinese economy, resulting from the attractive educational opportunities in Australia and the appeal of Australian properties, combined with Chinese people's growing purchasing power. No effects between the two countries' house prices were noted, since house prices in China and Australia have no long term history of co-integration.

The next key finding was that Sydney is the dominant source responsible for causing a spillover in house prices in Australia's four largest cities. This means that changes in house prices in Sydney result in contagious spillover outcomes that impact impacting the house prices in the other three major cities, due to the mechanisms for transmission of information. Sydney is also the main driver of Australian house prices nationally. The Melbourne house price is largely influenced by contagious spillover effects from other regions. Moreover, as short term disequilibria always self-correct, the empirical results offer evidence that long-run relationships exist between macroeconomic variables and house prices in all of the big four cities. However, heterogeneity was found in terms of macroeconomic effect on the four target cities' house prices.

Finally, with regard to China, the empirical findings reveal that house prices in the top eight second-tier cities cause first tier house price movements over the short term, while first-tier cities such as Beijing and Shanghai, and second - tier city Chongqing, function as a source of spillovers. Spillover effects occur among all of the target cities in China, due to the co-integration between house prices in China's major cities, in both its first tier and second - tier housing markets.

AUTHOR DECLARATION

The work presented in this thesis was carried out in the Macquarie Graduate School of Management at Macquarie University and is wholly my own. No part of the thesis has been submitted for any other degree or to any other university or institution.

The sources of information used in this thesis is from reputable data providers such as ABS, RBA, CoreLogic, US trading economics website and China CitiRE property database. Both primary and secondary data have been utilised to conduct the analysis and empirical estimates. Ethics Committee approval is not applicable in this thesis.

The views expressed in this thesis are those of the author and not of the Macquarie University.

Signed: Date:

ACKNOWLEDGEMENTS

I would like to thank my Principal Supervisor Professor John S. Croucher, Associate Supervisor Dr Alla Koblyakova, the late Professor Tom Valentine and Professor Piyush Tiwari for their suggestions, directions and patience.

I would also like to thank my family, friends and those who share common interests with me. Their support and encouragement have been my strong motivation in completing this thesis. Assistance from the senior academics from Macquarie Graduate School of Management, my industry alliances Mortgage Finance Association of Australia (MFAA) , CoreLogic and SIRCA are gratefully acknowledged.

CONTENTS

PAGE

LIST OF TABLES

PAGE

LIST OF FIGURES

PAGE

CHAPTER 1
INTRODUCTION

1.1 Outline of the thesis

In national terms, housing markets play a crucial role in the wider economy. Due to the significance of the housing market to a household's wealth portfolio, house price cycles can have a substantial influence on the economy overall and vice versa. Clearly, then, the mortgage market which functions to facilitate the purchase of property is crucial to the operation of the housing market and other inter related markets. Associated with this, given that the majority of Chinese and Australian property owners hold mortgage debt, the operation of monetary policy has important implications for the affordability of housing, through its effect on the mortgage market.

Fundamental structural changes took place in 1998 in the China real estate market, replacing the welfare housing distribution system with an openly traded real estate market. This transformation acted to enhance competitiveness and efficiency in terms of house market performance, which in turn resulted in a boom occurring between 2003 and 2013. This period is known as the "golden age" of China's prosperity, as measured by the performance of house prices. However, this position became unsustainable after the country entered into the economic period of "new normal" (2014 onwards), with the consequence that house price growth has slowed and the real estate market in general has become sluggish. Thus, these changes in the Chinese housing market from 1998 to 2015 suggest an opportunity and value in studying house price dynamics in China.

Meanwhile, the Australian housing market has several unique features, including: I) a very constricted land supply and extremely onerous planning approval processes; 2) income tax relief through negative gearing; 3) only recourse loans; and 4) a heavily urbanised population. Over the last 30 years, Australian house prices have risen 7.15% annually on average, and 7% annually during the inflation-targeting period (Kohler and Merwe, 2015); additionally, property investment has expanded, and housing has passed through three cycles of peaks and troughs (Harley, 2016). During the most recent housing boom from 2012 to 2015, prices soared. Hence, it is beneficial to understand house price dynamics in Australia in depth.

In recognising the importance of house price dynamics, the objective of this thesis is to investigate not only the spillover effects on house prices in China and Australia, but also to analyse the long term relationship between house prices and the macro-economy. Understanding the underlying forces driving house price movements can deliver insight into the conditions of both housing demand and supply, along with associated macroeconomic functions. Understanding the spillover effects among the key regional cities will contribute largely to the regional resilience; assist the balanced economic growth among regions. Furthermore, the study of housing bubbles also increases knowledge of how to minimise bubble risks to multiple stakeholders, including households, institutional agents and government policy makers.

To thoroughly examine and describe the institutional structure of the housing markets in both countries. The ordinary least squares (OLS) and vector error correction model (VECM) frameworks are used to study house price dynamics and housing bubbles, as these models are less restrictive and easier to apply when linking house prices and macroeconomic data (Jusélius, 2006). Based on the findings of the literature review, relevant extensive econometric tests were conducted to test key requirements underpinning assumptions made

under these two empirical econometric frameworks. The time series are tested to ensure each is non-stationery of order I (1), which is a necessary requirement for co-integration. This includes the use of the VECM framework for implementation of the variance decomposition test, the generalised impulse response model, and the Granger causality test to provide information about the relative importance of regional and national house prices as influencers on house prices elsewhere. To evaluate Chinese house prices, first tier house prices and second tier house prices are collated based on the principal components procedure described in Eviews.

The models are estimated using extended data sets, taken from a number of reputable data sources: ABS, RBA, CoreLogic, and the US economic trading website, CitiRE property database, which capture cyclical events in the housing cycles over the previous two decades. However, for China, the limited availability of appropriate time series data is anticipated to impede the empirical test results detailing house price dynamics. Most notably, the chapter investigates the impacts of the most recent housing booms (2012-2015) in Australia, as reflected in the macroeconomic environment, which has undergone unprecedented and remarkable performance over the last two decades, raising a number of pertinent and debated issues. In the context of China, the research studies house price performance, both in the prosperity era "golden age" (2007-2013) and the slow down period "new normal" (2014 onwards).

As a precursor to empirical estimation tests to determine housing price dynamics, spillover effects and relationships within the macro-economy, and the existence of housing bubbles later in the thesis, Chapter 3 analyses and reviews a number of important studies relating to these effects. However, relatively few studies of house price dynamics pertain directly to Australia and China at the national level. The theoretical model employed in the study is

derived from a housing demand model, wherein the central idea of housing demand suggests effective market demand is backed by purchasing power. In addition, rational expectation theory is applied, which represents households purchase decisions as largely depend upon factors such as people's expectations of future property performance, and economic conditions.

The findings suggest a heterogeneity among the impacts of macroeconomic factors on the regional house prices and national house prices in both countries. In addition, the findings identify long run equilibrium relationships between the macro-economy and house prices in the major regional and national housing markets. The finding on the spillover effects of house prices in both China's and Australia's major cities, and any cross border impacts between China and Australia are based on impacts towards housing prices from random important innovations and the Granger causal relationships among house price variables over both long run and short run. In aspects of the main drivers of Chinese and Australian house prices and of the tests for bubbles in both markets. The model suggests that the mortgage interest rate, unemployment rate, share market performance index and house price equations are of particular importance in determining both China and Australia house prices. In the Chinese market, GDP is also identified as a main driver affecting China house prices; while consumer sentiment is identified as a key factor driving Australian house prices. The short run dynamic estimations provided by the VECM equation to test the housing bubbles in both countries' housing markets, suggest China's and Australia's house prices typically self-correct in response to national economic forces, as shown by the long run equilibrium in prices. Thus, no signs of a housing bubble emerge in either housing market.

The PhD thesis is structured as follows: the next section documents the backgrounds of housing markets in Australia and China, while the third section presents the literature review of the research. The fourth section illustrates empirical methods and specifications, and the fdata. The fifth section analyses the long run relationships affecting house price and

macroeconomic variables, the sixth section presents the findings of the spillover effects. The seventh section analyses the house price main drivers and investigates the bubble risks. The final section aims to draw appropriate conclusions.

1.2 Motivations for the research

This section discusses the main reasons that motivate the research in this thesis. First, in previous research, few attempts were made to test for the presence of bubbles. This included a determination of the main drivers of Australian and Chinese house prices and spillover effects covering the most recent housing booms in Australia and China. This research fills the knowledge gap of the house price literature. Second, the contribution of this research has large implications in China and Australia's national and regional economies and also assists with household purchase decisions and the regional economic resilience. Moreover, it provides broad implications to markets such as the United States, the United Kingdom and New Zealand, which have all been seen with sustained house price movements in the last decade. Third, my personal interest in real estate investments has underpinned this research.

CHAPTER 2
HOUSING MARKETS IN AUSTRALIAN AND CHINA

2.1 Executive summary

Purpose and scope

During 2016, a four speed property market emerged in Australia, with Sydney and Melbourne ranked top for growth at 15%, Canberra and Hobart second at 9% and 11% respectively, Brisbane and Adelaide with a healthy but subdued growth of 3.6%, and Perth with negative growth of 4.3% (Knight, 2017). In China's housing market, over the last 15 years, the house price index has risen by at least 70% in the new freely trading real estate market. In China, accelerated growth is concentrated in Tier 1 and Tier 2 cities, which are driving the country's burgeoning real estate industry, responding to higher consumption and strong demand. Soaring prices are a major concern for both Australian and Chinese homeowners, as they are now finding house prices increasingly unaffordable. Due to the close economic relationship bteween China and Australia, together with the recent splurge of Chinese purchase of properties in Australia, we research these two countries' housing markets in detail.

In view of the large fluctuations in house prices, it crucial to ensure house prices are governed by a comprehensive policy framework. This is especially important as in both countries, the housing market contributes greatly to GDP. For instance, in Australia, the property industry contributes to 11.5% of total GDP (Bleby, 2016). Similarly, real estate investment made up of around 12% of GDP in China in 2013 (Cooper and Cowling, 2015). Although the two countries' housing markets are quite different, we expect there to be close relationships between these two countries' house prices due to their strong economic relationships. The first step undertaken for this research was to study house price dynamics in Australia and China to understand the background to both countries' housing markets.

The housing markets in Australia and China using secondary information was studied in Chapter 2.

Key findings

Housing Demand and Supply in Australia

Demonstrably, property prices in Australia are rising in response to multiple factors, including population growth, large migration inflows, low interest rates, and social factors, such as smaller households, a growing first time buyer group, and pent-up demand factors, including an expanding aging population.

One of the key characteristics of the current Australian housing market crisis is the acute shortage of available housing. Historically, a major reason for the limited supply of housing in Australia is failure to construct a sufficient number of new properties. Government policies are significant drivers, which crucially affect construction. Time is required to bring underdeveloped land back into use and the lag in regulations reduces the short-term responsiveness of supply to demand pressures. In addition, Affordable housing providers have built their capacity enormously over the last five to 10 years but it's not being fully utilised at the moment.

This also contributes to the historical acute shortage. (Williams, 2017) However, data from January 2017 suggest a substantial narrowing of the gap between housing demand and supply (Corelogic Housing Market and Economic Update, 2017), possibly because of the large apartment construction triggered by splurge of large Chinese purchase of properties in Australia and the record-low historical interest rate.

Tax Systems in Australia

The Australian tax system has multiple favourable features that attract investors, including no income taxation of imputed rent, no GST taxes on rents, and no CGT for owner-occupied housing, negative gearing, and no CGT upon unrealised capital gain. These attractive tax policies are boosting property purchase rates in Australia. The tax incentives are attractie due to the fact that they may encourage households purchase more properties with the aim of reducing their tax bill. Less flexible tax incentives exist in other similar developing countries such as the UK, US and Canada. (Abelson & Joyeux, 2007) See more details in Section 2.2.4.

Purchases by SMSFs, Purchases by Overseas Buyers

Recent contentious issues thought to have pushed up housing demands can be summarised into two strands. First, since 2007, the government has permitted investors to borrow from SMSFs to purchase properties. Second, since 2013, Asian investors have shown a strong interest in purchasing off-the-plan apartments in Australian residential development sites. Thus, a question naturally arises; i.e. Are these two factors main drivers affecting Australian house prices? The empirical analysis that answers this question in relation to both factors is described in Chapter 8.

Housing demand in China

China experiences strong housing demand arising from multiple factors, including demographics, increased income, low interest rates, ready availability of housing loans, and investment preferences. As the Chinese population are the hightest savers in the world, Chinese households have strong purchase power. (Zhang et al., 2016; Yu and Huang, 2016)

Urbanisation

By the end of 2008, the urbanisation rate in China had reached 45.7%, which is much higher than that in India, which had stagnated at 29%. Urbanisation is due to changes in agricultural technology that generates labour surpluses in rural areas and many farmer-workers are moving to urban areas where there is considerable cultural conflict between rural migrants and their host urban communities. Government policy has encouraged the development of medium-sized cities. (Quan, 1991) Similarly, Gong et al., (2012) supported the notion that China has seen the largest human migration in history. A provincial analysis of its urbanisation trends shows shifting and accelerating rural-to-urban migration across the country and accompanying rapid increases in city size and population.

According to a recent report by BNP Paribas (BNPP), China's urbanisation rate is expected to reach 60% by 2020 (see Figure 20). The spillover from this urbanisation has had a direct and immediate impact on real estate investment, triggering huge demand for raw materials and capital equipment. Urbanisation is important because of the larger housing demand as a result of the higher income of those Chinese domestic migrants travelling to work in larger busier cities.

The changing family structure in China

Household members formerly included grandparents, parents and children; however, the trend is now towards households comprising a younger couple and one child. This shrunken household dynamic is fuelling growing demand for housing in China. The smaller size households are also because of the one child policy of family planning that started in 1981. (Clarke, 2015) As a result, many one child families have created large demands on smaller-size properties. The implied impact of this phenomenon is thereby the increase in both national and regional house prices.

Huge profits from the construction of properties (Housing supply)

Easy credit from banks has helped developers to build more properties, to be sold with high profit margins. This has been supported by high demand from China's enormous population which has continuously pushed up the prices of properties. As a result, developers are constructing more and more properties, to accure ever greater profits. According to Cooper and Cowling (2015), persons working in the real estate and construction industries represents around 8 per cent of urban employment.

Government controls on the availability of land (Housing supply)

The Chinese local government's monopoly on the control of land has had a unique impact on the country's housing supply. Currently, local government performance is measured by the income index; as such, there is an incentive for local governments to sell land at high prices to developers in order to increase their fiscal incomes. In addition, some local governments have undertaken promotional policies to encourage local residents to buy properties, thereby persuading developers to purchase more land. This large contribution to local government incomes will potentially result in a deviation from the fundamentals of house pricing.

In the next Chapter, attention turns to an empirical study of house price dynamics in China and Australia. It provides a detailed literature review that also includes macroeconomic relationships, and spillover effects in Australia's and China's real estate markets.

2.2 Australia's housing market

2.2.1 Property prices in Australia

Australian property prices increased on average by 3% per annum in the 1970s and 1980s, and have been increasing by 6% per annum since the 1990s (Delmendo, 2016). These national averages conceal several uncharacteristic increases regionally, such as in Sydney, where the median house price rose 17% from $573,000 to $671,500 between 2003 and 2010, and some other capital cities where prices have doubled (Global Property Guide, 2016)

Over the past two decades, property prices have risen steadily in Australia, especially in Sydney and Perth, with prices in Melbourne currently ranking third among all the cities in Australia. To demonstrate; from Oct 2012 to Oct 2013 prices in Sydney rose by 9.33%, prices in Perth grew 7.09% and Melbourne prices increased by 5.38%. Other cities in Australia have experienced minimal or mild growth during this period (Which Real Estate, 2013).

The price rises continue in urbanised areas, and in 2016, the major city markets including Sydney and Melbourne witnessed dwelling values that rose by in excess of 15% and 13% respectively. Moreover, in 2016, Australia was classified as a four speed property market (Knight, 2017).

Additionally, the ABS (2017) dataset shows gradual increases in the four regions' AWE over the last two decades. House prices in NSW, Victoria and QLD are comparable, but the highest growth rate in AWE in WA was from 2006Q2, reflecting increased purchasing power due to the effects of mining boom. The increase in AWE for NSW, Victoria, WA and QLD over the study period were 101.08%, 90.30%, 144.50% and 120% respectively. Comparing with the

house price increases, the income growth is much more moderate.

The strong performance of the housing market leads naturally to the question of what are the causes of these rapid increases and are they results of investors' (include large Chinese buyers) irrational speculative activities and unrealistic assumptions of the long-term continuation of price increases. Are bubbles likely to arise due to these price increases? A risk in the increased purchases of property via SMSFs is that it will create a new source of demand which could potentially exacerbate prooperty price cycles. Taking into consideration the Australian housing market unique infrastructues, it is important to understand the speed of the growht in detail, in depth.

The property market's strong performance in Australia's major cities is further demonstrated in Figure 1, with high auction clearance rates during the first week of October 2013, with the weighted average auction clearance rate being 69.8% across all Australian cities. Sydney experienced the highest rate of 80.1%, Melbourne was second with 71.4% followed by Adelaide with 63.8%.

The Tasmanian auction clearance rate was 57.1%. Top ranking, as measured by total number of auctions, were Melbourne at 865 auctions, Sydney with 390 auctions and Brisbane with 93 auctions. In 2016, the auction clearance rate performance continued at a high level, with the exception of Perth where growth eased. According to Corelogic, clear rates remained above 70%, throughout the majority of December 2016 (CoreLogic housing market and economic update, Jan 2017).

The overall annual property price increase to Oct 2013 on houses across Australia was 4.8% while for unit it was 2.9% on each unit. Among these, both houses and units in Sydney performed best, with an average annual increase of 7.7% on houses and 4.6% on units (Which Real Estate, 2013). Up to 2016, housing delivered a total annual return of 14.7% when assessed on the combined capital cities index results (Corelogic, Jan 2017). However, in 2016,

the speed of growth underwent its first transformation since the beginning of the housing boom in 2013. This led to the emergence of a four speed property market in Australia, with Sydney and Melbourne ranked top for growth at 15%, Canberra and Hobart second, Brisbane and Adelaide with healthy but subdued growth of 3.6%, and Perth having negative growth of 4.3% during 2016 (Knight, 2017).

This short term strong performance of the housing market on Australia's cities has triggered researchers and stakeholders to question the causes of these rapid price increases. Particular questions raised include: Are the rises a result of investors' irrational speculative activities and unrealistic assumptions about the long-term continuation of price increases? Are bubbles likely to occur due to these price increases?

A bubble is normally characterised by a rapid increase in property values (i.e. house prices) which, once it attains an unsustainable level relative to income and rents, then declines. A suggested housing bubbles occurred in 2003, when national price-to-income ratio peaked, as since that time the ration has been more than 40% higher than the long run average (Delmendo, 2016). This led to the suggestion from some quarters that there was a property bubble in 2003 (Australian property bubble on a scale like no other, 2017). However, according to the Real Estate Institute of Australia's view of 2003:

> *Price to income ratio, generally calculated by using the average income, is not an accurate and sufficient indicator of housing overvaluations as it is an average measure that covers the whole population, whereas house prices are determined by a set of buyers whose income and thus the ability to service loans, are most likely to be higher than the population average income. (Real Estate Institute of Australia, 2010.)*

By this definition there was no property bubble in 2003. This is due to the limitation of price to income ratio available not being able to target the relevant income group. Moreover,

compared with fundamentals, higher price to income ratio may directly result in an affordability problem.

In fact, since 2001 there have been many other warnings about property bubbles in Australia. However, as will be shown later in this study, no bubble has yet been conclusively demonstrated to have arisen in Australia since 2000.

2.2.2 Housing demand in Australia

There is exceptional demand for residential properties in Australia, due to long run demographic and social trends along withmacroeconomic factors. The population has grown rapidly over the last 20 years, with the annual average population increase in the 1990s being 210,000 per year, rising to 305,000 per year after 2000.

Demographic factors

Based on ABS forecasts (ABS, 2017), it is anticipated that by 2056 the population of Australia will lie between 30.9 million and 42.5 million, and by 2101 it will have risen to between 33.7 million and 62.2 million (see Figure 2.1).

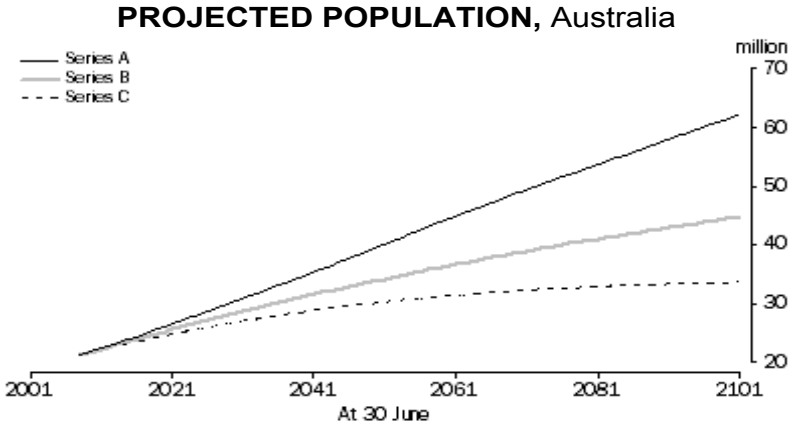

Figure 2.1 Projected population of Australia

Source: www.abs.gov.au, 3222.0 – population projectors, Australia, 2012, (base to 2101), Projected population Australia.

The causes of this population growth include both migration inflow and natural increase through births. ABS statistics report that 40% to 60% of the population growth up to March 2013 was contributed to by both natural growth and migration flow, as compared to March 2012. There was also an increase of 10.5% in net overseas migration in the period March 2013 (Real Estate Institute of Australia, 2010). Updates to the previous statistics, issued in June 2016, show the annual growth rate continues, at a rate of 1.4% per annum, which includes steady natural growth and overseas migration (ABS, 2016).

Of all Australian states, Western Australia has witnessed the fastest population growth rate at 3.4%, while Tasmania experienced the lowest growth rate of 0.1% in the year ending 31 March 2013 (Real Estate Institute of Australia, 2010). In data released in June 2016, NSW and Victoria were shown to have the largest population growth, and South Australia and Western Australia the lowest. This phenomenon is consistent with the house price growth trend discussed in Section 2.2.1. The statistics suggest that the majority of overseas migrants settle in NSW and Victoria demonstrated by the data for June 2016 in which 72% of migration was to NSW and Victoria (ABS, 2016).

A number of additional factors have pushed up the demand for residential properties in Australia, including Australia's ageing population, which has increased demand for properties that are easy to maintain and close to hospitals and other amenities (Peters, 2013) (see Figure 2.2).Complex social trends combining with population ageing to make these older households more diverse ,thereby raises new challenges for housing an ageing Australia. For instance, sustained and substantial numbers reaching old age as renters and whose housing choices will diminish as they grow older, thereby decrease the housing demand. (Australian Housing and Urban Research Bulletin, 2004)

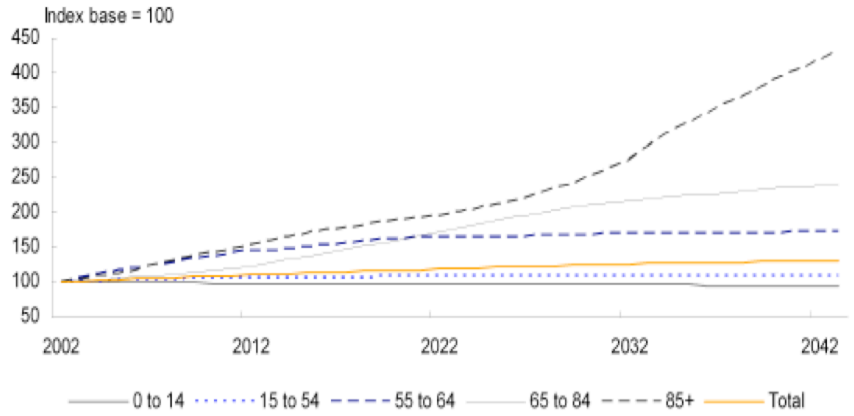

Figure 2.2 Population growth indices by age group

Source: Treasury website, 2013

The unemployment rate at the national level in Australia in 2014/2015 was below 6%, and by the end of 2016 had dropped to 5.6% (ABS, 2016). By region, at the end of 2016, NSW, VIC, and QLD all saw rates of below 6%, SA, although WA and TAS stood at 6.5%; NT and ACT had the lowest unemployment rate at 3% (ABS, 2016). These statistics confirm the house price growth trends discussed previously in Section 2.2.1. They also suggest higher unemployment rates leading to lower house price growth and vice versa.

Foreign exchange rates also have a strong impact on Australian housing demand. If the AUD rises in value against the USD or Euro, then Australian housing properties will be more expensive. If the AUD becomes less expensive, then Australian properties will be more attractive to foreign buyers.

After May 2013 the AUD started to depreciate against USD, ultimately falling to a three-year low. This reduction in the value of the AUD attracts many overseas investors to purchase Australian properties. Their lower prices and predicted strong capital growth, in conjunction with steady rental yields and low vacancy rates in a mature regulatory environment were very attractive. Current statistics show, the Forex has continued to experience a decreasing trend, and this remains the case at the beginning of 2017. This could be as a result of the end to the

mining boom and the lower cash rate issued by the RBA (RBA, 2016). Furthermore, these figures justify the current house price trend as previously reported in Section 2.2.1.

The fall in the AUD has been linked by some commentators to the cash rate cuts by the RBA that have taken place from May 2013 to present (March 2017). The historically low cash interest rate issued by the RBA, has been at 1.5% since September 2013. This has further accelerated housing demand due to the cheaper lending options available from Australian banks and financial institutions. The RBA has used these lower interest rates to boost consumer confidence.

At the beginning of the most recent mining boom, the drop in interest rates has prompted strong growth in lending activities in all states (Peters, 2013).WA has the highest loan approval rating due to the strong demand for housing, despite a slowdown in mining activities. High rents in the WA housing markets have also pushed up housing demand further. Growth in lending for housing purchase is expected to continue going forward (Peters, 2013).

High demand for housing in WA led to a strong rise in rents in Perth. High rents then redirected demand into the house-buying sector, and this, combined with low interest rates was expected to keep housing lending growth elevated in WA until at least the end of 2014. Over the medium-term housing demand would then be expected to stabilize as WA's population growth slows and mining activity continues to decline (Peters, 2013).Investors in Western Australia's housing market are being warned to expect further price falls, with an oversupply of houses and apartments set to worsen. will have an extra 14,600 dwellings — relative to underlying demand — by the middle of 2017, and an extra 17,500 dwellings by June 2018. (Piesse, 2017)

However, recent updates to the housing demand and lending data based on the actual situation in Jan 2017 show financing commitments for owner occupied properties in WA have decreased by 6% compared to the beginning of 2013 (ABS, 2017), consistent with negative

house price growth in WA (as reported in Section 2.2.1).

NSW, QLD and VIC have all also experienced rapid lending growth due to the strong labour market, growing demand for housing and FHB schemes. Lending in SA and TAS increased marginally with a fall in the cash rate (Peters, 2013). In early 2017, compared with the start of 2013, the finance commitments for owner occupied properties in NSW and Tasmania has risen by approximately 60%. VIC, QLD and SA show a growth trend of about 40% (ABS, 2017).

Furthermore, the savings ratio is at 10%, which makes it the highest since the 1980s, suggesting that the greater cash flow available to purchase properties will push up the property demand (Peters, 2013). Statistics published in the Trading Economics Database (2017) show the household saving rate fell to 6.30% in the third quarter of 2016. This drop in the saving ratio could reflect an increase in house prices, with higher mortgage payments leading to lower savings on householders' balance sheets.

The overall GDP growth of 2.6% in Q2 FY13 in Australia meant the country had performed better than other developed countries; thus providing a good investment environment for property buyers (Peters, 2013). By the third quarter of 2016 the annual GDP growth rate was 1.8%, reflecting a continuing impact from the end of mining boom, and the decrease in WA house prices. However, the lower GDP growth has not yet impacted house prices growth rates in other regions.

Social trends factor

An ageing population in Australia has triggered important social trends. This has meant smaller households as baby boomers have already reached the 'empty nester' phase of their lives, and most of their children have already left home. The resulting increasing proportion of couples without children in the population is resulting in a clear trend (Westpac, 2010).

A further important social trend contributing to housing demand is delayed co-habitation and the trend for women to have fewer and fewer children, leading to a long run trend to reduce the average number of persons per household (Westpac, 2010).

A smaller number of people in households increases the number of houses needed. This downtrend was temporarily accelerated in the 1970s and 1980s due to the rise in family separation rates following the introduction of 'no-default' divorce laws in 1975 (Westpac, 2010).

Another important factor contributing to increased housing demand is the growth in the first home buyer (FHB) group. This cohort, generally comprised of 25 - 34 years old, has seen solid growth due to incoming migration and the many children of the 'baby-boomer' generation. The average growth rate for the age cohort 25 – 34 in the ten years up to 2007 was around 0.2%. Over the 4 years up to 2010, this increased by 2.3% per year and was expected to continue to rise at a rate of 2% to 2014 (Westpac, 2010). Recent updates to the statistics show the actual increase in age cohort from 25 - 34 from June 2010 to June 2016 is 14% above the predictions (ABS, 2017). This is anticipated to be expected to lead to greater demand for housing during this period. The finding is also consistent with reports given regarding the house price growth trend in Section 2.2.1.

Merging large excess demand with the current restrictions on the housing supply imposed by the government, it becomes apparent that there is large pent-up demand in the Australian housing market. The possible impact of this pent-up demand on Australian people's lives are outlined below.

Impact of pent-up housing demand

Pent-up demand principally affects the age group 18 - 34 years, who under normal circumstances, would have left home to form their own home by either renting or buying their

own property. However, due to the high price of properties, they have to remain with their families longer, as they cannot afford to purchase or even to rent in some cases.

As indicated by the statistics, the number of 'children' over the age of 35 who stay within the family home increased threefold, from 65,000 in 1996 to 187,000 in 2006 (Westpac, 2010). This trend has continued from 2007 to 2017. (ABS, 2017)

Another major impact of pent-up demand is the rising number of ageing relatives choosing to live with families. Based on statistics provided by Westpac (2010), the number of 'extended' relatives were twice as many in 2006 (392,000) than in 1996 (181,000), illustrating how the impact of pent-up demand has changed social values. In addition, due to the rapid increase of housing prices and the pent-up demand on houses in Australia, first homebuyers tend to be older and require two incomes; also in many cases purchasing units, terraces, and townhouses, instead of individual houses or blocks of land. This new trend will continue to boost prices for all types of residential property (Westpac, 2010).

Pent-up demand for properties is approximately 40% of the total number of houses turned over in a year. This means that for every five home sales there are two potential buyers who will miss out due to the unavailability of stock (Westpac, 2010).

Demonstrably, property prices in Australia are being pushed up by multiple factors, including population growth, large migration inflow, low interest rates, and social factors such as smaller households, the growing first time buyer group, and pent-up demand factors including the expanding aging population.

In future, this strong demand is likely to intensify as migration is driving a population surge, which has accelerated to a growth of 425,000 a year over the last three years.

The long run expected demand is very likely to be even higher, only serving to exacerbate the problem of an imbalance in demand and supply in the Australian housing market. Discussing

property bubble analysis, high demand will continue to push up property prices (Abelson et al., 2005; Bleby, 2015). What is similar between Australian house prices and Chiense house prices is that the demand factors all push up hous prices. However, variations is identified in demand factors such as different social factors between China and Australia.

2.2.3 Housing supply in Australia

Shortage of housing supply

As outlined in the previous section, price changes occur in the housing market when an imbalance occurs between demand and supply. One of the key features of the current Australian housing market crisis is the acute shortage of housing supply. Figures up to 2010 show a 2.5% deficit in the total dwelling stock, equivalent to about a year's new construction (Westpac, 2010). However, data from January 2017, suggests the gap between housing demand and supply has since narrowed substantially (Corelogic housing market and economic update, 2017). However, historical research suggests housing supply is not elastic in the short term, that is the changes in house prices causes small changes in supply; but elastic in the long term (Sivitanidou, 2011). One possible explanation is it takes time to bring underdeveloped land back into use and the regulations lag reduces the short-term responsiveness of supply to demand pressures. Consequently, this short-term inelasticity of supply is one reason explaining the continued surge of Australian house price in the most recent boom starting from year 2012.

Based on the statistics for 2010, the annual stock of dwellings increased by an average of 105,000 a year, falling well below demand increases, and the shortage of housing stock each year is around 200,000 dwellings per year across the country (Westpac, 2010). These figures are used as an indicative of mismatch of demand and supply since it is hard to find the most recent data.

A major reason for the limited supply of housing in Australia is the failure to construct a sufficient number of properties. Government policies are important drivers crucially affecting construction with major events such as pre-GST, FHOG (First Home Owner Grant), FHOB (First Home Owners Boost) all increasing the number of construction commencements. Updates to the latest housing supply situation in Jan 2017, according to AFR, suggest that "today, cranes once again rise against the city skyline, this time building apartments for the seemingly implacable rationale of housing undersupply" (Harly, 2016). Despite this, during the previous twenty years there has been limited emphasis on construction activities (Peters, 2010). These factors all combine to result in a limited housing supply.

Nevertheless, housing construction activities increased in 2013, largely as a result of historically low interest rates and numerous state schemes to promote and support construction activities (Peters, 2013).

A number of state programs have been implemented to support housing construction regionally. For example, in Tasmania, the State Government's First Home Builder Boost supports construction activity through payments, in addition to the FHOG (First Home Owner Grant) of up to $8,000, which is available for eligible applicants who purchase a newly built home or who are owner-builders between 1 Jan 2013 and 30 June 2014.

In NSW, based on the 2012-2013 budget, the state government aims to provide $561 million for additional infrastructure to enable the release of up to 76,000 new housing lots to boost housing supply in NSW (NSW Budget, 2013). NSW also has a FHOG available to purchase or build a new home in the form of a $15,000 incentive.

The FHOG (New Homes) was applied to eligible transactions, in which the transaction commencement date (contract date) is on or after 1 October 2012. The FHOG (New Homes) grant was reduced to $10,000 on 1 January 2016 for eligible transactions with a commencement date (contract date) on or after 1 January 2016 (First Home Owner Grant,

2013). In contrast, no government scheme exists to support construction activities in Victoria due to historical over-building (First Home Owner Grant, 2013).

Queensland has the First Home Owner's Grant, which is a government initiative to support construction activity in which a buyer gains $15,000 towards buying or building their new house, unit or townhouse valued at less than $750,000 (Great Start Grant, 2013). After 1 July 2016, the grant was increased to $20,000. A detailed analysis of why Australia has a limited housing supply is outlined below; however, the situation is essentially due to the cost, the availability of readily developable land (including both greenfield and infill sites) and the rigidities affecting planning and development processes (RBA, 2012).

The number of new residential dwellings built relative to the size of the Australian population has declined over previous decades, although there have been considerable variations between states.

Further details relating to supply side issues in the housing sector include the length and complexity of the planning process, problems associated with the provision and funding of infrastructure, land ownership, geographical constraints, and other challenges related to infill development.

Housing supply policies and processes are usually the domain of state governments and local councils. State governments typically establish the outer urban boundary of their capital cities and, in conjunction with local councils, determine those areas in which they will permit the building of new dwellings. New dwellings can either be built on the city fringe ('greenfield developments') or within existing urban areas ('infill developments').

As outlined previously, Australia is experiencing an acute housing undersupply. However, it is relatively easy to demonstrate that building capacity has not been seriously stretched, since many more houses were built in the early 1990s than was the case 10 years later. Indeed, it is observed that the industry is presently under built by as much as 50%. (Harly, 2016)

The restrictions imposed on land use have been strongly supported by many conservationists and a majority of the planning fraternity. Some commentators argued that the increase in land availability would reduce prices, thereby easing the burden on potential homebuyers while leaving homeowners with tighter budgets poorer. Another politically significant view is that every generation wants its children to have access to lower cost housing, while maintaining its own capital gains and retaining the 'character' of our neighbourhood (Knight, 2017). This is also a major driver behind higher house prices.

Impediments during housing development processes

A second major factor contributing to the undersupply of homes in Australia is the difficulties incurred during the housing development process itself. The first impediment raised here is the complexity of the planning process. For example, there is often a long time lapse between development proposal and approval, even though it many cases they are eventually successful. There is also a lack of coordination between the various agencies involved, including local councils, utility companies and other infrastructure providers, as well as state planning and environmental departments. In addition, uncertainty about planning standards, development assessment policies and state and federal environmental laws, causes problems; especially as they can all change during the development process (RBA, 2012).

As a result, the uncertainty and time taken to settle planning issues can increase the costs and risks that proceed from housing development.

Another impediment then is the provision and funding of infrastructure. In the past, the state governments have covered the cost of providing infrastructure for new housing from general tax revenues. In recent years, however, state policies have preferred 'user-funding' as the basis of infrastructure, which has dramatically increased the private costs of development (RBA, 2012).

A third impediment is land ownership and geographical constraints. For example, in North-

West Sydney, and in pockets around Perth, it is difficult and costly to consolidate and bring large parcels of land to market on the urban fringes, as all these cities have grown in size and have multiple owners at the fringe.Therefore, expanding the city fringe further could also be particularly difficult in cities such as Perth and Sydney (RBA, 2012).

A fourth impediment is the public's attitude towards infill development. As mentioned above, complicated planning processes have led to unacceptable delays in infill development, also causing obstacles to arise in the form of possible community opposition. Sometimes, local residents raise concerns about new building projects that they believe will change the character of the suburb, prompt environmental issues, increase traffic congestion, and ultimately even erode the value of their homes. As a result, some developments might not be approved (RBA, 2012).

A fifth factor that affects the undersupply of houses in Australia is the high costs incurred during the construction process. For example, when developers negotiate with a local community and council or engage in disputes, this may render a project unprofitable or lead to the building not being completed as planned.

Moreover, uncertainties about the eventual level of the infrastructure charges also contribute to difficulties. These infrastructure charges are levied on infill development and calculated as a share of construction costs, or might even be subject to negotiation between the builders and concerned councillors (RBA, 2012). As a result, cost over-runs will increase the burden of construction (RBA, 2012). An example of increased cost is from infrastructure charges, which used to be borne by the state government and paid by general tax revenue, but which are now paid by owner builders themselves, causing the construction to be more expensive. This has the consequence of discouraging people from choosing to build.

Another factor that will increase the overall cost of construction is the lengthening of the approval time taken, which demands a longer finance period (RBA, 2012). Accordingly, the

shortage of supply of housing will push up the market price of the resulting properties. The shortage of housing problem is only likely to worsen in the near future. Therefore, the market price is expected to continue on an uptrend and a bubble could arise if there is irrational speculation in Australia. As of now, no bubble is identifiable, although there is a strong imbalance between demand and supply in the Australian property market.

Influence of planning laws

Beginning in the 1980s, the Australian states (which under the Constitution have control of environmental and land use issues) started progressively implementing more rigid planning laws regulating land use. From the 1990s onwards, these planning laws often concentrated on restricting greenfield development in favour of "urban densification", or infill development (RBA, 2012). Land rationing is a system involving banning development in all but designated areas, and can lead to extreme land price inflation if insufficient land is designated for development.

Restrictive planning laws in Australia have employed land rationing systems as part of the objective of restricting greenfield development in favour of infill development (National Housing Supply Council, 2011); however, this inevitably leads to increased land prices, and thus house prices. There is ample evidence to suggest that the price of a new units of housing is the ultimate anchor of all housing in an area, so planning laws that implement severe land rationing drive up the cost of new homes, causing all other homes to follow suit. (National Housing Supply Council, 2011; Productivity Commission, 2011)

Housing prices and affordability related to land prices are largely determined by the supply of developed urban land. Residential land supply is affected by factors such as development costs, the structure of the land development industry, relative returns from non-housing uses, and the rules and effectiveness of land-use planning system. Controls over use of land impact on both the availability of developed land and its cost. It takes time to bring underdeveloped

land back into use and the regulations lag reduces the short-term responsiveness of supply to demand pressures. Therefore, this short-term price inelasticity of supply is one factor explaining rising house prices in Australia.

During the period from 1992 to 2003, the real price of land in Australia increased by around 12% per annum, while the price of constructing a dwelling increased by around 3% per annum. During this time, the land component has contributed by around 80% to the increase in the price of an established dwelling in Australia (Bond, 2003). Due to the limitation of most recent data, these data are used for illustrative purposes.

The Australian government also imposes taxes, levies and charges on the development and use of urban land. To some extent these costs are passed on in final house prices. These are: developer levies (local government and other infrastructure providers), stamp duty on the sale and transfer of land and land tax (state government); and GST on new house construction and the renovation of existing houses.

All these costs contribute to a high proportion of the house price. Quoting from the Housing Industry Association, Berry and Dalton (2004) noted that, for new housing, "the total indirect tax take is over $124,000 in Sydney and $88,000 in Melbourne".

2.2.4 Tax systems in Australia

Negative gearing

In 1987, negative gearing was reintroduced to provide a significant incentive to property buyers. Negative gearing occurs when rental interest costs exceed the rents and the deficit can be written off against other income. The interest expense can be deducted against rental income, providing a positive incentive for investors. The tax law states that a property owner can claim a deduction for the decline in value of furniture, plant, equipment and buildings that is used in or part of a rental property. These deductions all add more attractions to a

households' purchase of properties.

Under the negative gearing scheme, cash losses on expenses affecting the ability to maintain properties worth in excess of the rental income are absorbed by the taxable income paid. In Australia, negative gearing has helped many investors to accumulate property portfolios over many years, helping them to accumulate capital gains to fund their retirements.

Capital gains tax (CGT)

In 1999, CGT was reduced from 100 to 50 percent (on property held for at least one year), although 100% of costs remained deductible. CGT is a tax on net capital gains, which is calculated as total capital gains, less total capital losses, less CGT discount. The CGT discount rate is 50%, i.e. the rate is 50% of the taxpayer's marginal tax rate, and this can be granted after the property has been held for at least 12 months. CGT is only paid in recognition of the capital gain.

Total capital losses can be deducted from total capital gains. CGT is not levied on unrealised capital gains, explaining why investors can accumulate capital gains. Fifty percent of net capital gains are then subject to normal marginal tax rates. (CGT discounts have attracted many buyers due to the lower tax paid on capital gains.) However, if assets were purchased before 20 Sep 1985, they are exempt from CGT requirements (ATO, 2013).

Other tax Concessions

The Australian government now also grants additional tax concessions, such as exemptions from land tax, on family homes, as well as the advantage of passing pension tests if the property is owner occupied. Owner occupied houses are not included in assets tests for pensions. *(*Your home and the age pension, 2017)

For investment in properties, which are administrated through self-managed superannuation funds, the government allows investors to borrow from self-managed funds to invest as from 2007. This allows investors to purchase properties employing a new approach, which could also explain why properties prices rose.

In summary, the Australian tax system has many favourable features that are attractive to investors, including no income taxation of imputed rent, no GST taxes on rents, and no CGT for owner-occupied housing, negative gearing, no and CGT upon unrealised capital gain. There are also grants to assist first time homebuyers and rent subsidies for members of low-income households in private and public housing at both Federal and State levels (see Table 2.1). These attractive tax policies are contributing to the continued price increase affecting properties in Australia.

Influence of the tax system

The Reserve Bank of Australia has noted "a number of areas in which the taxation treatment in Australia is more favourable to investors than is the case in other countries." (RBA, 2016) The foremost tax incentives include tax deductions for losses on investment properties, even those that were negatively geared, and the 50% discount on CGT when selling investments properties.

Investors using their superannuation for property investments also have a tax advantage. compared to 'savers' who are effectively taxed up to 45% (the top marginal taxation rate) for income earners over $180k on income on bank interest or bonds. This is because superannuation contributions are normally only taxed at around 15%.

Table 2.1 Major Australian taxes and house subsidies affecting house prices

Tax or subsidy	Main features
Tax concessions	
Non-taxation of imputed rents	Imputed rental income is not assessed as part of taxable income.
Non-taxation of rental services	No consumption tax on imputed or actual housing rents.
Concessional capital gains taxes	(a) Home owner-occupiers pay no capital gains tax. (b) Property investors pay tax on half the nominal capital gains.
Tax treatment of losses on rental property (negative gearing)	Investors can deduct 100 per cent of nominal losses from rental property against other taxable income.
Public expenditure subsidies	
First home owner grants	Grants of $7000 to first home owner purchasers since 1 July 2000.
Assistance to private renters	Australian Government provides rental subsidies to low income persons, who comprise about one quarter of all private renters.
Assistance to public housing tenants	State governments provide public housing to 5 per cent of Australian households - in most cases at below market rents.
Main taxes on land and housing	
State land taxes	States taxes on value of land used for rental properties and second homes. Some land taxes on premium value owner-occupied property.
Local government land taxes	Local governments levy land taxes (rates) on most residential properties.
Stamp duties on transfers of land and housing and on mortgages	Most state governments levy stamp duty on the value of property when it is transferred and on mortgages.
GST on home renovations, land sales and new buildings	10% GST applies to (a) maintenance and renovation expenditure for existing housing and (b) sales of land and new buildings.
Infrastructure developer charges	Most state and local governments levy infrastructure charges on developers.

Source: Abelson & Joyeux, 2007, pp.147-169

2.2.5 Self managed super funds (SMSFs)

Retirement planning and investment strategies are widely discussed. Property investment, often classified as a defensive growth asset, is perceived to have a strong and stable return across all economic cycles. As a safe bricks and mortar investment, it attracts considerable attention from investors. Since 2007 the Australian government has made it legal for ordinary Australians to borrow money to buy property using their SMSFs. This has resulted in many purchases of property through SMSFs. The question of how this process works is now discussed and why it is so appealing to investors.

How do SMSFs work?

The main advantage when purchasing a property through a SMSF is the tax advantage. For example, if investors in their 50s purchase a property for retirement purposes and want to sell it 10 years later, they will be subject to CGT. However, if the purchases is made through a SMSF the capital gain will not affect their normal pension which will remain tax-free. If the property is held in an SMSF for more than 12 months, the sale of the property will be subject to a capital gains tax of just 10%. Another major advantage is that the rental income will only be taxed at 15% if the property is held in a SMSFs, and not taxed at all if it is in the pension phase.

The biggest hurdles for investors when purchasing properties via SMSFs are the costs incurred include setting up the fund, property strategies, complex structures and property management fees. For example, loan agreements, and the costs to establish a simple mandatory trust with a company trustee and associated documentation can range between $2,000 and $3,500. In addition, there are many other fees charged by financial institutions, such as legal fees, stamp duties, and government fees on top of the property costs.

The LVR (loan to valuation ratio) represents the amount borrowed as a percentage of the value of the property being used as security for the loan. Banks allow a SMSF to borrow about 65% to 70% of a property's value with any borrowing through a SMSF being made through a non-recourse loan, which means that the underlying security for the loan must be the property purchased by the fund. In addition, properties purchased via SMSFs have to be made purely for financial reasons, which means you cannot live in it, nor can the investor lease it to family and friends.

The major risk when managing property via an SMSF is liquidity, and it is crucial to ensure that sufficient cash flow is maintained in the fund to cover any liabilities and pension

payments. For example it would become difficult if tenants were to stop paying rent and insufficient cash were left available to run the SMSFs.

Investors must also be aware of the diversification risks of investment in an SMSF, as an investment in a property can take more than half of the total super fund value. This would be very dangerous in the case of a property bubble bursting, as the investors would be very likely to lose their lifelong retirement savings.

There are many other risks associated with this new means of purchase. Examples include when contracts are not made properly or when an unwinding agreement cannot be allowed. In such cases buyers might be forced to sell the property, potentially then becoming subject to large financial losses.

In addition, to get out of SMSFs is a cumbersome process, which includes multiple steps such as timely notification of the ATO, involving the completion of tedious reporting and a cumbersome tax office audit. Any tax losses incurred on investment property could not then be deducted from taxable income outside the fund. The ATO also has heavy penalties for non-complying activities engaged in by superfunds.

Recent purchases via SMSFs

In recent years, leveraging through banks to purchase properties in SMSFs has increased strongly. Financial advisers have provided training and advisory facilitation to investors related to how to set up and manage these funds.

Based on the statistics obtained, in the last 10 years, the purchase of investment properties via SMSFs has doubled due to government changes to regulations lending to investors investing via SMSFs in 2007. (RBA, 2013) The purchase of properties via SMSFs includes the purchase of both residential properties and commercial properties. These accounted for 15% of total SMSFs, which is one third of the $1.6 trillion of superannuation industry assets in

Australia in 2013. (See Figure 2.3) (RBA, 2013; Shappard, 2013).In 2015, the superannuation industry assets in Australian has risen to $1.9 trillion (CoreLogic, 2015).

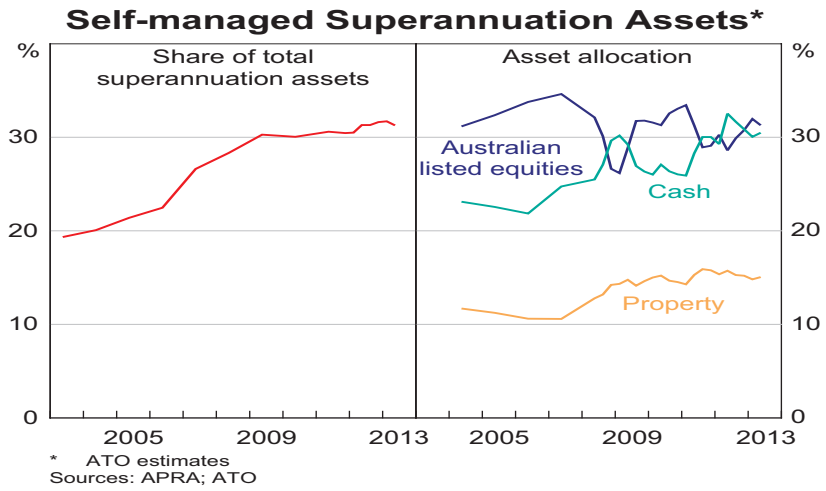

Figure 2.3 Self-managed superannuation assets in Australia

Source: RBA, Financial Stability Review, September 2013

According to statistics published by Multiport, a SMSFs trustee and subsidiary of AMP, in the past two years the percentage of property held in clients' schemes has increased from about 50% to 80% (AFR, 2013). Meanwhile, financial assets, that are typically shares and fixed income, have slipped back to just 20%. The number of clients with some form of gearing has also risen, from about 13% to 15.5% (AFR, 2013).

Moreover, according to Rate City (2016), investor borrowing, which includes SMSFs, is squeezing first-home buyers out of the marketplace. They have jumped from about one-third to nearly half of new financial commitments.

A risk from the increased purchase of property via SMSFs is that it will create a new source of demand, which might then potentially exacerbate property price cycles. It will also lead to consumer protection concerns, since members of SMSFs could be subject to higher financial risks than they expected. According to an ASIC report released in April 2013, most advice given to individuals about SMSFs was of good quality, but there is also some poor advice being offered, in particular relating to geared residential property investment.

ASIC responded to the risk by expanding the available information on its *Money Smart* website, to highlight the rules, costs and relevant considerations around SMSFs and residential property investment. It also released a consultation paper discussing the role of advisors, and imposing disclosure requirements on them; including with regard to matters that may influence an individual's decision about whether to setup a SMSFs.

Furthermore, ASIC commissioned research to examine the minimum cost-effective balance for an individual to setup a SMSF, and is also proposing to provide guidance requiring advisers to inform individuals of the costs associated with having a SMSF. This approach will enable household purchase properties with a new channel, and consequently will increase the house demand.

ATO and ASIC have also both warned advisors against inappropriate recommendations to purchase using SMSFs, as they are becoming a favourable sales tool among real estate dealers promising both a home and capital growth.

Geared real estate remains very attractive for SFSMs because the introduction of gearing brings real estate within reach of average SMSFs. Moreover, as estate recommendations are exempt from the regulations governing financial advice, property developers can offer large commissions to distributors. This raises the possibility of developers pursuing property sales through SMSFs and delivering them to customers. For example, in a single day, a promoter will require a consumer to set up an SMSF, borrow heavily and invest in a property off a plan. Because of the large borrowing for investment properties, the majority of SMSFs will be in investment properties, which is not a good strategy according to the diversification risk rule. Diversification can be defined as to avoid the ups and downs of financial markets by spreading your money across different asset classes. So if one sector you've invested in isn't performing well, you won't lose all your money (Self-managed super fund, 2017). In addition,

gearing is important since it will help households make their tax more effective through negative gearing regime.

Many investors and advisors are routinely invited to lunchtime seminars and town hall meetings related to completing high commission property deals, and advisors often receive offers to boost their income by six figure amounts annually if they recommend property investments for superfunds. Techniques advisors use to recommend properties to investors include presenting projected inflated values, the promise of guaranteed rents, high commission, and a one-stop shop. All these developments increase the risk to investors as they may be lured into a deal which they do not clearly understand with an expensive and complicated tax structure, which could result in long run financial losses.

This increased promotion of leveraged property purchases by SMSFs has been identified as a worrying trend by the Reserve Bank (2013). They are concerned that this strategy is not properly regulated by APRA, and that it exaggerates the scale of the financial risk if the property market were to collapses (Shappard, 2013). Undoubtedly, increased purchasing via SMSFs raises demand for properties and is likely to be largely speculative, and so would be expected to potentially skew property price cycles.

Canavan (2017) have argued against the view that there is currently a bubble in the market, declaring that most borrowing by SMSFs has not related to residential property, and that the surges in housing prices are not due to SMSFs.

According to the Reserve Bank's Financial Stability Review in Sep 2013, the ability to borrow for investments has increased property holdings. Specifically SMSFs have a higher proportion of their assets in property than other super funds; although property, without differentiation between residential and commercial, still ranks fourth behind cash, Australian equities, and 'other' investment classes.

The SMSFs Professionals Association of Australia (SPAA) claims residential property is a minor element of the total SMSFs investment market, as most property held by SMSFs is commercial.

This is a reasonable point because, as at 30 June 2013, 11.7% of SMSF investments were held in commercial property compared to 3.4% held in residential property. Investment in commercial properties offers a steady return that is also not uncorrelated with the equity market. Moreover, the latest taxation statistics show under 0.5% of all property investment was geared (Shappard, 2013).

It follows therefore, that although there has been significant increased activity in the purchase of properties via SMSFs, owing to the insignificant impact it has on the total SMSFs assets value, it will not be a major driver of a property bubble in the short term. Therefore, although this mode of investment has pushed up the property prices significantly, it has not raised the market price beyond fundamentals to date.

Nevertheless, from the long run perspective, when purchases through SMSFs gain more leverage, there is a higher possibility of a bubble, due to the higher possibility of irrational investment decisions made through SMSFs.

Furthermore, irrational behaviour can also be explained as a diversification risk, as noted in relation to investments in the majority of superannuation funds that are in property, instead of a diversification into multiple types of investment choices. These investment decisions are not sensible, and could result in a property bubble if more and more investors gain greater leverage by buying large numbers of properties through SMSFs in the future.

2.2.6 Overseas buyers

Regulations on purchases by overseas buyers

The Australian government has imposed numerous regulations on the purchase of properties by overseas buyers, with the aim of creating a stable mature regulatory environment. Some examples of these are:

In December 2008, the federal government introduced legislation relaxing rules for foreign buyers of Australian property. According to the FIRB ('Foreign Investment Review Board'), foreign investment in Australian real estate had increased by more than 30% to September 2009 (FIRB Annual report, 2013). Unfortunately, many investors do not rent out their purchases, and the houses simply sit vacant awaiting capital growth. In 2016, China was the largest source of foreign investment ($47.3 billion) of which $31.9 billion was investment in real estate. (Needham, 2017)

In April 2010 the government announced amendments to its policies to ensure that foreign non-residents can only invest in Australian real estate if that investment adds to the housing stock, and that investments by temporary residents in established properties would only be permitted for their use whilst living in Australia.

Under the rules, temporary residents and foreign students are to be screened by the Foreign Investment Review Board to determine if they should be allowed to buy a property.

They will also be forced to sell their property when they leave Australia, and punished if they do not sell by a government-ordered sale, also suffering confiscation of any capital gains. There is also a requirement to build on vacant land within two years of purchase, to stop 'land banking'. Failure to do so would also lead to a government-ordered sale.

Foreign citizens cannot normally purchase established (i.e. second-hand) properties either as homes or investment properties. Two broad exceptions to this rule exist. Foreign citizens may,

if given approval, buy established dwellings for redevelopment (involving the demolition of the existing dwelling and erection of a new building), where this produces an increase in Australia's housing stock.

Foreign citizens who operate substantial businesses in Australia may obtain approval to purchase established dwellings to house Australian-based staff, but these approvals are normally granted subject to conditions requiring the sale of the property in circumstances where, for example, the dwelling is unused for a specified period of time. Foreign citizens can apply to purchase new dwellings, and these proposals are normally approved without conditions. Proposals for the purchase of vacant land are also normally approved, subject to the requirement that the construction of a dwelling commence within a period of 24 months.

Realized Capital gains are added to taxable income over the year in which the gain is made and taxed at the appropriate marginal rate. Hence, for non-residents, this will be between 32.5% and 45%.

When an asset is held for one or more years, a discount of 50% for individuals or 33.67% for superannuation funds applies to any capital gains; consequently only half the realised gain needs to be included in the taxable income.

The 2010 rule represents a major tightening of foreign investment rules, as they relate to residential real estate and a package of tough new civil penalties, such as compliance, monitoring and enforcement measures.

In the 2012 Federal Budget, the Government announced non-residents (including Australian expatriates and temporary residents in Australia) would cease to qualify for discounts on capital gains tax earned after May 8, 2012 on taxable Australian property.(ATO, 2013)

One of the major reasons for the many changes in regulations was to ensure investment in Australian real estate by temporary residents and foreign non-residents, would be legal,

meeting community expectations, and not placing undue pressure on housing stock availability for Australians.

International investments that boost the number of houses available for people to rent is considered beneficial, and temporary residents living in the country should, within very strict rules, have the opportunity to buy their home.

However, the rules have to be sufficiently tough to make sure the system operates in the best interests of the Australian real estate industry, and meet community expectations. The most recent updates to the regulations in 2016, impose additional charges on foreign buyers, including a $5000 fee for any property sold for less than $1million. Further, foreigners are subject to increased stamp duty surcharges (NSW: 4%; Victoria: 7%; Queensland: 3%) and land tax surcharges (NSW: 0.75%; Victoria: 1.5%) in other major states in Australia (Tan, 2016).

The re-imposition of compulsory notification, screening and approval at the front end, and forced sale of properties when temporary residents leave Australia, is indicative of the Australian government's intent to guarantee that more housing is available to Australian people. This tight approval process before permitting purchases further shows the government's close monitoring of the property market.

It can therefore be concluded that the Australian investment environment is well regulated and relatively mature compared with that in many developing countries. This mature regulatory investment environment itself appeals to overseas buyers.

Recent purchases by Asian buyers

Since 2013, Asian investors have shown a strong interest in Australian residential development sites and off-the-plan apartments (Needham, 2017). This is mainly a consequence of the political and property policy changes in Asian countries, which have

generated uncertainty around their own countries' investment environments.

For example, China transitioned to a new leadership, with Xi JinPing replacing Hu JinTao as general secretary of the Communist Party in November 2013, along with six new appointments to the party. The new Chinese government has already introduced tougher home purchase rules in around 40 cities to control house prices, and has introduced a property tax in both Shanghai and Chongqing. Moreover, there are also plans to impose a nationwide real estate tax. These measures are currently encouraging Chinese property investors look offshore instead of investing locally.

Malaysian investors are also considering increasing their investments in Australia ahead of a national election, planned before August 2017, as political tensions are rising following the deportation of Australian independent senator Nick Xenophon in February 2013 due to his apparent support for the then opposition leader Anwar Ibrahim. These events have prompted questions about Malaysia's democratic freedoms and caused concern among investors about investing locally.

Many other factors are also attracting Asian buyers to invest in Australian apartments as detailed below.

This group of investors favour an apartment–style living lifestyle, are often very highly educated and enjoy the benefits of being located close to amenities, recreation facilities, educational institutions, transport and employment. They do not like long commutes and prefer ready access to playgrounds, local parks, restaurants and similar.

The Australian market offers a good return on investment, as indicated by low vacancy rates and a relatively high rental yield, as well as easy management of investment properties. Australian investments are also made attractive by the mature, well-managed, transparent regulatory system which enables investors to have confidence when purchasing properties in Australia.

Asian buyers are very active in Australia. For example, Chinese developers have invested almost $500 million in Melbourne alone during the past two years. And the Shanghai Greenland group is spending $1.2 billion on property projects in Australia according to the Australian Financial Review (Chittenden, 2013). Indeed, in 2013, foreign buyers purchased one in every eight new build properties, up from one in 20 properties in 2011, according to National Australia Bank research (Chittenden, 2013).

Colliers International's managing director of residential property in Australia, Peter Chittenden, stated that Asian buyers are purchasing 60 per cent of the units being sold off-the-plan in big developments. He added that overseas buyers had snapped up two in every three of the 588 luxury apartments in the Singaporean-owned Tower Melbourne development, which was constructed as the city's tallest building (Chittenden, 2013).

Offshore property marketing specialist Damon Nagel, the managing director of Iron Fish, a property management company in Adelaide, stated that many Asian investors were abandoning Singapore and Hong Kong in favour of Australia. He went on to say "Australia is very much seen as the Switzerland of Asia - it's a neutral country with a strong government, reliable currency and stable marketplace" (Chittenden, 2013).

Foreign investors have bought 15% to 20% of the 710 apartments being built by Pearls Australasia and Metro Property Development in three towers in the inner-Brisbane suburbs of Bowen Hills and Fortitude Valley. Pearls Australasia executive director David Higgins claims Asian buyers are more likely to buy the more expensive apartments (costing more than $600,000), which offer extra space or views: "They see Australia as a safe bet" he added (Chittenden, 2013; Allens, 2016).

Global realtor CBRE has stated that inquiries from offshore buyers for off-the-plan apartments and industrial development sites doubled over the period from March 2013 to September 2013 (Chittenden, 2013). Furthermore, Asian investors have pushed up CBD land

prices in both Sydney and Melbourne. Average land value for purchases made by foreign investors was three times in 2013 what it was in 2009. (Chittenden, 2013).

The above comments from various real estate developers illustrate the strong interest of Asian buyers in Australian investment properties. As outlined previously, significant increases in house prices have recently affected Australian property. The high demand from Asian buyers has definitely contributed to this, and this raises the question of whether Asian investors' purchases are speculative in nature, with potential to create a bubble position in the Australian property market.

Chinese people are buying in Australia with expectations of capital growth, hoping to provide a home for their children who attend university there, or are simply planning to live outside China. They believe that investing in Australia is secure, due to the more established regulatory system, the shortage of housing supplies and the steady economic environment.

Therefore, their interest in the Australian housing market is likely to create high demand and push up Australian property prices. However, Asian buyers do not ignore demand and supply fundamentals when making their purchase decisions. Their expectations are based on rational justifications deduced from properties' historical performance, rather than the irrational expectations of a continuous indefinite increase.

As such, Asian investors' large purchases are unlikely to lead to a bubble situation in the short term. There is risk of a bubble in the long run if additional irrational investors and speculators enter the market hoping to manipulate it in order to make profits, or if investors expect the property prices in Australia to rise indefinitely.

Foreign investment in residential property

In December 2008, the federal government introduced legislation relaxing the rules for foreign buyers of Australian property. According to Foreign Investment Review Board (FIRB)

data released in August 2009, foreign investment in Australian real estate had increased by more than 30% since 2007.

In April 2010, the government announced amendments to its policies to "ensure that foreign non-residents can only invest in Australian real estate if that investment adds to the housing stock, and that investments by temporary residents in established properties are only for their use whilst they live in Australia" (FIRB, 2016).

Under the rules, temporary residents and foreign students will be:

1. Screened by the Foreign Investment Review Board to determine if they will be allowed to buy a property;
2. Forced to sell property when they leave Australia;
3. Punished if they do not sell by a government-ordered sale plus confiscation of any capital gain; and
4. Required to build on vacant land within two years of purchase to stop "land banking".

Failure to fulfil these conditions would leave the purchaser subject to a government-ordered sale. Several Australian Banks currently provide home loans to non-residents for the purchase of Australian real estate, and this is another factor thought by some to have contributed to have fuelled increases in Australia's property prices.

2.3 China's housing market

2.3.1 Performance of China's property market

Since 1978 China has implemented an open door policy focused on promoting its economic development to become the world's second largest economy. As part of the ongoing change, the welfare housing distribution system was replaced with an openly trading real estate market in 1998.

Over the last 15 years China's housing price index has risen by at least 70% on this freely traded open real estate market (Hoon, 2013). According to Reuters, average new home prices in China's 70 major cities rose a record 9.6% in the year to October 2013; it was the tenth straight month of year-on-year increases in 2013.

Moreover, China's house prices rose at their fastest rate, with Beijing witnessing the highest house prices in China, rising by 16% in the year to September 2013. These figures were the culmination of a boom period from 2003 to 2013, known as the "golden age" of China's prosperity in terms of house price performance. However, this position became unsustainable during the economic period of the "new normal" (2014 onwards), as the pace of house price growth slowed down and the real estate market became sluggish (Zhang et al., 2016).

The Chinese government has implemented a four-year campaign to cool the housing market by restricting home purchases, raising down payments and curtailing bank lending to the real estate sector (Hoon, 2013). Meanwhile, China also has "ghost cities" with many empty houses and high vacancy rates, such as in Weizhou and Ordos. This phenomenon is affecting China, due to the collapse in exports in some areas, which results in low value added manufacturing sectors and problems with local governments' balance sheets.

In general accelerated growth is concentrated in Tier 1 and Tier 2 cities, which are driving the country's burgeoning real estate industry in response to consumption and strong demand. Soaring prices are a major concern for urban Chinese aspiring homeowners, as they find house prices are becoming increasingly unaffordable.

There are strong concerns that there is a housing bubble in China with the potential to severely threaten the health of the world's second largest economy. There could be a huge impact if such a bubble were to burst in China. Consequences would include a slowing in GDP and some people would lose their life savings overnight. In addition, foreign investments would fall due to lack of confidence in the Chinese economic environment.

2.3.2 Government regulation

The Chinese property sector is a crucial growth driver in the country, propelling growth in other industries. However, the country's immature regulatory systems and potential for illegal irrational speculative activities have led many to fear that China's soaring market denotes the presence of a property bubble.

Therefore, China's policymakers and central government are closely monitoring property prices and implemented measures, including boosting the supply of housing for middle-income families and punishing illegal speculative activities in to calm rising discontent over the record-highs in house prices. After the global financial crisis in 2008, the Chinese government ploughed USD586 billion into stimulus spending (the treasury working paper 2011-01, 2011), much of which went into infrastructure, including building more houses to meeting the demand prompted by growing urbanisation. To manage speculation, the central government has raised the minimum down payment for second home purchases from 50% to 60% of the property's value, alon with approving the launch of property taxes in Shanghai and Chongqing.

Moreover, to meet genuine demand, a new category of housing for middle-income earners has been introduced. According to the Beijing Municipal Commission of Housing and Urban – Rural Development office, these new categories of homes will cost more than public housing, but will be 30% lower to purchase than normal residential real estate (Reuters, 2013).

The objective behind introducing this new category is to further balance the supply of homes, and to support demand for owner-occupied apartments while also stabilising market sentiment.

In addition, measures are being taken in specific regional contexts. For example, the Beijing municipal government has issued new rules limiting the number of houses a family can buy in attempts to cool the property market. These new restrictions prohibit new house purchases by

Beijing families who already own two or more apartments, and non-Beijing registered families who own at least one apartment.

Non-Beijing registered families without residence permits or documents certifying that members of their family have been paying social security or income tax for five straight years in the area are also banned from buying apartments. Beijing's new rules also allow banks to further raise down-payment requirements for apartment buyers and to raise interest rates on mortgages.

The government has also introduced new policies to manage speculative activities. For example, speculators found to have avoided government controls that bar residents from owning more than two homes are to be stripped of their houses and prohibited from buying real estate in Beijing for the next five years. Beijing authorities will also bar developers from selling homes if they do not accept the government's "guidance" on pricing.

In addition, the government will also provide guidance for property developers on how to set prices reasonably. Elsewhere, almost 30 cities across China have announced house purchase limits. Alongside these measures, investment in housing is focusing on second and third–tier cities by imposing home purchase limits, aiming to encourage buyers to purchase in other cities across China (Hoon, 2013).

In addition, authorities are also tightening mortgage regulations to ensure speculators are not granted loans, and to closely scrutinise sources of financing (Hoon, 2013). As a result, speculative, investment-driven purchases have fallen to 10% of all home purchases, from around 50% since the implementation of the new policies in 2013.

China has imposed many different regulatory and lending requirements on properties compared with Australia. For example, property taxes are only used in a few cities, and are not applicable to most households. The mortgage rate is not adjustable and interest rate only

mortgages are not available to most Chinese buyers. In addition, there is no scope for tax deductibility on borrowing for investment purposes.

While it is uncertain whether the government controls benefit the economy in the medium to long term, this intervention reduces the risks of lending in the short term and mitigates illegal speculative activities.

2.3.3 Housing demand in China

China, has the highest GDP growth in the world, as well as the second largest economy. It experiences strong housing demand arising from multiple factors including demographic factors, increased income, low interest rates, easily available housing loans and investment preferences. Details are as outlined below.

Demographic factors

Demographic factors are among the most important influences on China's housing demand. China's population in 2012 was 1.347 billion. The population in 2013 was 1.354 billion and 1.382 billion in 2017. (China population website, 2017)

The one child family planning policy started in 1981 (population reference bureau, 2012), and since then, the population growth rate has declined year on year (see Figure 2.4). Nevertheless, the country's large population base has driven strong demand for housing in China. More recent statistics show the total population in 2017 represented an average annual increase of 0.50% between 2012 and 2017 (China population, 2017).

Since 1979, Chinese people have become progressively wealthier. Their disposable incomes have increased dramatically each year and increased household income has created a desire for Chinese people to own better homes and improve their life styles. Property ownership has also became a symbol of wealth and high class in China.

Year	Population (million)	Growth Rate (%)
2008	1,321.29	0.52
2009	1,328.02	0.51
2010	1,334.50	0.49
2011	1,340.91	0.48
2012	1,347.35	0.48
2013	1,354.04	0.50
2014	1,360.72	0.49
2015	1,367.82	0.52
2016	1,375.13	0.53
2017	1,382.49	0.53

Figure 2.4 China population and growth rate

Source: Worldometers Website, 2017

The growth in Chinese people's disposal income rose steadily from 2005 to 2011. There was a minor decrease in 2009 caused by the global financial crisis, but its impact was not severe. The bounce back after the global financial crisis in 2008 - 2009 was due to government stimulus spending, as mentioned above, and the imposition of macroeconomic controls on the country's GDP development.

The increase in disposal income has resulted in the many large scale property investments. The most recent data shows, disposable income in China continued to increase from 2011 to 2015, rising by 46% in this period (trading economics database, 2017).

Furthermore, the boom in the Chinese property market was heavily supported by the non-stationary fundamentals of rapid real GDP growth, wage inflation and increase in private wealth. In 1990, China's average per capita national income was around AUD350. Within a

decade, a threefold increase occurred, taking the figure to AUD1,000. By the end of 2008, the figure had tripled and China's average per capita national income reached another high of $3,000. If China's average national income continues to rise at an annual rate of 8%, the countries per capita income will reach $8,500 by 2020 and will touch the $20,000 mark by 2030. If this occurs, then China's average per capita income will exceed the current incomes of Taiwan and Korea and will raise housing affordability in China in the long term, assuming ceteris paribus (Kenneth, R, 2011).

As the world's highest saving country, Chinese households have strong balance sheets with Chinese residential mortgage debt being 15% of GDP as of 2009, compared to 81% in the US (Junheng, 2013).

In China, property buyers typically do not incur a lot of debt when buying property; cash has traditionally been the principal mode of payment. Unlike other countries, the amount of Chinese real estate financed by mortgages is quite low, albeit much of the leverage behind residential real estate consists of borrowing from friends and family, which is not recorded on balance sheets.

Urbanisation, home upgrading and favourable demographic change

In 1980, just 19.8% of China's population were urban dwellers, compared with 23.1% in India. By the end of 2008, the urbanisation rate had reached 45.7%, much higher than India which had stagnated at 29%. According to BNP Paribas (BNPP), China's urbanisation rate is expected to reach 60% by 2020 (see Figure 2.5). The urban population rose from 191 million in 1980, to 502 million in 2002, to which a further 100 million was added over the next five years (Guillaume & Gullaume, 2013). In 2012, the urban population had increased to 702 million.

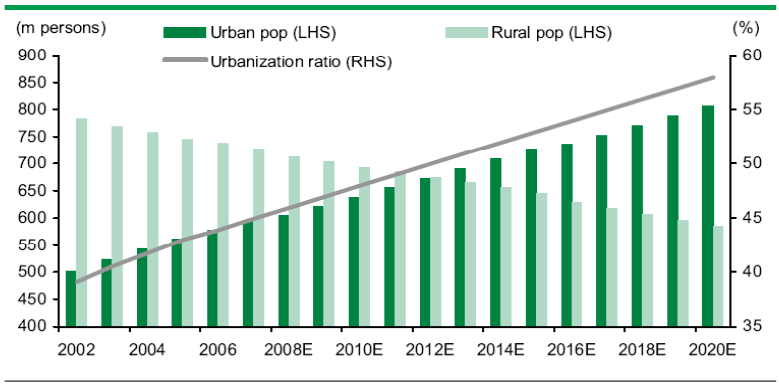

Figure 2.5 Urbanisation trend

Source: Guillaume & Guillaume, 2009.

The from this urbanisation has had a direct and immediate impact on real estate investment, triggering a spectacular demand for raw materials and capital equipment. Furthermore, a one percent increase in the urban population triggers an expansion of five percentage points in the use of raw materials, and construction materials such as cement, steel, copper and aluminium.

The result is that, for example, China now consumes more than half of the world's concrete (as of 2007). Simultaneously, energy consumption has risen by 2-3 points, influencing both the construction industry's capacity to keep pace with demand and the supply of housing in China. Interestingly, according to Mccarthy (2014), China used more concrete in three years than the U.S. used in the entire 20th century.

Low interest rates

China has very low interest rates, due to the economic strategy it employs to encourage Chinese people to consume in order to boost GDP growth. The emphasis of low interest rates is on creating easy credit for Chinese people borrowing from banks wishing to purchase properties. At the same time, low interest rates and easy credit also assist property developers to construct more houses, thereby increasing the purchase of properties by speculators. Updates to these statistics reveal interest rates have fallen since 2012 to reach a record low of 4.35% in Oct 2015 (Trading Economic Website, 2017).

The changing family structure

Historically, Chinese people have lived in large families with multiple generations sharing the same house. Chinese people have lived a life style that is very family orientated and traditional. However, with the rapid expansion of the Chinese economy, and the introduction of Western culture to the younger generation of Chinese, more and more families are living separately when younger couples marry. Household members used to include grandparents, parents and children; however, now the trend is towards households comprising a younger couple and one child. This new trend is also fuelling the growing demand for housing in China.

Social values of Chinese people in housing

Chinese people have very traditional preferences in terms of their ownership of housing. China has the highest household savings rate in the world. The saved wealth of Chinese people is predominantly being spent on purchasing properties and investing in shares.

Chinese people do not like to live in rental properties, due to perceived lack of security and a reduced sense of belonging. Research has suggested that many people from the spot-checked 10 largest cities, including Beijing, Shanghai and Tianjin prefer to own their own homes.

Moreover, Chinese people do not like to lose face. If they do not own their houses, they feel they are less important than others. Traditional Chinese values also expect that men should purchase a property before marriage if they want to marry a “good” wife. All these social values are contributing to the accelerating demand for housing in China.

Increased housing loans

Due to the large demand for housing properties, mainly caused by demographic factors, urban trends, social values, low interest rates, Chinese banks have relaxed the lending conditions

imposed on borrowers. This affects the balance of demand and supply in the housing market, and is expected to cause problems in the Chinese property market over time.

As shown in statistics issued by the National Bureau of Statistics of China, total individual housing loans were about 42.6 billion Yuan in 1998, while by the end of 2007 this number had increased to 2.7 trillion Yuan. In addition, total real estate development loans in 2008 provided by China's banks were 725.7 billion Yuan at a 3.4% growth rate in 2007 (Xiao and Lundstrom, 2010).

Based on recent data from the Central Bank of China, "China's home lending is larger than the entire economy of India. The housing boom there has no bounds, growing 19% year over year in Sep 2013 to a total of 2.31 trillion Yuan in new home loans." (Rapoza, 2013)

Investment preferences

As one of the highest saving countries in the world, Chinese household wealth has increased significantly with national high economic growth. The wealth in the pockets of individuals has led them to search for the best ways to invest. In recent years, investments in Chinese share markets and other financial markets have been quite challenging due to their unstable character; this has increased the large capital flow into Chinese property markets.

Furthermore, despite the growth in wealth management products, the asset menus available to most Chinese investors are restricted. Most investors can only access deposits with regulated rates just above inflation and domestic stocks from companies with poor governance.

According to Bloomberg (2016), despite four years of growth in China post the global financial crisis, China's stock market has lost more money for investors than any other in the world. The Shanghai Composite Index (SHCOMP), which doubled in 10 months through to August 2009 as the government poured USD586 billion of stimulus into building roads,

railways and housing, has tumbled 43% from its peak, destroying USD748 billion in market value.

Chinese companies were ranked among the world's 10 biggest by market value for the first time in June 2013. The country's stock market was then like a "dead animal" destroying investors' wealth (Frost & Lim, 2013). More recent data show that, by the end of 2016, China's share market had improved by 41% from June 2013 to Feb 2017 (Trading Economics website, 2017).

As a result, the soaring price of properties in China has led many investors to view real estate as a better alternative than saving to accumulate wealth.

2.3.4 Housing supply in China

Supply within the Chinese housing market is very complex due to the constantly changing regulatory system, the cumbersome process of construction undergone by developers, and the changing government policies concerning housing construction to align with the country's GDP growth. Some details of the factors affecting housing supply in Chinese markets are discussed below.

Huge profits from the construction of properties

China is well known for low labour costs and the cheaper cost of inputs into its manufactured products. The impact of this on housing construction is a potential to reap large profits from the development of housing properties, due to the much higher property prices versus the materials inputted.

Easy credit from banks has also helped developers to build more properties, which could then be sold at a high profit margin. The large demand arising from China's huge population has continuously pushed up the prices of properties. As a result, developers have been lured into constructing more and more properties in order to make even greater profits.

Real estate as a pillar industry in China's economy

The real estate industry has been regarded as an important pillar industry, supporting China's economy. With the country's expectations of strong economic growth, the government has predicted that the real estate industry will grow continuously, enhancing the country's strong economic growth overall.

Thus, to assist the development of real estate industry, the government has implemented a number of fiscal policies.The real estate industry has grown quickly and contributed strongly to the country's GDP growth (Xiao and Lundstrom, 2010). However, the fast development of the real estate market creates many opportunities for speculation, which could push the real estate industry into an unhealthy bubble.

Government controls on the availability of land

Chinese local government's monopoly on the control of land has a unique impact on the country's housing supply. Currently, local government performance is measured by the income index, so there is an incentive for local government to sell land at very profitable prices to developers, in order to increase the local government's fiscal income. In addition, some local governments have even undertaken promotional policies to encourage local residents to buy properties and to persuade developers to purchase more land.

Based on data from the National Bureau of Statistics in China, 30% - 40% of local government income was generated by both bidding for and the renting out land (Xiao and Lundstrom, 2010). This large contribution to local government income will potentially lead to a deviation from the fundamentals of house pricing.

Large amounts of construction

China has seen a large amount of construction over the last 15 years. According to the Economist Intelligence Unit:

> *At current rate of construction, China can build a city the size of Rome in only two weeks. In the decade leading up to 2010, China built houses equivalent to roughly twice the total number of houses currently in Spain or the UK, or about the same number as Japan's current total housing stock (Economist Intelligence Unit, 2013).*

This construction will boost supply considerably in China's real estate market, influencing market prices by moving them above fundamentals. Excessive construction in China could also lead therefore create the possibility of irrational speculative behaviour and the formation of a property bubble.

The findings reported reveal the importance of factors associated with housing demand and the impact of supply on house price performance. They provide a good understanding of the housing market and provide as a basis for conducting empirical tests on house price dynamics for Australia and China. Moreover, a useful distinction in the demand and supply factors that drive house price dynamics lies between long-term and short-term influences. Long-term factors incorporate fundamentals such as demographics, household income and tax regime (Tsatsaronis and Zhu, 2004; Meen, 2011). In a short run, the institutional structure of the housing finance system and prevailing mortgage lending conditions affect volatility in house prices via the cost of mortgage credits and availability of mortgage funds (Whitehead and Williams, 2011; Scanlon and Whitehead, 2011). On the other hand, housing supply is not elastic in the short-term; that is the changes in house prices causes small changes in supply but are elastic in the long-term. (Sivitanidou, 2011)

Furthermore, this chapter illustrates the specific but different indicators affecting Chiense and Australian house prices. The two countries' housing markets contain significantly different demographic, social and economic fundamental backgrounds and thereby lead to very different house price performances. Common to both countries' house prices are the driving in a long run by planning, availability of land etc and legal infrastructure and housing policies.

Over the short run, house prices in these two coutnries are also driven by availablity of housing finance had mortgage costs, although to different extents.

CHAPTER 3
LITERATURE REVIEW

3.1 Executive summary

This chapter analyses the relevant literature pertaining to housing bubbles, house price spillover and house price macroeconomic relationships. Spillover effects are examined because they are an important aspect of house price dynamics. The aim in doing so is to establish a theoretical context in which to position household purchase decisions, informing the empirical specifications for econometric estimations and identifying gaps in the existing research. Recognising the importance of national and regional house prices, this review offers an overview of the main drivers of house prices, followed by a review of historical studies of housing bubbles, continuing with a discussion of the literature pertaining to macroeconomic relationships and spillover effects. Literature regarding the main drivers of house prices, housing bubbles, the influence of macroeconomic relationships on house prices and effects on house prices are outlined in Chapter 3.

Key literature

House price main drivers

With the majority of mortgages and many small business credits being secured against residential properties in Australia, property plays a critical role in securitisation, backing financial institutions' financial position statements (Kohler and Van Der Merwe, 2015) and contributing to growth in property related industries, and thereby countries' economic growth and financial stability. Since house price in China and Australia all experienced paramount changes over the last two decades, to understand the main drivers of house prices will add

great value to manage housing market performance and countries' economic performance.

Previous literatures has discovered that housing investment provides a large direct contribution to household wealth (Rahman, 2008), although Miles (1993) demonstrated a small net effect on household wealth because of the impact on household savings and consumption. Englund and Ioannides (1995) concluded that house prices and house returns are predictable, based on their own past values (Wang and Xie, 2012).

Tsatsaronis and Zhu (2004) highlighted the importance of macroeconomic factors, and demand and supply factors influencing the dynamics of residential real estate prices (Chinloy, 1992; Kohler and Van Der Merwe, 2015; Otto, 2007). Further, evidence of cyclical behaviour was identified as influencing house price changes in Hendershott and Abraham (1995), and Muellbauer and Murphy (1994) claimed a combination of rational and irrational expectations drive cycles.

The findings to date suggest variation in the long run and short run real house prices determinants (Tu, 2010; Otto, 2007). Further, the associated demographic forces lead to smaller sized households, and a greater demand for houses among the population (Kearns, 2012; Kohler and Van Der Merwe, 2015; Richards, 2009a, 2009b).

Housing bubble

The term "bubble" is widely used, but rarely clearly defined (Case and Shiller, 2004). With the most popular definition relating to long-term equilibrium prices, whereby when the long-run equilibrium price is measured according to market fundamentals, house prices that significantly differ from the long-run equilibrium prices indicate a likely bubble (Diba and Grossman, 1988; Flood and Hodrick, 1986). Teng et al. (2013) argued that a bubble exists when there is an unreasonable expectation that house prices will increase forever, and when prices differ excessively from their true fundamental value.

Concerns over difficulties measuring fundamental house price values empirically were raised by Hui and Yue (2006). They question of what is an appropriate measure for determining the fundamental price of housing is significant as a value must be established as a baseline to ascertain the existence of bubbles. Elsewhere, Flood and Hodrick (1990) offer evidence of difficulties estimating intrinsic value, due to the lack of data extending infinitely into the future. Thus, it is necessary develop new perspectives from which to explore bubble testing.

To resolve these complications, Hui and Yue (2006) introduce the concept of "exogenous macroeconomic fundamental variables" to establish housing bubbles, to overcome the difficulty of measuring the intrinsic value of assets. Their work implies that if property prices are driven by macroeconomic fundamentals, such as the disposable income of urban households, local GDP, Stock Price Index, the stock of vacant new dwellings, and if residual values raise no major diagnostic concerns, then there is no housing bubble.

To date, related work comparing the econometric techniques applied to test bubbles in studies of house prices is limited. Informing an empirical analysis of housing market dynamics, and understanding the strengths and limitations of various models is crucial for any study of housing bubble risks (Hou, 2010; Phillips et al., 2013; Shi, 2016; Stevenson, 2008; Teng et al., 2013).

The effect of macroeconomic relationships on house prices

According to Adam and Füss (2010), house prices can exhibit a feedback reaction to the macro-economy. Several recent studies have indicated that macroeconomic shocks, such as unexpected changes in monetary supply, industrial production, and interest rate changes influence house prices, with a lag dependent on the speed with which financial information flows (Adams and Füss, 2010; Kaspavora and Whilte, 2001; Tsatsaronis and Zhu, 2004; Yu et al., 2012; Yu and Huang, 2016).

Käfer (2014) commented that central banks commonly react to financial instability by initiating interest rate cuts, since changes in interest rates affect the cost of borrowing. The resulting impact could be a downturn in house prices under circumstances where excessive interest rate reduction occurs (Apergis and Rezitis, 2003). However, another study reports no significant relationship between house prices and interest rates (Huang, Wu, and Du 2008). Conversely Otto (2007) argues that house prices are indeed significantly affected by real mortgage rates.

It has been found that changes in house prices can affect aggregate demand and supply within a society (Yu and Huang, 2016). Elsewhere, employment and household income are identified as influential factors driving house prices (Baffoe-Bonnie, 1998) Related work on the stock market shows it can impact the real estate market. (Okunev, 2002).

Spillover effects on house prices

Historical research supports the expectation that house price shocks would affect different areas (Alexander and Barrow, 1994; Cook, 2005; Macdonald and Taylor, 1993; Meen, 1999; Stevenson, 2004; Tu, 2000).

Fereidouni (2014) defined a ripple effect as a phenomenon that occurs when a house price shock in one location or region spillovers and influences prices in other locations. Other details relating to spillover effects are presented in the next few sections.

Meen (1999) presented empirical evidence detailing four possible explanations for the interactions arising from the observed pattern of ripple effects: i) migration ii) equity transfer iii) spatial arbitrage, and iv) spatial patterns determining house prices. Additionally, Muellbauer and Murphy (1994) found that migration in conjunction with equity transfer increases the value of house prices in the new region. However, Gordon (1990) and Holmans

(1990) argued that the impact of migration and equity transfer on house prices are weak, measurable only in a limited number of empirical studies. From a theoretical perspective, it is important to understand the causes of spillover effects and its implications in house prices since the national and regional house prices are closely related and affected by each other.

Meen (1999) and Pollakowski and Ray (1997) studied the house price spillover effect in the UK, suggesting geographical proximity to be an important factor transmitting house price rises from one region to another. They observed that house prices rise first in one region, then spread throughout the remainder of the UK.

Some housing markets are recognised as being more highly interdependent and integrated than others (Chen et al., 2011; Diebold and Yilmaz, 2012; Pollakowski and Ray, 1997). For example, Meen (1999) studied a market composition model with applying spatial coefficients for heterogeneity and noting regional housing markets as cause of heterogeneous coefficient effects, due to the various macroeconomic variables affecting regional house prices.

Holly et al. (2011) demonstrated that in the UK house prices within each region in the UK react directly to shocks to London, and subsequently the effect of shocks expands both through the internal dynamics of each sub-housing market and interactions with neighbouring sub-segment housing markets. Furthermore, they concluded that London's house prices are directly impacted by New York's house prices, since the global financial centre in London has close ties with New York. The findings suggested house price spillover affecting Malaysia extends across the border to Singapore (Fereidouni, 2014).

Stevenson (2004) presented evidence that geographical, economic and demographic proximity could ease the dispersion of information in housing markets between the Republic of Ireland and Northern Ireland. Their results suggested limited house price spillovers in the Eurozone. (Vansteenkiste and Hiebert, 2011).

Related work on the ripple effects affecting Australian house prices principally focused on Australian large capital cities up to the early 2000s.

The dynamics of real house prices in Sydney appear to have a significant influence on national real house prices or other cities' house prices according to Tsai (2015). Although Tu (2011) argued that Sydney real house prices neither dominate national house price dynamics nor house price dynamics in other cities in the long run. In the short run, they do influence prices in Melbourne only.

However, Liu et al. (2013) suggested that Melbourne could be identified as the dominant housing market; confirming long-run equilibrium relationships between the house price levels in Melbourne and other capital cities. Finally, Liu et al. (2013) presented evidence that the two biggest cities in Australia, Sydney and Melbourne, have the most stable housing markets, with markets in Adelaide, Brisbane and Canberra being relatively sensitive to outside influences.

Yu and Huang (2016) studied the significant spillovers between house prices throughout China's 35 major cities. Their findings suggested spillovers in house prices in first-tier cites exceeded those in eastern cities, while spillovers affecting the house prices in eastern cities were higher than those in central and western cites. The evidence presented demonstrates that the positive feedback mechanism from house prices in first-tier and eastern cities is distinct, although that in central and western cities is only moderate. In summary, previous studies on spillover effects in China are limited. None of the research has focused on the top 13 major cities in China's first and second-tier housing markets.

Theoretical framework

The central ideas informing house price dynamics and bubble literature (Chan et al., 2001; Flood and Hodrick, 1990; Kim and Suh, 1993; Mikhed and Zemcik, 2009) proceed from rational expectation theory and the theory of housing demand.

Hou (2010) states that the theoretical model elaborating rational expectation theory in housing bubble analysis aims to assess whether a housing bubble exists by calculating the deviation between observed house prices and expected prices. Moreover, according to the theory of housing demand, a smaller amount of space or number of units is demanded at a higher price. Thus the central notion determining housing demand suggests effective market demand is backed by purchasing power (Sivitanidou, 2011). A number of studies have offered evidence regarding key indicators associated with housing demand theory (Abelson et al., 2005; Kohler and van der Merwe, 2015; Otto, 2007).

Limited analysis has been performed to capture both the implications of the Australian and Chinese house price spillover effects and house price dynamics for major regions; therefore, this research aims to address this knowledge gap by being the first to study questions at the regional level, focusing on dimensions associated with Australia's largest four cities and China's largest 13 cities. As outlined in Chapter 3, few studies have considered the existence of spillover effects across borders between Australia and China. There is a need to investigate this aspect further and in-depth, owing to the close economic relationship between China and Australia. Further, Zhang et al. (2016) suggested that previous studies on the relationship between house prices and macroeconomics in China had focused only on the national real estate market overall instead of on just segments of it. However, both China's and Australia's real estate markets act very differently in different tiers of cities; therefore, it is insufficient to study the relationship between the real estate market and the macro-economy at the national level. Importantly, the in-depth evidence available covering both bubble effects and the main drivers of house price change for China's 13 main cities, sharing both the prosperity period of the "golden age" (2003 – 2013) and the "new normal" era (2014 onwards) (Zhang et al., 2016) and Australia's most recent housing boom from 2012 are relatively limited. The existing literature reports some absent data and ambiguous results, possibly relating to the limitations associated with the data and lack of research debates. Thereby, this research adds a paramount

contribution by filling in gaps in the knowledge.

In the following chapter attention turns to an empirical study of house price dynamics in China and Australia. Chapter 4 provides a detailed review of a combination of rigorous methodologies and empirical specifications.

3.2 House price main drivers

3.2.1 General

For the majority of Australian householders, residential property is their most overbearing asset. The associated mortgage costs demand the commitment of a major proportion of household wealth, while the property itself serves a dynamic dual role as an investment channel and a lasting consumer product.

With the majority of mortgages and many small business credits being secured against residential properties in Australia, property also plays a critical role in securitisation and the backing financial institution's financial position statements (Kohler and Van Der Merwe, 2015). Thus, house price movements impact on and proceed from a number of associated economic variables. For instance, household wealth directly influences property purchases, and property investment stimulates the economy taking the form of investment when projected returns exceed the breakeven cost of the investment (Tobin's Q relationship); while the impact of small businesses facing liquidity constrain investment and economic growth.

The real estate market exerts an important influence over the construction industry. If property prices exceed the cost of construction, it is profit savvy to engage in new construction. Thereby, growth in the construction sector improves employment rates and creates demand in property-related industries. The impact of this can be considerable, as real estate investment usually reflects a substantial proportion of the wealth within an economy (Rahman, 2008).

Furthermore, the effects of property prices on construction are impacted by other important real estate sectors, the elasticity of real estate supply, and the concurrent credit situation. Additionally, the presence of rigidities affecting supply and planning regulations could create high pent up demand for housing.

When property prices decrease, borrowers heavily mortgaged might eventually find themselves in 'negative equity'. This arises when household borrowers owe more on their mortgage loans than is held in the current market value of their properties. This raises the probability of mortgage default, causing the non-performing loans held by banks and other lenders rises. Thus, the lending capacity of lenders for all purposes falls, with potentially unfavourable effects for the economy overall (Berry and Dalton, 2004).

Zhu (2003) suggests that changes in property prices can have a sizable impact on the banking industries' performance overall. In particular, declining property prices could bring the banking sector to an economic crisis point via various channels. For example, this would manifest in an increase in loans, defaulted expenses on property loans, or through the financial hardship of borrowers and banks themselves, or indirectly through a recession in economic activity and transactions.

Kohler and Van Der Merwe (2015) presented evidence that changes in house prices also influence financial stability due to their influence on household balance sheets and a bank's balance sheets becoming securitised by assets.

Housing investment has a large direct contribution to household wealth. Thereby, research suggested households tend to feel significantly less wealthy when house prices fall. As a result, householders reduce consumption, which in turn leads to reduction in the aggregate demand in the form of economic activity increasing the risk of an economic recession (Rahman, 2008).

Furthermore, when people borrow massive amounts to purchase houses, they do not invest

heavily in other vehicles. Thus, the percentage of households without a mortgage has been declining over time. Perception of over-indebtedness may lead some borrowers to largely reduce their consumption during times of falling house prices especially when interest rates are rising (Rahman, 2008).

Evidence provided by Englund and Ioannides (1995) compared house price dynamics in fifteen OECD countries based on data covering the period 1970-1992. Their research suggested a remarkable degree of similarity in house price dynamics. Particularly, the evidence suggested the GDP growth rate and the rate of change in real interest rates varies significantly along with first-order lag, reflecting a strong predictive power on house prices. They further explained that house price dynamics are commonly on the agenda for a number of reasons: i) owner-occupied homes contribute to a large component of private-sector wealth, and so house prices may affect aggregate demand due to household saving and consumption preferences; and ii) the mechanism renders the redistribution of houses throughout their different life cycles important.

Further, they challenged the suggestion that an increase wealth would occur due to increases in asset prices. They suggested that increased asset prices indicate higher rental costs for owner-occupied housing, which could offset the impact on real wealth when taking into consideration the appropriate cost-of-living index.

Contributing to discussions concerning the impact of house price increases on households' wealth effect, Miles (1993) demonstrated a small net effect on household wealth due to the impact on household savings and consumption. This was countered who explored evidences from empirical research that a number of countries identified large and statistically significant effects between increased house prices and growth in householder wealth. One possible explanation given for this by Englund and Ioannides (1995) was that any statistically significant effect mainly relates to the household balance sheet composition due to debt-

equity ratios rather than from net wealth per se. Their analysis of this new aspect was based on the common notion that mortgage expense contributes significantly to the household balance sheet. Households tend to increase their mortgage borrowing when encouraged to do so by low-interest rates. The empirical importance of household indebtedness and borrowing constraints had earlier been identified by Muellbauer and Murphy (1992).

In brief, Englund and Ioannides (1995) concluded that house prices and house returns are predictable based on their own past values. Interestingly, they questioned what other factors might contribute to successfully predicting prices. In answer to this, Case and Shiller (1990) had previously suggested the level of construction costs and the percentage change of the demographic population adds weight to forecasting accuracy. Furthermore, Mankiw and Weil (1989) emphasised the importance of demographics on returns on housing, as one kind of interest-bearing asset.

More recently, Tsatsaronis and Zhu (2004) concluded that house prices generally are affected by factors including inflation, the yield curve and bank credit, and so the characteristics of individual mortgage markets are also significant. Furthermore, house prices are more sensitive to short-term rates and floating rate mortgages, due to stronger feedback mechanisms from prices to bank credit. Further, Tsatsaronis and Zhu (2004) highlighted the importance of macroeconomic factors influencing the dynamics of residential real estate prices, suggesting 17 cross-country differences based on data from 1970 to 2003 due to the structural features of the various national mortgage finance markets.

These findings summarise key features to note as follows: i) there is a strong and long-lasting correlation between inflation and nominal interest rates with house prices. This evidence shows that long term elevated inflation, followed by a sharp decline in house price growth, may in the shorter term lead to asymmetric performance between house prices and the main macroeconomic drivers; and ii) extensive implications from house price growth on financial

stability were found. Moreover, the feedback from property prices to credit growth is the most significant in countries that have prevalence of variable rate mortgages, plus market-based property valuation processes.

In summary, the above studies took an empirical approach to ascertain factors to clarify the extent of the "efficiency" of housing markets. Detailed analysis could then be performed on the types of shocks that drive the movement of house prices and house returns away from the predicted values as follows. Chinloy (1992) found anticipated inflation to be the primary macro driver impacting on house returns. Hendershott and Abraham (1993; 1994) identified changes in construction costs, employment rate, income growth and real after tax interest rates drive house price changes.

Further, evidence of cyclical behaviour was identified to influence house price changes by Hendershott and Abraham (1994). The model specification included lagged house price changes with major economic explanatory variables. The test results then suggested a slow adjustment towards equilibrium, together with a considerable positive impact on lagged price changes.

Next, the implications for the finding of cyclical behaviour imply a cyclical adjustment path, which contradicts the simple asset-market model. This finding was supported by Muellbauer and Murphy (1994), who claimed a combination of rational and irrational expectations drive cycles.

3.2.2 Australia's national house prices

Using data from 1970 to 2003, Abelson et al. (2005) found positive and statistically significant effects of long-run economic determinants on Australian house prices. Their study suggested that real house prices between 1970 and 2003 were determined significantly, and positively, by variables including real disposable income, the consumer price index, unemployment rate, real mortgage interest rate, equity price, and housing stocks.

According to Kohler and van der Merwe (2015), house prices can be determined jointly by demand and supply over the long run. Applying short run housing financials, Otto (2007) claimed mortgage interest rates are a major determinant of house prices. Using data from 1979 to 1993, Bourassa and Hendershott (1995) demonstrated that anticipated changes in the house prices are mainly a consequence of income and demographic factors combined. However, in a later update in the Australian context, presenting research on macroeconomic relationships and Australian regional house prices, Tu (2000) found real weekly earnings per employee, nominal mortgage rates, unemployment rates and housing construction activities are the key drivers responsible for leading the national housing market out of recession.

The findings to date suggest the long run and short run real house prices determinants can differ. For example, real income is the most critical factor influencing real house prices dynamics in the long run, but with no significant influence on short run house price fluctuations, while unemployment rates and nominal mortgage rates both have long run and short run effects on real national house prices. Tu (2000) also discussed the supply factor, noting that housing completions are an important factor for determining long run real house prices movements, whereas housing commencements have a significant influence on short run real house price fluctuations. Further, Otto (2007) presented evidence that real house prices are determined significantly and positively by real disposable income and the consumer price index over the longer term. They are also determined significantly and negatively by unemployment rate, real mortgage rates, equity prices and the housing stock.

Hendershott (2000) studied the Sydney office property market based on an asset pricing type approach, which presumes the market is “efficient” and that predictable changes in house prices can be arbitraged out of the housing market. The findings reported also suggest the Sydney office market in the late 1980s was subject to “excess price volatility” due to cyclical variations in office construction, vacancies, rents, and global price changes in that decade.

Furthermore, according to Kohler and Van Der Merwe (2015), Australian house prices grew consistently with general price inflation in the 1980s, and the strong price growth in the 1990s up to the mid-2000s reflect changes in the debt-to-income ratio of Australian families. Moreover, strong population growth contributed to increased house prices in the mid-2000s. The authors also note that, all other things being equal, when new houses are built a downward pressure affects pricing until the supply and demand cycle reaches a new equilibrium over time. The new equilibrium price is influenced by the price elasticities of housing demand and supply.

Richards (2009a and 2009b) explained that changes in average household size indicate a combination of demographic changes and preferred household choices, representing an endogenous response to Australian house prices. Furthermore, Kearns (2012) established that the smaller household size over the past five decades in Australia resulted from falling fertility rates, the ageing population and rising household incomes. These demographic forces led to smaller sized households and a greater demand for houses among the population.

3.2.3 China's national house price

In reference to house pricing in the Chinese context, Wang and Xie (2012) studied China's house price data from July 2005 to December 2010. They observed that house price changes in each month are affected by house prices in previous periods. They then determined an optimal number of price lags using VAR optimal lag techniques.

Finally, Wang and Xie (2012) concluded that land price and CPI are the key factors informing house price changes. Thus, combining these two variables improved the predictive power of the autoregressive model they employed.

3.3 Housing bubble

3.3.1 General

The term "bubble" is widely used but rarely clearly defined (Case and Shiller, 2004). Nevertheless, exploring house prices determinants and considering the risks associated with housing bubbles are key to understanding the housing market. Fernández-Kranz and Hon (2006) suggested that a bubble arises in relation to three typical scenarios: i) when in a bubble market occurs, property prices attain high peak prices; ii) house prices are higher than expected based on a fundamental equilibrium in a bubble situation; and iii) sharp price growth results from unexpected market-shifts.

Extending further to examine housing bubble risk, the most popular definition of a bubble relates to long-term equilibrium prices. If the long-run equilibrium price is measured according to market fundamentals, then house prices that significantly differ from long-run equilibrium prices might then indicate a likely bubble (Diba and Grossman, 1988; Flood and Hodrick, 1986). Conversely, if house prices are always in long run equilibrium, then the housing market is unlikely to be in a bubble.

Hui and Yue (2006) suggested there are difficulties arise when measuring fundamental house prices values empirically. They raised concerns about the appropriate measures for establishing the fundamental price of housing. Peng and Hudson-Wilson (2002) and Stiglitz (1990) suggested three factors determine the asset market's fundamental prices: the total cash flow received over the period of investment, the horizon value at the end of the ownership of the asset, and the required rate of return when discounting future cash flow into present value. Previously, Flood and Hodrick (1990) had demonstrated difficulties when calculating the true fundamental values using the above three factors, due to the data limitations.

To resolve the above difficulties measuring the intrinsic value of assets, Hui and Yue (2006) introduced the concept of "exogenous macroeconomic fundamental variables". Their work

implies that if property prices are driven by macroeconomic fundamentals, including the disposable income of urban households, Local GDP, Stock Price Index, stock of vacant new dwellings, while residual values generate no major diagnostic concerns, then there is no housing bubble.

Beyond the scepticism expressed regarding policy effects, Teng et al. (2013) argued that when there is an unreasonable expectation that house prices will increase forever, and when prices differ excessively from their true fundamental value, the housing market can be considered to be in a bubble. They considered the risks from property investors' irrational expectations; also noting that when property owners believe there is no risk involved in purchasing properties, they engage in excessive consumption and do not save. These behaviours underpin the risk of a housing bubble. However, the authors also presented an example of positive feedback effect arising from a housing bubble (Teng et al., 2013). They stated that at the beginning of a housing bubble's formation, increases in house prices over market equilibrium prices lead to increased housing investment returns, further increasing house prices. Therefore, the positive feedback effect provided by house prices themselves can increase the risk of a housing bubble.

In brief, bubbles can form when expectations of future house price appreciation are inflated causing prices to deviate significantly from what could be justified by market fundamentals. However, as noted above, establishing market fundamentals is not straightforward. The situation is further complicated because, empirically, it is difficult to differentiate between deviation caused by bubbles and noise in the data (Teng et al., 2013).

To date, related work comparing the econometric techniques applied to test bubbles in studies on house prices is limited. Informing an empirical analysis of housing market dynamics, and understanding the strengths and limitations of various models is crucial for any study of housing bubble risks.

Utilising Irish data, Stevenson (2008) presents a dynamic inverted demand model to estimate house prices. Its limitations include estimations based on original level data, which can entail the stationarity issues and co-integration concerns that arise between variables.

Stevenson (2008) argues that Levin and Write's method raises concerns about poor diagnostics, because the data are subject to heteroscedasticity risk. In addition to diagnostic and stationarity issues, the use of statistical models, which calculate the system in equilibrium, are of a time-invariant nature, and so might lead to bias and inconsistent estimates when establishing fundamental house prices.

Applying present value to housing bubble analyses, and highlighting the importance of rational expectations for housing equilibrium values, Teng et al. (2013) estimated the size of housing bubbles using the 'state space' method. They overcame the problem of unstable intrinsic bubble specification, implying that a bubble will never burst as long as dividends remain positive.

There is a distinction between prospective real-time and retrospective ex-post methods for analysing housing bubbles. Highlighting the importance of bubble detection using ex - ante data, Shi (2016) and Phillips et al. (2013) stressed the importance of employing real-time methods to detect housing bubbles. Their research should significantly reduce the chance of false positive identification. Shi (2016) applies a recursive bubble detection method to residual components to identify bubble episodes. This use of real-time data contrasts sharply with existing bubble detection techniques, in which methods are applied directly to actual data.

Interestingly, Hou (2010) employed a control chart method to test for bubbles, presenting evidence supporting the assumption that house prices follow a normal distribution. If the house price deviation lies within a specified distribution, it is considered under control; otherwise, there is a bubble. The argument against this approach is that house prices might not

follow a normal distribution.

When reviewing the above methods, contention emerges regarding data issues, econometric estimation, omission and misspecification issues, as well as the presence of other mitigating factors. It is acknowledged that there may be shortcomings in the research methods due to the limitations in the economic models' fit to real-world data (Leamer, 1983); although each method has strengths and weaknesses, and imperfections cannot be avoided.

In conclusion, further studies of housing bubbles will unquestionably produce considerable economic benefits (Fereidouni, et al., 2014). In addition, while present research into a housing bubble risk is generally based upon rational expectation theory and theoretical frameworks regarding housing demand, recognition of affordability issues and the need for opportunities to address the risks associated with financial instability caused by movements in interest rates are crucial in reference to house prices.

3.3.2 Housing bubble in Australia?

Until the early 2000s, Australian housing market analysis mainly related to major capital cities. The result is that studies regarding Australia's national housing market as a whole are limited; consequently, the impact of varying factors on the national market are not well understood. The understanding of house prices dynamics and housing bubbles in Australia at the national level needs to be reassessed.

Using Sydney data collected from 1991 to 2006, Hatzvi and Otto (2008) provided evidence regarding the residential property prices in Sydney's housing market. Their findings suggested that a significant proportion of the variation in property prices in western regions of Sydney could not be explained by either rents or discount factors, reflecting a possible speculative bubble. Bodman and Crosby (2004) supported these findings by presenting evidence of a quantitatively significant overvaluation of median house prices occurring in mid-2003 in Brisbane and Sydney.

3.3.3 Housing bubble in China?

Similar to the Australian context, until the early 2000s, analysis of China's housing market principally related to major capital cities. Studies regarding China's national housing market are themselves limited. As a result, the impact of change on China's national market is less well understood. Therefore, there is a pressing need to evaluate house price dynamics and housing bubbles in China at the national level.

3.4 Macroeconomic relationships on house prices

3.4.1 General

Several recent studies have indicated that macroeconomic shocks, such as unexpected changes in monetary supply, industrial production, and interest rate changes influence house prices with a lag that depends on the speed with which financial information flows (Adams and Füss, 2010).

Käfer (2014) commented that central banks commonly react to financial instability by initiating interest rate cuts. Case, Glaeser, and Parker (2000) analysed the relationship between the American real estate market and macroeconomic performance from multiple perspectives. These studies raised an obvious concern that the housing market would be directly affected by monetary policy through interest payments on mortgage loans, and, as a result, house prices suffer from greater sensitivity to macroeconomic variable shocks (Miles, 2003; Aron and Muellbauer, 2010).

Meanwhile, according to Adam and Füss (2010), house prices may exhibit a feedback reaction to the macro-economy. From a theoretical perspective, it is important to understand that the central notion of a demand for housing derives from literature concerning purchasing power and perspectives assessing households' rational expectations. Early theoretical models played an important role by offering a theoretical basis for modelling house prices by linking

housing demand with the rational expectations (Flood and Hodrick, 1990; Kim and Suh, 1993; Chan et al., 2001; Mikhed and Zemcik, 2009) and householder purchase power (Sargent, 2013). Explorations of the relationship between house prices and the macro-economy have mainly been focused at the national level (Case, Glaeser, and Parker, 2000).

Reflecting that macroeconomic variables have a significant effect on house price movement, research indicates a long-term negative relationship between house prices and interest rates. (Otto, 2007). Other findings include that short-term interest rates are the Granger cause of house prices and there is a two-way causality between house prices and GDP while no significant relationship between house prices and interest rates (Cho and Ma, 2006). X Granger-causes Y, then past values of X should contain information that helps predict Y above and beyond the information contained in past values of Y alone. (Eviews 8 User Guide, 2014)

Otto (2007) argued that house prices are significantly affected by real mortgage rates. Reflecting the fact that housing development has increasingly been viewed as contributing to economic growth since the 1970s (Harris and Arku, 2005), Tang, Xu and Ba (2010) presented evidence that investment in real estate positively impacts GDP growth, and moreover, that the inflation response to changes in house prices is not significant.

However, changes in house prices can affect aggregate demand and supply within a society (Yu and Huang, 2016). The three channels identified as affecting aggregate demand are: i) the Wealth Effect (Pigou, 1930), as changes in asset prices cause changes in a currency's real purchasing power, and further causing a change in consumption and aggregate demand; ii) the Collateral Effect, whereby the increase in house prices indicates an increase in credit collateral, and increased bank lending is then expected to push up aggregate demand and general prices (Jud and Winkler, 2003); and iii) Tobin's Q Effect, which establishes that changes in house prices will affect related investment spending, thereby affecting inflation.

With regard to the supply aspect, higher house prices are likely to push up the nominal wages of workers to compensate for the rising cost of living, implying higher service prices and a higher level of inflation (Yu et al., 2012; Yu and Huang, 2016).

Evidence of a relationship between macroeconomic variables and international house prices was established by Adams and Füss (2010), who examined the long-term impact and short-term dynamics of macroeconomic variables on international house prices in 15 countries over a period of 30 years and found that macroeconomic variables significantly impact house prices. Earlier, Kasparova and White (2001) had investigated how EU housing markets might be affected by the single monetary policy. Their results suggested, that due to differences in the transmission mechanism, the UK and Sweden showed greater susceptibility in terms of house prices changes in monetary policy than Germany and the Netherlands. This reflects the view that a single monetary policy could have an asymmetric impact on house prices in the EU.

Related works on the stock market show it can impact the real estate market (Brueckner, 1986). Findings reported reflect that stock market performance is the cause of changes in the real estate market, but that changes in the real estate market do not cause changes in the stock market. Case, Glaeser and Parker (2000) presented additional evidence that the real estate appreciation is affected by the stock market.

Assessing the interdependence between the house prices index and macroeconomic variables using a VECM framework in the context of Greece, Panagiotidis and Printzis (2015) reviewed the Greek housing market. Their findings suggested the direction of causality is from mortgages and retail trade towards house prices over the long run. Over the short term, CPI and retail trade Granger cause house prices. However, the most important variable in the long run is retail trade. Mortgage loans were identified as the second most important factor. Shocks to the CPI do not affect house prices significantly. Moreover, findings suggest that movement

in Industrial production does not affect house prices.

The research identified an equilibrium relationship over the long term with mortgage loans and the retail sector proving the most important variables for house prices, contributing the most to explanatory power. The findings reported suggest that banks play an important role in house prices, due to their close relationship with mortgage loans.

Leung (2004) has shown the dual nature of housing markets, as represented by consumption goods and investment. However, Hilbers et al. (2008) mention four policies as follows: i) fiscal (reflected by rents and income); ii) monetary (reflected by interest rates); iii) structural (reflected by the supply and demand for housing); and iv) prudential (reflected by the financing of the housing market) in their study.

Iacoviello and Neri (2008) studied the response of GDP to house price changes. Mikhed and Zemcik (2009) presented evidence that in the USA, the decline in house prices was severely affected negatively by both consumption and GDP, establishing a strong relationship between GDP, income, and the housing market. Moreover, GDP growth has been shown to have an increasing influence on the housing market (Adams and Füss, 2010). However, the effect is apparently limited; for example, when Tsatsaronis and Zhu (2004) analysed house price data from 17 industrialised countries they discovered that GDP contributes to less than 10% of the variance of the house price. Nevertheless, there is a body of literature evidencing a short term relationship between the housing market and GDP (Davis and Heathcote, 2003; Goodhart and Hofmann, 2008), although, Madsen (2012) states that over the long term the relationship becomes weak.

Elsewhere employment and household income are identified as influential factors driving house prices (Baffoe-Bonnie, 1998). Certainly, Smith and Tesarek (1991) offered evidence that a drop in real estate activity could result in a fall in the employment growth rate. Further, Schnure (2005) suggested that an increase of one unit of unemployment resulted in a house

price decrease of 1%. Blanchflower and Oswald (2013) presented evidence that home-ownership rate increasingly affects labour mobility and results in higher unemployment.

Another factor of note identified in the literature described the impact of inflation on house prices, suggesting a negative impact from inflation on demand and house investment (Kearl, 1979. Andrews (2010) presented arguments detailing the upward trend in house prices with changes to inflation in both directions.

Further, Manchester (1987) found that increasing inflation generates housing investment motives, due to the reduction in real user costs after tax. In summary, there are contradictory views regarding the impact of inflation on the housing market.

The next issue to consider, as suggested by Apergis and Rezitis (2003), is changes to interest rates, which affect the cost of borrowing. Such changes could potentially impact buyers' purchase decisions and in turn, housing demand is affected. However, Andrews (2010) argued that the correlation between house prices and loan interest rates is negative and thus competition in the banking sector also contributes to these correlations. Nevertheless, despite the apparent significance of rates, Jud and Winkler (2002) argued that the influence of house prices from interest is minor, although this view is unusual, as most other researchers suggest interest rates are the most critical driver impacting house prices (Statuaries and Zhu, 2004).

Looking for another explanation, Case et al. (2000) suggested the reduction in house prices decreases bank capital and curbs lending, thus constraining investment in properties. However, Adams and Füss (2010) argued that house price increases raise bank lending due to the ratio of loan to valuation.

Pillaiyan (2015) studied the macroeconomic drivers of house prices in Malaysia over a fifteen-year period and identified key macroeconomic variables including real GDP, bank lending rates, consumer sentiment, business conditions, monetary supply, number of loans approved, stock market and inflation. The resultant research suggests significant

macroeconomic variables influencing Malaysian house prices are inflation, stock market, money supply, and the number of residential loans approved. What stands out from the finding was the GDP was not identified as a driver of house prices, although house prices over the fifteen years to 2015 in Malaysia were undoubtedly driven by economic fundamentals.

3.4.2 Macroeconomic relationships to Australia's big four cities' house prices

Exploring regional patterns in house prices and considering macroeconomic affects, Baffoe-Bonnie (1998) reviewed the effect of four kinds of key macroeconomic variables in the US housing market; namely, the mortgage interest rate, consumer price index, employment rate and money supply, on house prices and housing sales. This research found that house prices and sales closely relate to economic fundamentals and that the effects of certain macroeconomic variables differ at the national and regional levels.

The majority of the current literatures focuses on the relationship between the real estate market and macroeconomic factors at national level. However, Zhang et al. (2016) argued that real estate markets differ according to the tier of the city in China. Thereby, in order to understand regional house prices dynamics, it is not adequate to only study the relationship between the real estate market and the macro-economy at the national level.

To date, the study of macroeconomic policy as it influences Australian regional house prices has been hampered by limitations in the availability of regional data. Regional analysis of the macro-economy and Australian house price dynamics has only related to the period up the early 2000s (Abelson et al., 2005; Bodman and Crosby, 2004; Bourassa and Hendershott, 1995). For example, Bourassa and Hendershott (1995) studied the divergence in real house prices in six Australian major cities from 1979 to 1993, highlighting the importance of wages and population as influencing house prices, rather than interregional influences. Data showed that, real house prices have increased by 35 per cent in Australian capital cities during the

period from 1979 to 1995, with Brisbane, Canberra, and Sydney experiencing rises of 48% to 61% and Adelaide, Melbourne and Perth increases of 20% or less (Bourassa and Hendershott, 1995).

This article estimates a single model for the six cities to explain divergent real price behaviour over time and space. It is assumed that the fundamental forces driving real house prices are the growth rate in real wage income (primarily due to employment growth) and growth in population caused by net overseas migration (Bourassa and Hendershott, 1995). It is also considered that Tu (2000) presented evidence showing the significance of real weekly earnings per employee, the nominal mortgage rates, unemployment rates, and housing construction activities as key drivers altering housing market performance.

However, in their pooled study on the changing rates impacts on the real house prices across the Australian six capital cities between 1979 and 1993, Bourassa and Hendershott (1995) found increases in the real mortgage rates had the opposite effects. However, Tu (2000) argued that each city be treated the same regarding the aspect of real house price changes due to the nature of the pooled study.

According to basic economic theory, interest rates should be more important in the regions where the elasticity of supply of housing is relatively low or the likely growth of future demand relatively high; although, there is little evidence of this effect in state-by-state regressions (Shiller, 2004).

Finally, Tu (2000) suggested the national house price model would differ from each capital city's house price model based on research by AETM (1991) that presented evidence of a large heterogeneity of real house price dynamics among Sydney, Melbourne and Adelaide.

3.4.3 Macroeconomic relationships with China's first tier and second - tier major 13 cities house prices

Zhang, Hui and Wen (2015) presented evidence that house price trading volume linkage could be weaker under the rigorous policy of purchase limits in 35 Chinese metropolitan areas. They also noted that inflation is more significant in first - tier cities than in second - tier and third - tier cities. The influence of the macroeconomic growth rate on house prices is generally positive in all cities, with the strongest effect found for first-tier cities, and trading volume.

Zhang et al. (2016) investigated the relationship between house prices and the macro-economy for China's first, second and third - tier cities. They selected Beijing, Shanghai, Guangzhou and Shenzhen as first-tier cities, and Chengdu, Ningbo, Qingdao and Hangzhou as the second-tier cities. Their finding suggested interest rates had a significantly negative impact on house prices with a reduced effect from first-tier, second tier and third-tier cities. This reflected the sensitivity of investment demand to interest rates and noted that this impacts first tier cities more significantly than second and third tier cities.

The impact of inflation on house prices is positive at the beginning of a period, and then becomes negative. The negative impact felt in first tier cities is notably stronger. The findings reported by Zhang et al. (2016) indicate that the effect of inflation on house prices in different tiers of cities is consistent with the impact from interest rates on regional house prices. For example, the researcher presented evidence of an increase in house prices in first tier cities, placing pressure on the household balance sheet.

Thus, households tend to spend less, which affects inflation by changing it from positive to negative over time. The findings also imply the influence of macroeconomic growth rate on house price is positive for all three cities, while the impact on the first - tier cities is strongest. What stands out from the study is that the impact of the macro-economy on house prices in

first, second and third - cities suggests more differences than similarities.

In another study, Hui et al. (2012) reviewed data from Guangzhou and Shenzhen, important regional housing markets in Pearl River Delta in China. Their findings reveal that house prices in Guangzhou and Shenzhen are largely affected by macroeconomic and economic fundamental forces. They recommend that the government review the research to find a way to resolve the issues of softening which was affecting China's heated housing market.

Furthermore, evidence presented also considers heterogeneity in regional house price dynamics. For example, disposable income impacts on house prices in the two cities due to the low explanatory power when using constructed fundamental house prices.

Yu and Huang (2016) analysed the regional heterogeneous response between house prices, inflation and monetary aggregate shock for China's 35 major cities using a Globe Vector Autoregression model. The finding suggests house price shocks have a weak positive affect on CPIs (consumer price indexes). Furthermore, house price shocks in first-tier cities and eastern cities, have a stronger influence on national house price and regional house prices. Monetary aggregate shock has a stronger impact on house prices in first-tier and eastern cities, and a relatively weaker impact in central and western regions.

3.5 Spillover effects on house prices

3.5.1 General

Some housing markets are more highly interdependent and integrated than others (Green and Wachter, 2005). Diamond and Lea (1992) explained that, in some areas, structural developments appeared to have created an efficient system, in which competitive forces resulted in possible large spillover effects on various housing markets.

Research supports the expectation that the effect of house prices shocks can potentially affect different areas (Alexander and Barrow, 1994; MacDonald and Taylor, 1993; Meen, 1999;

Pollakowski and Ray, 1997; Stevenson, 2004; Tu, 2000). Meen (1999) presented evidence of a fundamental phenomenon arising from the interconnected relationship between regional house prices, suggesting that housing markets function as a series of interconnected sub-national markets.

More recently, Tsai (2016) suggests the impact of information dispersal in a country can be observed by exploring the relationship between regional house prices. Chen and Chen (1998) emphasised subsequent developments in house price literature, encouraging research interests from local housing markets experiencing ripple effects in regional housing markets, since it is essential for policy makers to recognise the deep causes of house price changes and to anticipate when a market might shift directions.

Fereidouni (2014) defined the ripple effect as a phenomenon arising when a house price shock in one location or region spillsover and influences the house prices in other locations. However, Meen (1999) argued that the immobility of houses results in distinctions between house prices in different regions. However, regional house prices are interconnected as a result of migration, equity transfer, spatial arbitrage, and spatial patterns that determine house prices. Evidence is presented that a degree of long-run connectedness among regional house prices exists where there are ripple effects (Meen, 1999).

Other findings reveal that a regional market composition model with applied spatial coefficient heterogeneity might result in structural differences in regional housing markets, causing heterogeneous coefficient effects, these being due to the various macroeconomic variables affecting regional house prices. Namely, regional house prices represent different spatial patterns (Meen, 1999).

Meen (1999) studied a market composition model with applied spatial coefficient heterogeneity, comprising structural differences in regional housing markets. This prompts the interesting view that, if house prices are higher in one region relative to another, then

households may migrate to other regions, generating a ripple effects in regional house prices, and consequently increasing regional housing demand.

Highlighting the importance of this ripple effect for regional house prices, Clapp and Tirtiroglu (1994) confirmed regional housing markets are not only impacted by historical movements in individual markets but also by movements in neighbouring markets.

Studies also suggest that a house price shock in one area is likely to be felt in other areas, as revealed by house price spillover or ripple effects (Alexander and Barrow, 1994; Ashworth and Parker, 1997; Cook, 2005; MacDonald and Taylor, 1993; Meen, 1999; Pollakowski and Ray, 1997; Stevenson, 2004; Tu, 2000).

Further, Odland (1988) defines spatial autocorrelation, which occurs when house prices in one region are dependent on house prices in other regions. King (1984) outlined the theory of central place, arguing that a phenomenon may emerge in the largest city first, and then spreads to the second largest city, and so on.

Turning attention to the causes of spillover effects, Muellbauer and Murphy (1994) presented the finding that migration in conjunction with equity transfer, means that house buyers in higher price regions might experience higher purchasing power, increasing the value of house prices in the new region. However, Holmans (1990) argued that the impacts of migration and equity transfer on house prices are weak, and shown only in a limited number of empirical studies.

Pollakowski and Ray (1997) further explained that financial flows offer a powerful incentive leading to spatial arbitrage; noting that this may contribute to a reduction in the differences arising from regional spillover effects. In other words, when new information is generated in one region, this is then naturally transmitted to the second region with a consequent spillover effect on house prices. Furthermore, Meen (1999) empirically presented evidence detailing four possible explanations for the interactions resulting in the observed pattern of ripple

effects; these were: i) migration, ii) equity transfer, iii) spatial arbitrage, and iv) spatial patterns determining house prices. This research also highlighted that structural differences in the regional housing markets are important, although regional house prices may generate spillover impacts irrespective of regional growth patterns.

Updating previous studies, Case and Shiller (1989) questioned the efficiency of the housing markets in response to information dissemination. Their empirical evidence suggested the discriminatory nature of the transmission mechanism of information between the regional and the national housing markets, when observing the comparatively slower or faster, information responses in different regions. Drake (1995) and Cook (2005), later found that links between house prices regionally can also be either time variable or asymmetric.

Relating the house price spillover perspective to spatial patterns, Holmans (1990) and Giussani and Hadjimatheou (1991), highlighted that a pattern of house prices similar to those observed under the ripple effect can occur even when there are no spatial links between housing markets, according to the assumption that the main determinants of house prices follow similar patterns.

Muellbauer and Murphy (1994) presented a view of migration that reflects if house prices are high in one area relative to other regions, then households might migrate to others, thereby increasing housing demand in the other regions and leading to an equalisation of house prices. This can cause an equity transfer, and create a ripple effect in regional house prices.

The results of these experiments suggest purchasers from the area in which house prices have increased will experience greater buying power, forcing households experiencing affordability issues to purchase in other regions. In this way, prices in those regions are forced upwards.

Overall, migration flows are not quantitatively powerful enough to cause the observed movements in house prices. Financial flow and information transmission without households physically moving are key factors affecting the changes observed in house prices (Holmans,

1990). Underlining this, Gordon (1990) and Holmans (1990) state that migration flows are weak and so house price differences are not a major factor influencing flows.

Similarly, Pollakowski and Ray (1997) argued that interregional migration flows are weak, as financial flows are powerful enough to generate spatial arbitrage and reduce the differential in regional house prices, since new information is disseminated from one area then transmitted first to contagious areas. There may be an alternative explanation for the spillover effect; Clapp and Tirtiroglu (1994) presented evidence suggesting individual housing markets are not only affected by their own discrete historical movements, but also by the changes in the neighbouring housing markets (1994) when testing the significance of a positive feedback hypothesis.

Exploring house price movements to account for the ripple effect perspective, Alexander and Barrow (1994) considered the relationship between regional house prices in England. Estimating the effects of continued integration between different regional house prices, their experiments explored the overall relationship applying a vector error correction model (VECM). Their findings suggested that geographical proximity acts as a critical factor in the transmission of house prices between regions. At the regional level, they suggested the South East of England acts as an exogenous price source for other regions in the South, while the Midland regions affected prices in the North.

Further studies (Macdonald and Taylor, 1993; Meen, 1999; Pollakowski and Ray, 1997) in the UK studied the house price spillover effect, suggesting geographical proximity as an important factor transmitting house price rises from one region to another, reflecting that house prices rise first in one region, before the increase gradually spreads throughout the rest of the UK. In general, the spillover effect was found to involve changes in house prices that occur earlier and more extensively in the Southeast of England, than in other sub segment markets in the UK.

Based on data regarding the UK, regional house prices from 1973 to 2008, Holly et al. (2011) demonstrated that house prices within each region react directly to shocks to London and subsequently the effect of shock is expanded by both the internal dynamics of each sub - housing market and the interactions with neighbouring sub-segment housing markets. Furthermore, they concluded that London's house prices are directly impacted by New York's house prices, since the global financial centre in London has close links with that in New York.

On the contrary, Macdonald and Taylor (1993) also indicate the presence of weak segmentation in the UK housing market. The analysis by Cook (2005) shows the phenomenon of an asymmetric spillover effect; namely, a consistent return to equilibrium that takes effect more swiftly when house prices in the south of England decline relative to those in other regions developing a moderate velocity when prices move relative to those in other regions. In doing so, Cook (2003) demonstrated the convergence of regional house prices in the UK, allowing for asymmetric feedback from shocks.

In an additional study comparing the Malaysia and Singapore spillover effects on housing markets, Fereidouni (2014) analysed house price spillover between Singapore and Malaysia, illustrating the existence of ripple effects in Malaysia's major economic regions. The findings suggested house price spillover affecting Malaysia does extend across the border to Singapore. Earlier, Hui (2010) had studied the nature of inter-regional house price spillover in the short and long run in Malaysia. The results obtained in that study suggested a stable long-run relationship, as well as a short run bidirectional causality between the housing markets in the three regions. Evidence of a ripple effect arising in more developed states then influenced the less developed states in Malaysia.

Stevenson (2004) presented evidence that geographical, economic and demographic proximity might ease the dispersion of information in housing markets between the Republic

of Ireland and Northern Ireland. The research, conducted in the Republic of Ireland and Northern Ireland, suggested the Dublin housing market was at the centre, with effects spreading to housing markets in other regions of Ireland. It also suggested that the housing markets of Northern Ireland and the Republic were interlinked.

Pollakowski and Ray (1997), Clapp and Tirtiro-Glu (1994) and Holly et al. (2010) demonstrated house price shocks in one area cause subsequent shocks in the same area, as well as in other regions of the US housing market. They specifically analysed the dynamic relationship affecting house prices in a number of US Census divisions and metropolitan areas for the period from 1975 to 1994. Their research adopted a VAR model, concluding the phenomenon of ripple effects between neighbouring regions.

In other contexts, extending the pre-existing body of research further, Karaganis (2011) detailed the positive and significant spatial effects in Greece, and Oikarinen (2008) presented evidence that the Finnish regional housing market experiences spillover effects from the economic centre (the Helsinki Metropolitan Area), to regional centres, and then to the peripheral regions. In addition, results obtained indicated that house price changes in the suburbs cause price movements in the city centre.

Rates and the housing construction activities are believed to be the key drivers likely to bring national housing markets out of recession. Results obtained suggest disparities in economic performance at subnational level. Understanding the existing literature regarding ripple effects, Chen et al. (2011) applied a vector autoregression (VAR) model to investigate the unique relationships among four regional house price indices in Taiwan (capital city and its suburban area as well as two mega- cities). Their results demonstrated a long-run equilibrium co-integrating relationship in the house prices among the four regions. Consider spillover effects research suggested house prices in the capital city are the most exogenous, whereas the suburban area of the capital city is endogenous, with the result that is highly affected by house

prices in Taipei.

Using a global vector autoregression (GVAR) model, Vansteenkiste and Hiebert (2011) examined the issue of house price spillover across seven Eurozone countries, noting their importance relative to shocks to real domestic long-term interest rates over the period 1971 to 2009. Their results suggested only limited house price spillovers in the Eurozone.

Empirically, expanding the identification of econometric methods to analyse the ripple effects taking into consideration regional heterogeneity, Holmes (2007) employed a seemingly unrelated regression (SUR) unit root test, and studied regional house prices in the UK. The results obtained proved more reliable than the univariate unit root tests.

Subsequently, Holmes and Grimes (2008) included the theory of the first principal component with the SUR unit root test to identify house price differentials in the UK. The results illustrate that constant long run price ratio convergence exists in all regions in the UK.

In their research, Tsolacos et al. (2009) reviewed the variation in retail yields in eight Asia-Pacific centres using panel regression, suggesting it is a useful method for studying market dynamics across cities.

Diebold and Yilmaz (2012) presented evidence of spillover indices across asset markets within a more generalized VAR framework in which variance decompositions are unresponsive to variable ordering. This methodology was also employed to investigate spillovers across US stock, bonds, foreign exchange, and commodity markets during the global financial crisis.

3.5.2 Spillover effects on Australian big four cities house prices

Since the various housing markets have distinctive financial features and local macroeconomic environments, the various spillover effects from regional house prices suggests different local market risk profiles. This section analyses the relevant literature

pertaining to the spillover effects on regional house prices dynamics in Australia's major four cities, comprising Sydney, Melbourne, Brisbane and Perth.

This is with the aim of establishing a theoretical context from which to understand to the depth of household purchase decisions, and the impacts of ripple effects on regional house price dynamics, to inform empirical specifications for econometric estimations and identify gaps in the existing research.

AETM (1991) reviewed that the expected elasticity of house prices in reference to household income range from 1.3 in Melbourne to 1.7 in Sydney. Based on supply perspectives, the estimated elasticity of house prices to housing supply ranged from 20.39 in Adelaide, 20.55 in Melbourne and 2 0.65 in Sydney. This evidence suggests certain common factors, such as accessibility to the CBD and environmental attributes impose a higher risk of a spillover effect from house prices.

A regional spillover effect has been found to relate strongly to an individual city's average house prices dynamics. Studying the spillover effects in Australia, the AETM (1991) studied the real house prices of Sydney, Melbourne and Adelaide. They concluded that there are significant differences in real house prices dynamics across the three cities. Each capital city's house pricing model has its own unique individual dynamics. In addition, the AETM (1991) found real (adjusted for inflation) house prices were only slightly more volatile in Sydney than in Melbourne and Adelaide.

The dynamics of real house prices in Sydney may have a significant influence on national real house prices or other cities' house prices (Tsai, 2014). Accounting for household incomes and home ownership rates in metropolitan and non-metropolitan areas in all Australian states between 1986 and 1996, Yates (2002) presented evidence that house prices in the regions with a higher incidence of income polarisation were more likely to increase at a greater rate. This suggests low income households might therefore seek home ownership in non-

metropolitan areas (Luo, 2007).

Related work on ripple effects affecting Australian house prices had mainly focused on Australian megacities up to the early 2000s. The Australian national housing market comprises a series of segmented subnational housing markets. Tu's (2011) findings suggest the Australian housing markets at the subnational level are highly segmented, particularly in the long run, with some causal relationships present in the short run. Additionally, Sydney real house prices neither dominate national house prices dynamics nor house prices dynamics in other cities in the long run. In the short run, they do influence Melbourne house prices, but no such effect is felt elsewhere.

Luo et al. (2010) presented evidence that a 1-1-2-4 diffusion pattern exists in Australian mega cities. Sydney is located on the top tier with Melbourne on the second; Perth and Adelaide are at the third - tier and the other four cities lie at the bottom. Meanwhile, three unilateral causal relationships arising from feedback mechanisms from the lower tiers were discovered: Darwin to Sydney, Perth to Sydney and Hobart to Sydney.

Furthermore, short term causal relationships can also be identified in the Melbourne housing market: Brisbane to Melbourne. These results expose a convergence phenomenon that exists between pairs of regional markets; i.e. Melbourne and Sydney, Melbourne and Perth, Melbourne and Adelaide. The result indicates that each pair of housing markets return to equilibrium at set ratios (Luo et al., 2010). Similarly, Liu (2013) identified a convergence phenomenon showing that the eight capital cities house prices return to equilibrium (although again with their own ratios).

Liu (2013) confirmed that Melbourne could be identified as the dominant housing market, as its house price levels were cointegrated with house price levels in other capital cities. The house price movements in Melbourne were able to significantly influence the housing markets in other capital cities, but could not be influenced themselves.

However, house price levels in Melbourne failed to reach a constant level in the long-run, despite long-run equilibrium relationships being confirmed between the house price levels in Melbourne and other capital cities. Interestingly, the housing market in Adelaide approaches equilibrium first, while the speed of approach in Sydney was slowest. In addition, previous house price changes in Melbourne cause significant short-run impacts on house price dynamics in Adelaide, Canberra, Perth and Sydney immediately, while delayed influences arise in Brisbane, Darwin and Hobart. Finally, Liu et al. (2013) presented evidence that the two biggest cities in Australia, Sydney and Melbourne, have the most stable housing markets with markets in Adelaide, Brisbane and Canberra being relatively sensitive to influences from elsewhere.

Next, the spatial correlation patterns for house price levels in Australian capital cities were confirmed by integrating the results for the impulse response function. The house price dynamic was found to commence initially in Melbourne, with the effects spreading immediately to the housing markets in Adelaide, Canberra, Perth and Sydney. The house price movements in those cities located at the first and second tiers influenced house price movements in Brisbane and Hobart via the housing market in Canberra. The housing market in Darwin was then influenced by the housing markets in Brisbane and Hobart, but could not influence other capital cities.

It should be noted the previous data was obtained before mid-2005, and so does not analyse any ripple effects that might have occurred during the recent housing boom in Australia from 2012 until now (2017). Therefore, further research into regional house prices ripple effects covering the most recent housing boom needs to be conducted.

3.5.3 Spillover effects on China's 13 major cities' house prices in the first and second - tier housing markets

Zhang et al. (2016) suggested that previous studies on the relationship between house prices

and macroeconomics in China had focused only on the national real estate market overall instead of on just segments of it. However, in China, real estate markets act very differently in different tiers of cities; therefore, it is insufficient to study the relationship between the real estate market and the macro-economy at the national level.

A number of studies have researched the spillover effect in China. Shih (2014) investigated potential contagion and spillover effects from housing bubbles from core to peripheral provinces based on data from the provinces in China. Empirical findings suggest that most of the provinces experience bubbles and affordability problems resulting in house prices in the provinces within contagious regions becoming co-integrated. In particular, spillover effects exist in contagious regions around Beijing and Shanghai (Zhang et al., 2016; Shih, 2014; Yu and Huang, 2016).

Shih (2014) analysed house price data from 28 provinces in China, for the period from the first quarter of 2000 to the fourth quarter of 2012. Their results reflected house prices in the provinces within the same potentially contagious region were cointegrated. This result suggests that spillover effects from exogenous house prices in core areas affect the equilibrium in housing markets in peripheral areas. Furthermore, house prices in the provinces in contagious regions can be identified. For example, Beijing and Shanghai are two significant core provinces in China and their house prices can be described by an exogenous variable influencing the house prices of peripheral (neighbouring) provinces over the long term.

More recently, Yu and Huang (2016) studied the significant spillovers between house prices throughout China's 35 major cities. Their finding suggested the spillovers in house prices in first-tier cites exceeded those in eastern cities, while spillovers in house prices in eastern cities were higher than those in central and western cites. Evidence presented demonstrates that the positive feedback mechanism from house prices in first-tier and eastern cities is distinct, while

that in central and western cities is only moderate.

3.5.4 Spillover effects between China and Australian housing markets

China's close business relationship with Australia, and the large migration flows from China to Australia raise the possibility that the housing markets between two countries might be linked. Fereidouni (2014) combined housing bubble and effects analysis, considering macroeconomic main drivers, and not just individual householders' personal wealth creation strategies per se, but in particular the trading policies in place between China and Australia.

As outlined previously, few studies have considered the existence of effects across borders. Fereidouni (2016) examined house price among Malaysia's major economic regions into the major regions of neighbouring Singapore using quarterly data from 2000Q1 to 2011Q1. They observed a house price ripple effect in Malaysia that extended to neighbouring Singapore. Furthermore, as discussed previously, Stevenson (2004) investigated whether house price s from the Republic of Ireland could be felt in Northern Ireland. Based on quarterly data and employing the VECM econometric method, he found house prices in Northern Ireland and the Republic are indeed contagious.

Additionally, as touched on above, Holly et al. (2011) presented evidence that London's house prices were influenced by New York house prices as London is a global financial centre. Again, touched on above, Vansteenkiste and Hiebert (2011) studied the issues of house price ripple effects among seven Eurozone countries, and concluded limited house price ripple effects, but strong country heterogeneity.

To date there is a dearth of studies on cross border house price spillover relating to Asia Pacific countries. Nevertheless, co-movement in house prices across countries may be very relevant due to the general trend with monetary union, which is bringing growing interconnectedness in trade, financial markets, and general economic conditions.

3.6 Theoretical framework

The central ideas informing most house price dynamics and bubble literature (Chan et al., 2001; Flood and Hodrick, 1990; Mikhed and Zemcik, 2009) proceed from rational expectation theory and the theory of housing demand. According to rational expectation theory, any outcome depends partly on what people expect will happen. The rational expectation theory is an economic idea that people make choices based on their rational outlook, available information and past experiences. It also suggests that the current expectations in the economy are equivalent to what people think the future state of the economy will become. Theoretically, households would make house purchase decisions considering income, investment returns, interest rates fluctuations and the liquidity constraints. Economists, including A. C. Pigou, John Maynard Keynes, and John R. Hicks, have all applied rational expectation theory when tying business cycles to people's expectations (Sargent, 2013).

In addition to creating uncertainty surrounding counter-cyclical policy intervention, rational expectations became an important component of a theory of business cycles in the 1970s and 1980s. The key components of these models offer up a theory of economic fluctuations that provided an alternative to the Keynesian demand-based explanation. The assumptions of rational expectations are that firms maximize profits and individuals maximize utility, which was pleasingly consistent to the foundation of macroeconomic theories. (Chernoma and Hudson, 2017)

From household investment perspective, at expectations of economic variables may be subject to error , which has been recognized as an important part of most explanations of changes in the level of investment activities. Expectations are informed predictions of future events, are essentially the same as the estimations of the investment risks during the house purchasing decision process. At the risk of confusing this purely descriptive hypothesis with a

pronouncement as to what the household buyers ought to do, we call such expectations "rational." (Muth, 1961)

Hou (2010) states that the theoretical model elaborating rational expectation theory in housing bubble analysis assesses whether a housing bubble exists by calculating the deviation between observed house prices and the expected prices. However, irrationality affects purchase decisions, as people often prioritise their preferences and personal aspirations while disregarding their financial interests. For example, herds and frenzies reflect investors' tendency to buy or sell in the direction of a market trend (Glaeser, 2014); this can lead to a self-fulfilling prophecy, as positive feedback arises between belief and behaviour (Shiller, 2000). According to Henckel (2017), the real estate investment behavior is like "the frenzy in the market with and emulate our peers, herd like sheep and act on rumours". From a theoretical perspective, it is important to understand the expectations of the informed predictions of future events and the estimation of the investment risks during the house purchase decision process.

According to the theory of housing demand, a smaller amount of space or number of units will command a higher price. The central notion of housing demand suggests that effective market demand is backed by purchasing power. The model builds on the assumption that the demand function can be characterised by a discrete choice of the households. Demand for residential real estate property obeys the fundamental law of demand, highlighting three main types of drivers: i) population, households and employment, or output, as determined by metropolitan growth processes; ii) income and wealth, which represent purchasing power; and iii) relative prices or expectations over prices and growth (Sivitanidou, 2011). An individual household's housing demand can be modelled with standard utility/choice theory. The equality indicates that the money spent on all the goods and services must be equal to the available income (Maisel, Burnham and Austin, 1971). A number of studies

have presented evidence regarding the above key indicators associated with housing demand theory (Abelson et al., 2005; Kohler and van der Merwe, 2015; Otto, 2007). Main drivers affecting house demand are illustrated in Section 8.2 and 8.3 for Australia and China house prices. The respective econometric specifications are explained in Section 4.2.2 and 4.5.2.

Concluding remarks

The findings reveal the importance of factors linking housing demand and supply, and describing how macroeconomic variables impact house prices performance. These findings are especially useful, as they provide a good understanding of historical data, and identify the knowledge gap before embarking on empirical tests of house price dynamics for Australia and China.

Several empirical tests have been performed on contemporary data to understand the implications of the most recent housing booms in Australia and China. However, in previous research, few attempts were made to test for the presence of bubbles, with the result that the main drivers of Australian and Chinese house prices, and the presence of housing bubbles over the last two decades, are not well understood.

Moreover, the majority of previous studies investigating Australian and Chinese house prices have been confined to data covering to the early 2000s.

CHAPTER 4

ECONOMETRIC METHODS AND MODEL SPECIFICIATIONS

4.1 Executive summary

Purpose and scope

This section analyses the econometric methods and model specifications employed to deliver the empirical estimations describing housing bubbles, house price spillover and house price macroeconomic relationships. It aims to establish an empirical econometric context within which to position house price dynamics and housing bubbles, to inform empirical specifications, and provide original findings.

Recognising the importance of house prices to countries' regional and national economy, this review begins with an overview of the econometric methods available for estimating the main drivers of house price dynamics in China and Australia, for testing spillover effects in the key regional cities in both countries, for determining the housing bubble positions. It offers a detailed description of the model specifications applicable for relevant empirical estimates.

Econometric modelling

Econometric methods and model specifications for house price main drivers, housing bubbles, macroeconomic relationships with house prices and spillover effects on house prices were all studied in Chapter 4 by drawing on secondary data. This study attempts to detect the ripple effect using the VECM models to document the lead-lag relationship between regional and national house prices (Fereidouni et al., 2016).

In addition, this study employs OLS and VECM frameworks to analyse the main drivers and house price bubbles (Abelson et al., 2015).

Key findings

A combination of rigorous Methods

This paper describes the application of combined enhanced econometric frameworks, such as OLS, Granger causality, the Vector Error Correction Model (VECM), and the Principal Component methods to provide an in depth understanding of house price dynamics and bubbles in China.

A thorough analysis has been performed in view of the diagnostic concerns and potential econometric estimation issues. In addition, Variance Decomposition and Generalised Impulse Response tests were employed to provide an in - depth understanding of macroeconomic relationships and house price spillover effects in China.

The national house prices in China, including the first and second - tier housing markets, were calculated using Principal Component methods based on the linear combination of house prices in the top 13 cities (Eviews 8 User Guide, 2014).

The research employs a combination of econometric methods to model house prices using both correlation and causal dimensions, as recommended by Nanda and Tiwari (2013).

Econometric assumptions/issues

An estimation procedure involves several econometric issues, reflecting specific requirements for the OLS, the Johansen co-integration, and the VECM model assumptions using time series data. Time series data are routinely used in applied macroeconomics. To resolve any violation of these assumptions including multicollinearity, autocorrelation and homoscedasticity, a number of extensive econometric tests were conducted using advanced time series analysis techniques, such as a best subsets test in Minitab, the Durbin Watson Statistic a Glejser test, normality test and principal components method (Croucher, 2017; Wooldridge, 2012).

An Augmented Dickery-Fuller (ADF) and Phillip and Perron test (PP) were employed to test the null hypothesis (Ho) that a unit root is present in the time series data sample. The number of optimal lags involved in the estimation process follow the Schwarz Information Criteria (SIC) rule, reducing the number of optimal lags by one, due to the first difference requirement of the VECM estimates (Eviews 8 User Guide, 2014).

p-value/test statistics

p-values are routinely employed in null hypothesis significance testing. A significance level of 10% is applied as the threshold value for p (Croucher, 2017; Wooldridge, 2012). Main features of each method are explained in details in Sections 4.1.1, 4.2.1, 4.3.1, 4.4.1.

Data transformation

The variables tested in the unit root test, Johansen co-integration test and VECM incorporated transformed logarithm values. This is in accordance with theoretical recommendations suggesting transformed empirical variables may be a better indicator for visualisation and interpretation purposes (Croucher, 2017; Wooldridge, 2012). From a theoretical perspective, it is important to understand that the data transformation ensure the reasonable empirical analysis of house price main drivers and bubble risks according to the housing demand model and rational expectation theory.

Concluding remarks

This section summarised a combination of rigorous econometric methods regarding empirical tests of main house price drivers, macroeconomic relationships and house price spillover effects. Understanding these econometric methods provides a good theoretical econometrical grounding to assist the understanding of the estimation outcomes relative to the current research questions. Detailed model specifications are included in Sections 4.1.2, 4.2.2, 4.3.2, 4.4.2. Estimation issues and assumptions are discussed in Section 4.5.

Detailing the datasets employed for the econometric estimates is the subject of Chapter 5. It presents, a detailed review and analysis of the datasets applied in the empirical tests for housing bubbles, macroeconomic relationships and spillover effects.

4.2 Australian house price dynamics and the property bubble

4.2.1 Econometric methods

This study uses separate Equation models, as suggested by Abelson et al. (2005), with the addition of two extensions. First, this study models main house price drivers at the national level, whereas previous studies focused on major capital cities in Australia (Abelson et al., 2005; Bodman and Crosby, 2004; Otto, 2007; Bourassa and Hendershott, 1995). Second, it employs a combination of econometric methods to model house prices using both correlation and causal dimensions (Nanda and Piwari, 2013).

The econometric techniques employed here provide a basis for the empirical testing of housing price dynamics. The estimation techniques used are ordinary least squares (OLS; Equation 1) and co-integration techniques such as vector error correction models (VECM; Equation 2). Equations 3 and 4 depict the empirical expressions of the models when estimating the proposed theoretical variables.

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_i X_i + Y_i\,(-1) + \mu_i \qquad (1)$$

In Equation 1, house price Y_i is a function of one lag of the Y_i variable (Yi (-1)) and a set of independent variables X_i. β_0 is the intercept, and β_i represents the parameter estimates. Equation 1 is an autoregressive (AR) model, which specifies that the output variable depends linearly on its own previous values and on a stochastic term. The variable μ_i describes the error term or disturbance. It contains factors other than X_i that affect Y_i (Croucher, 2017; Wooldridge, 2012).

$$\Delta Y_t = \alpha_0 + \gamma_0 \Delta X_t + \delta\,(Y_{t-1} - \beta_0 X_{t-1}) + \mu_t \qquad (2)$$

In Equation 2, if ΔY_t and ΔX_t are I (1) processes and are *not* co-integrated, a dynamic VECM model is estimated using first differences. The first difference for house price ΔY_t is a function of the short-term impact of change in ΔX_t, as represented by γ_0. The long run gravitation toward equilibrium in the relationships between variables is represented by δ. Random shocks to the system are denoted by μ_t, when $\delta < 0$ reflects the speed at which the error correction pushes the short-term disequilibrium in housing prices to revert towards equilibrium (Wooldridge, 2012).

Johansen (1991, 1995) introduced a VAR-based co-integration regression to test for a co-integrating or long run relationship. Group estimated VAR variables are used to perform this test. The VAR model of order p can be calculated as follows:

$$y_t = \alpha_1 y_{t-1} + \cdots + \alpha_p y_{t-p} + \beta x_t + \mu_t \quad (3)$$

where y_t is a k-vector of the non-stationary variables; x_t is the d-vector of the deterministic variables; and μ_t is the vector of innovation. With the aim of analysing the co-integrating relationships, two kinds of test statistics were employed, namely, trace statistics and maximum eigenvalue. The maximum eigenvalue statistic checks the null hypothesis of r co-integrating relations against the alternative of r + 1 co-integrating relations (Eviews8 User Guide, 2014). The trace statistic verifies the null hypothesis of r co-integrating relations against the alternative of k co-integrating relations, where k refers to the number of endogenous variables and r = 0, 1..., k – 1. The alternative to k co-integrating relations indicates none of the series has a unit root and a stationary VAR, as may be concluded when considering the levels of all the series (Fereidouni, 2013).

4.2.2 Model specifications

House prices are influenced by various macroeconomic variables (Abelson et al., 2005). According to the OLS specification in Equation (4), house price (HP) is a function of one lag in HP and a number of explanatory variables, including the mortgage interest rate (IR), unemployment rate (UNEMPLOY), consumer sentiment (CS), and Australian S&P/ASX 200 stock market index (AUSHARE). See Appendix 1 for Abbreviations:

$$HP = \beta_0 + \beta_1 IR + \beta_2 CS + \beta_3 AUSHARE + \beta_4 UNEMPLOY + \beta_5 HP(-1) + \mu \quad (4)$$

$$\Delta L(HP_t) = \alpha_0 + \gamma_0 \Delta L(X_t) + \delta (L(HP_{t-1}) - \beta_0 L(X_{t-1})) + \mu_t \quad (5)$$

The empirical specifications for the VECM equations are given in Equation 4. In the case of the VECM model, when the error correction coefficient δ is negative and very significant, it induces a positive change in house prices back towards equilibrium (Wooldridge, 2012). Appearing as a dependent variable in the VECM Equation (5), the first difference in the transformed logarithmic values of house price ($Ln(HP_t)$) is proxied by the first differences for the transformed logarithmic values of the four key macroeconomic variables ($Ln(X_t)$), namely IR, UNEMPLOY, CS, and AUSHARE. Macroeconomic variables may be used as a property explanatory argument for the VECM model of house prices (Adam & Füss, 2010). According to this study's econometric estimates, if the long run equilibrium of house prices is corrected through the short run disequilibrium in the key drivers of Australian house prices, the deviation is temporary and house price equilibrium is always achieved over the long term; thus there are no housing price bubbles (Abelson et al., 2005).

4.3 A comparative study of house price dynamics in China and Australia housing price bubbles

4.3.1 Econometric methods

The econometric model was specifically designed to empirically examine and compare ex-post housing price bubbles and ripple effects of house prices in China and Australia, taking into account the main macroeconomic variables. The OLS and VECM equations focused on the main drivers for house prices, and potential for a house pricing bubble was modelled in Equations (1), (2) and (3). In these equations, modelling identifies time series patterns relative to the theoretical considerations associated with the response variable (Y_i) and a set of explanatory variables (X_i) that are anticipated to be statistically significant when presented in estimated form (Eviews 8 User Guide, 2014). Both models cover a much wider set of functional forms; contributing greater power to the results (Croucher, 2013; Wooldridge, 2012).

The national house prices in China were calculated using principal component methods based on the linear combination of the house prices in the most important 13 economic developed cities (Eviews 8 User Guide, 2014).

4.3.2 Model specifications

In this study, econometric specifications were used as a basis for the empirical testing of housing price bubbles and main drivers of house prices in Australia and China, taking into account the main macroeconomic factors. These include a combination of supply and demand factors and macroeconomic policy factors which may help explain house price drivers, housing demand factors and the risk of housing price bubbles within the Australian and Chinese housing markets.

The empirical specifications are based on theoretical considerations presented by Hui and Yue (2006) regarding housing demand, economic policy regarding housing, and monetary policy perspectives. When considering the influence of macroeconomic policy on housing perspectives, it is anticipated that the level of house price changes, as well as the risk of housing price bubbles, are likely to be affected by interest rates, share market performance, consumer sentiment, GDP, purchasing power and demand and supply factors (Koblyakova et al., 2014). From a funding perspective, it is anticipated that securitisation affects gross mortgage lending volumes and may influence housing demand volumes.

The empirical specifications for house price equations in China and Australia and the test for the housing bubbles equations in China and Australia are given by Equations (6) and (7) respectively. See Appendix 1 for Abbreviations:

$$CNHP = \beta_0 + \beta_1 CNIR + \beta_2 CNGDP + \beta_3 CNSHARE + \beta_4 CNUNEMP + \beta_5 CNHP(-1) + \mu \quad (6)$$

$$\Delta \text{ Ln } (CNHP_{t)} = \alpha_0 + \gamma_0 \Delta \text{ Ln } (X_t) + \delta \text{ (Ln } (CNHP_{t-1}) - \beta_0 \text{ Ln } (X_{t-1})) + \mu_t \quad (7)$$

Thus, house price (CNHP) appears as a dependent variable and the OLS and VECM models in Equations (6) and (7) are a function of the macroeconomic explanatory variables, namely interest rate (CNIR), GDP (CNGDP), share market performance (CNSHARE) and unemployment rate (CNUNEMP). House price (CNHP) is also a function of one lag in HP.

Furthermore, from the macroeconomic perspective, in an environment of uncertain economic conditions, the housing demand flow is influenced by the volatility of economic growth, purchasing power, consumer confidence and interest rates (Koblyakova, 2016). This is because fluctuations in interest rates and changes in the macroeconomic environment create additional risks which are associated with imbalances in housing demand and supply (Adams and Füss, 2010). From the purchasing power perspective, house price depends on the degree of integration between affordability and the mismatch between demand and supply in the

housing markets (Kasparova and White, 2001).

It is also predicted that an increase in real average earnings would positively affect housing demand flows. This implies that empirical testing of the relationship between house prices and average wage could reflect the responsiveness of home buyer affordability to movements in house prices and expectations of housing investment capital gains (Kasparova and White, 2001).

With reference to macroeconomic influences, share market performance and interest rates (IR) aim to reflect the impact of volatile information and changes in interest rates on the cost and, thus, the volume, of house purchasing decisions (Meen, 1999; Koblyakova, 2014). House prices are denominated in nominal terms, and since wages and house prices are usually positively correlated, higher wages could significantly affect the movement of house prices. However, an upward house price movement could also capture the effects of wealth, as purchasing power might rise in response to a wage rise, reflecting the fact that perceived wealth would increase (although this may merely be an illusion of having more money).

House price is anticipated to be highly negatively correlated with interest rates. Higher interest rates could significantly impact the mortgage expense and mortgage lending volume. The residential debt to GDP ratio empirically proxies mortgage lending liquidity constraints that refer to the maturity, size and distribution of mortgage debt (Koblyakova, 2014).

With reference to the main drivers of Australian and Chinese house prices, the empirical investigation (ref Equations (4) and (6)) aims to establish whether the dominant factors of house price movements within the Australian and Chinese housing markets can be partially explained by housing price fundamental factors and macroeconomic arguments. Thus, house pricing (HP and CNHP), which appear as a dependent variables on the left hand side of the Equation(4) and (6), respectively, is a function of the following empirical arguments:

Mortgage interest rates (IR) are suggested to reflect the theoretical proposition that a historic decline in mortgage interest rates lowers mortgage funding costs, generating an increase in house prices (Koblyakova, 2014; Koblyakova and White, 2016). This is because the funding for Australian and Chinese mortgages proceeds predominantly from retail deposits or short-term interest rate swaps, while lower mortgage interest rates may positively impact housing purchase decisions.

Suggested as a proxy for the prevailing economic conditions, share market performance aims to establish whether volatility, information and, thus, change of purchasing power due to share investment may have impacted house purchasing decisions and, in turn, the demand for houses (Sargent, 2013).

To account for purchasing power, unemployment rates have been included with the aim of exploring whether the purchasing power of households can be accounted for by movements in the unemployment rate (Abelson et al., 2005; Bodman and Crosby, 2004; Bourassa and Hendershott, 1995).

Differences in consumer confidence as a macroeconomic level variable mean that the Australian housing market reflects householders' confidence when making purchasing decisions, based on the costs of funds and profit margins.

Furthermore, to account for the possibility that China's economic growth may encourage towards household purchasing decisions, GDP has been included in these econometric estimates. It is anticipated that a higher GDP would impact housing purchase power, due to increased wages and higher confidence in the macroeconomic and housing market environments (Sargent, 2013).

Thus, the empirical specifications include macroeconomic variables in consideration of the fact that house price determinations are largely systematic; that is, they correlate with the slope and the level of the term structure of given data sets. Therefore, these specifications include important macroeconomic variables covering aspects of the country's economic performance, monetary policy indicators, household owners' purchasing power and confidence in the housing markets in China and Australia.

4.4 Australia's big four cities house price spillover effects and macroeconomic relationships

4.4.1 Econometric methods

The modelling approach encompasses the formulation of VAR, Johansen co-integration, the VECM, Granger causality test, the Variance Decomposition and the Generalise Impulse Response estimation techniques.

The vector autoregression (VAR) is commonly used for forecasting systems of interrelated time series and for analysing the dynamic impact of random disturbances on the system of variables (Eviews 8 user guide, 2014). (See Equation (3) in Section 4.2.1). In the VAR model, a unit root may spur the development of the theory of non-stationary time series analysis. Phillips-Perron (PP) unit root tests are applied to test whether the first difference of time series data is stationary. A series is said to be stationary if the mean and autocovariances of the series do not depend on time (Wooldridge, 2012). Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary linear combination exists, the non-stationary time series are said to be co-integrated, which may be interpreted as a long run equilibrium relationship among the variables. When learning about a potential long run relationship between two series, the concept of co-integration enriches the kinds of dynamic models at the researchers' disposal (Eviews 8 User Guide, 2014).

If co-integration is detected, Vector Error Correction (VECM) or non - stationary regression methods may be used to estimate the co-integrating equation. The VECM equation is modelled as a restricted VAR, designed for use with non-stationary series that are known to be co-integrated. The assumption of stationarity of time series data is important since these time series is relatively easy to predict and obtain meaningful results. Spurious outcome may incur should this assumption not be met.

The VECM specification restricts the long-run behaviour of the macroeconomic variables and house prices to converge to their co-integrating relationships. 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 (see Equation 2 in Section 4.2.1).

Correlation does not necessarily imply causation in any meaningful sense of the word (Eviews 8 User Guide, 2014). Resolving a spurious correlation problem, the Granger (1969) approach to the question of whether x causes y is to see how much of the current y can be explained by past values of x, and then to see whether adding lagged values of x can improve the explanation. y is said to be Granger-caused by x if x helps in the prediction of y, or equivalently if the coefficients on the lagged x are statistically significant. It is important to note that the statement "x Granger causes y" does not imply that y is the effect or the result of x. (Engle and Granger, 1987; Eviews 8 user guide, 2014)

Variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR (Eviews 8 User Guide, 2014). Impulse response functions trace the effects of a shock to one endogenous variable on to the other variables in the VAR. A shock to the i-th variable not only directly affects the i-th variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR. An impulse response function traces the effect of a

one-time shock to one of the innovations on current and future values of the endogenous variables. Generalised impulses, as described by Eviews 8 User Guide (2014), constructs an orthogonal set of innovations that does not depend on the VAR ordering. The generalised impulse responses from an innovation to the j-th variable are derived by applying a variable specific Cholesky factor computed with the j-th variable at the top of the Cholesky ordering.

4.4.2. Model specifications

The econometric specifications provide the basis for empirical testing of the model of ripple effects among regional house prices and relationships with macroeconomic variables. Given the inclusion of the regional perspective, the empirical specification follows Fereidouni's (2016) and Tsai's (2014) analyses. These econometric specification are important as they show the details of the estimations variables impacting any house price ripple effects.

The empirical specifications of long run equilibrium relationships on regional and national house prices and macroeconomic variables under VAR model are given by Equations (8) to (12). See Appendix 1 for Abbreviations.

$$LHP_t = \beta_{0i} + \beta_{1i} LBHP_t + \beta_{2i} LMHP_t + \beta_{3i} LPHP_t + \beta_{4i} LSHP_t + \beta_{5i} LMAC_t + \mu_t \quad (8)$$

$$LBHP_t = \beta_{0i} + \beta_{1i} LAUSHARE_t + \beta_{2i} LBAWE_t + \beta_{3i} LMIN_t + u_t \quad (9)$$

$$LPHP_t = \beta_{0i} + \beta_{1i} LAUSHARE_t + \beta_{2i} LIR_t + \beta_{3i} LMIN_t + u_t \quad (10)$$

$$LMHPt = \beta_{0i} + \beta_{1i} LMAWE_t + \beta_{2i} LMGDP_t + \beta_{3i} LMRY_t + u_t \quad (11)$$

$$LSHP_t = \beta_{0i} + \beta_{1i} LIR_t + \beta_{2i} LMIN_t + \beta_{3i} LSAWE_t + \beta_{4i} LSUNEM_t + u_t \quad (12)$$

In the case of the VECM model, the long run equilibrium is corrected gradually through a series of partial short run adjustment by error correction terms. (Eviews 8 User Guide, 2014). The negative coefficient of the co-integrating vector measures the speed of adjustment of the

endogenous variable towards the equilibrium by the economic force. At any time period, there can be deviations from the equilibrium, but they will be temporary since there are economic forces that drive the I (1) variables back toward the equilibrium relationship. The long-run relationships with short term error correction are empirically validated representing strong explanatory power and makes regressions involving I (1) variables potentially meaningful (Wooldridge, 2012).

The empirical specifications of VECM models between regional house prices and macroeconomic variables are given by Equations (13) to (16), See Appendix 1 for Abbreviations:

$$\Delta \text{ LBHP}_t = \alpha_0 + \gamma_0 \Delta \text{ LMAC}_t + \delta \text{ (LBHP}_{t-1} - \beta_0 \text{ LMAC}_{t-1}) + \mu_t \quad (13)$$

$$\Delta \text{ LPHP}_t = \alpha_0 + \gamma_0 \Delta \text{ LMAC}_t + \delta \text{ (LPHP}_{t-1} - \beta_0 \text{ LMAC}_{t-1}) + \mu_t \quad (14)$$

$$\Delta \text{ LMHP}_t = \alpha_0 + \gamma_0 \Delta \text{ LMAC}_t + \delta \text{ (LMHP}_{t-1} - \beta_0 \text{ LMAC}_{t-1}) + \mu_t \quad (15)$$

$$\Delta \text{ LSHP}_t = \alpha_0 + \gamma_0 \Delta \text{ LMAC}_t + \delta \text{ (LSHP}_{t-1} - \beta_0 \text{ LMAC}_{t-1}) + \mu_t \quad (16)$$

Appearing as a dependent variable in the VECM of housing price (Equations (13) to (16), the first difference of regional LHP_t is proxied by the first difference of the key macroeconomic explanatory variables LMAC_t. Macroeconomic variables are recommended as proper explanatory drivers for house prices (Abelson et al., 2005).

The inclusion of stock market performance (AUSHARE), the mining performance index (MIN) and mortgage interest rates (IR) in econometric estimates is a novelty which aims to include macroeconomic effects in the consideration of house prices movements (Abelson et al., 2005, Fereidouni 2016). Regional average weekly earnings (RAWE), regional unemployment rates (RUNEMPLOY), regional rental yields (RRY) and regional GDP (RGDP) are important empirical arguments that reflect spatial patterns of determinants of

regional house prices (Liu, 2013).

Thus, the first difference of the regional LHP_t is a function of the first difference of the key macroeconomic explanatory variables $LMAC_t$, the co-integration vector between regional LHP_{t-1} and $LMAC_{t-1}$, and the error terms μ_t. As the VECM specification indicates, if the long run equilibrium of the house price is corrected through the short run disequilibrium by the key macroeconomic drivers of regional house prices, house price long-run equilibrium is achieved (Abelson et al., 2005).

The identification of the model is achieved as follows. Applying the Phillip Peron test to ensure stationarity of time series at I (1), the Johansen co-integration equation is identified with the macroeconomic time series variables and by regional and national house prices included in econometric estimates (Eviews 8 User Guide, 2014). The VECM equation is identified by the macroeconomic variables and house price variables which are relevant to the regional housing price dynamics and are co-integrating relationships (Wooldridge, 2012). The number of optimal lags involved in the estimation process follows the SIC rule, reducing the number of optimal lags by 1 due to the first difference requirement of the VECM estimates (Eviews 8 User Guide, 2014), followed by the variance decomposition test, the Generalised impulse response and the Granger causality tests.

4.5 China's first and second - tier major 13 cities house price spillover effects and macroeconomic relationships

4.5.1 Econometric methods

Croucher (2017) and Wooldridge (2012) state that, when estimating non-linear relationships, the traditional assumption of an underlying linear model structure and its application in non-linear estimation procedures could lead to a biased estimate and misspecification. In order to minimise the possibility of misspecification, co-integration tests and VECM models were

employed to model non-linear relationships for a fixed set of macroeconomic variables for the first two tiers cities' housing price variables, with appropriate data transformation and test modification procedures (Croucher, 2017; Wooldridge, 2012).

The modelling approach focuses on the formulation of the VECM, the Granger causality test, variance Decomposition test and generalise Impulse Response estimation on first - tier housing price and second - tier major cities' house prices in China. Furthermore, China's first and second - tier city house prices are calculated using principal components methods based on the top 13 cities' house prices using Eviews 8. Principal components analysis models the variance within a set of observed variables using linear combinations of these variables. These linear combination or components, may be used in subsequent analysis and the combination coefficients or loading, may be used in interpreting the components. (Eviews 8 User Guide, 2014).

Equations 1, 2 and 3 in Section 4.2.1 represent the formal structure of the model.

4.5.2 Model specifications

The econometric specifications provide the basis for the empirical testing of the model of ripple effects among regional house prices and relationships between house prices and macroeconomic variables. Given the inclusion of the regional perspective, the empirical specification follows Fereidouni's (2016) and Tsai's (2014) analyses. It is expected that regional variations in the relationships between macroeconomic variables and house prices and regional house prices spillover effects may be reflected by migrations, equity transfers, spatial arbitrages and spatial patterns in the determinants of house prices (Liu, 2013).

Equations 17 to 19 represent the empirical specifications of the model with the variables being empirical proxies for the theoretical variables identified and, in some cases, used for empirical estimations in previous research, See Appendix 1 for Abbreviations:

$$LFIRSTP_t = \beta_{0i} + \beta_{1i} LSECONDP_t + \mu_t \quad (17)$$

$$LFIRSTP_t = \beta_{0i} + \beta_{1i} LCNSHARE_t + \beta_{2i} LIR_t + \beta_{3i} LGDP_t + + \beta_{4i} LUNEMP_t + u_t \quad (18)$$

$$LSECONDP_t = \beta_{0i} + \beta_{1i} LCNSHARE_t + \beta_{2i} LIR_t + \beta_{3i} LGDP_t + + \beta_{4i} LUNEMP_t + u_t \quad (19)$$

The empirical specifications of long run relationships between variables of regional housing price spatial patterns and the VECM model representing housing price long run equilibrium are given by Equations (1) and (3) in Section 4.2.1, respectively.

Equations (20) and (21) represent the empirical specifications of the model with the variables being empirical proxies for the theoretical variables identified and, in some cases, used for empirical estimations in previous research.

$$\Delta LFIRSTP_t = \alpha_0 + \gamma_0 \Delta LMAC_t + \delta (LFIRSTP_{t-1} - \beta_0 LMAC_{t-1}) + \mu_t \quad (20)$$

$$\Delta LSECONDP_t = \alpha_0 + \gamma_0 \Delta LMAC_t + \delta (LSECONDP_{t-1} - \beta_0 LMAC_{t-1}) + \mu_t \quad (21)$$

The empirical specifications of long run relationships between variables of regional housing price spatial patterns and the VECM model representing housing price long run equilibrium are given by Equation (2) in Section 4.2.1.

In an environment of uncertain economic conditions, a house price is influenced by macroeconomic variables, as well as the spillover effects of national and regional house prices (Fereidouni, 2016; and Tsai, 2014; Abelson et al., 2005; Liu, 2013). It is novel to include the stock market performance (CNSHARE), GDP, mortgage interest rate (IR) and unemployment rate (CNUNEMP) in the econometric estimates which consider the macroeconomic effects on house prices movements in order to explore whether the spatial patterns of housing price dynamics and the housing price ripple effects differ by regional location (Abelson et al., 2005; Fereidouni, 2016).

These variables are included because variations in spatial patterns of housing price dynamics may have created regional diversities in housing price movements. They are important empirical arguments that reflect the spatial patterns of determinants of regional house prices (Liu, 2013). Regional average weekly earnings (RAWE) and the regional unemployment rates (RUNEMPLOY) reflect purchasing power implicated in house purchase decisions (Liu, 2013). Based on the argument that there are contagious effects on house prices (Liu, 2013), the first - tier house price (FIRSTP) and second - tier house price (SECONDP) account for the regional variations in house prices spillover effects (Fereidouni, 2016; and Tsai ,2014).

The hypotheses to be tested are: i) spillover effects of regional and national house prices do influence regional house prices; and ii) the spatial pattern of long run equilibrium with macroeconomic variables exist on regional house prices.

The identification of the model was done as follows. First the Phillip Peron test was applied to ensure the stationarity of time series at I (1) on first - tier and second - tier house prices and the macroeconomic variables. The Johansen co-integration equation was then tested (Eviews 8 User Guide, 2014). Next, the VECM equation was identified by the macroeconomic variables and house price variables which are relevant to the regional housing price dynamics and have co-integrating relationships (Wooldridge, 2012). The number of optimal lags involved in the estimation process follows the SIC rule, reducing the number of optimal lags by 1 to meet the first difference requirement of the VECM estimates (Eviews 8 User Guide, 2014).

4.6 Estimation issues and assumptions

4.6.1 OLS

An estimation procedure involves several econometric issues, reflecting specific requirements for the OLS, the Johansen co-integration, and the VECM model assumptions using time series data. Time series data is routinely used in applied macroeconomic fields. To resolve the

violation of these assumptions, a number of extensive econometric tests were conducted using advanced time series analysis techniques (Croucher, 2017; Wooldridge, 2012).

Multicollinearity is a phenomenon in which two or more predictor variables in a multiple regression model are highly correlated. The issue of multicollinearity is avoided by employing a best subset test using Minitab Statistical Software (Pennsylvania, US) to identify the combinations of explanatory variables that contribute to a high value of R^2 (Croucher, 2017).

Under the OLS assumption, concerns about autocorrelation with error terms are typically raised. The issue of autocorrelation is avoided by analysing the Durbin–Watson statistic (d) which is appropriate for testing the possibility of a first-order autoregressive model. The value of d always lies between 0 and 4. The closer the value of d is to 2, the better the OLS model fits the data (Wooldridge, 2012). The endogeneity issue is also resolved with the outcome of a biased OLS estimator.

In an OLS model, all random variables in the sequence are expected to have finite variances to ensure a good fit of data (Wooldridge, 2012). Homoscedasticity is tested using the Glejser test, which regresses the absolute value of the residuals from the original equation to test the null hypothesis of homoscedasticity and reject the null hypothesis when the p-value is statistically significant. Further, the normality assumption is tested by employing the Jarque-Beta statistic. The null hypothesis, that the errors are normally distributed when it is true, cannot be rejected (Croucher, 2017; Wooldridge, 2012).

P-values are routinely employed in null hypothesis significance testing. A significance level of 10% is applied as the threshold value for p (Croucher, 2017; Wooldridge, 2012).

4.6.2 Co-integration test

To resolve the non-stationarity or the unit root problem, the Johansen co-integration estimation requires integration of a number of variables of order 1 at first differences (Wooldridge, 2012). The augmented Dickery-Fuller (ADF) and Phillip and Perron test (PP) were employed to test the null hypothesis that a unit root is present in the time series data sample. Furthermore, the primary reason for employing a VECM to test for house price bubbles arises from the assumption that if the economic equilibrium is a condition and economic forces are balanced or in equilibrium, it can be concluded that there is no existence of a housing bubble (Valentine and Garrow, 2013). If the error correction coefficient is negative and significant, the short-term adjustment is corrected back to long run equilibrium, thus suggesting that the housing price is always in equilibrium. Therefore, no bubble exists (Wooldridge, 2012).

The variables tested in the unit root test, Johansen co-integration test and VECM incorporate transformed logarithm values. This is in accordance with the theoretical recommendation that the transformed empirical variables may be a better indicator for visualisation and interpretation purposes (Croucher, 2017; Wooldridge, 2012).

An estimation procedure involves several econometric issues, reflecting specific requirements for the co-integration and VECM models. In particular, to resolve any spurious correlation problems, the VECM estimations require variables of co-integrating relationships (Angrist and Kreuger, 2001).

An issue here is that the non-existence of long run relationships among these variables will not meet the assumption of VECM framework tests. Another issue is that the number of variables involved in the estimation process should be stationary at first difference, I (1) and non-stationary at levels (Davidson and Mackinnon, 1993; Wooldridge, 2012).

The Phillips-Perron (PP) unit root tests are conducted to test if stationary assumptions are met

for variables used in the estimation. These examinations are predicated on the outcomes of several studies (Wooldridge, 2012) which suggest the necessity to report p-values routinely in null hypothesis significance testing, concluding that the significance level of 10% is applied as the threshold value for p (Croucher, 2017; Wooldridge, 2012) for VECM framework tests.

Additionally, the variables tested in the unit root test, Johansen co-integration test and VECM test incorporate transformed logarithm values to establish the robustness and consistency of any estimates. This is, in accordance with the theoretical recommendations that the transformed empirical variables may be a better indicator for visualisation and interpretation purposes (Croucher, 2017; Wooldridge, 2012). Robustness check, where the researcher examines how certain core regression coefficient estimates behave when the regression specification is modified by adding or removing regressors are conducted (Lu and White, 2014) along with the identification of the best value of parameters. (Gujarati and Porter, 2009)

This combination of co-integrating advanced time series testing avoids the diagnostic concerns raised by the OLS when testing the relationships between house prices and macroeconomic variables.

A common exercise in empirical studies is a "robustness check", where the researcher examines how certain "core" regression coefficient estimates behave when the regression specification is modified by adding or removing regressors.

4.7 Data

4.7.1 Executive summary on data

Purpose and scope

This section analyses the datasets pertaining to housing bubbles, house price spillover and house price macroeconomic relationships. The aim of doing so is to establish an empirical research context to estimate house price dynamics and housing bubbles, informed by

empirical specifications for econometric estimations and identifying original findings using time series data with advanced empirical techniques.

Recognising the importance of the impact of house prices dynamics and housing bubbles on national and regional economies, this review begins with an overview of key datasets, including national and regional house prices, the macroeconomic variables used in the empirical tests in Australian housing markets, and datasets including national and regional house prices, and macroeconomic variables used when testing China's housing markets. It continues with a discussion of the limitations of using correlation tests alone, and the needs to conduct further econometric estimates.

Methodology

Datasets regarding empirical estimates of house price main drivers, housing bubbles, how macroeconomic relationships effect house prices, and spillover effects on house prices in the national and regional housing markets in China and Australia, were analysed in Chapter 4.7 using secondary information.

Key Literatures

Summary of Australian Data

The sample of data used in this research was taken from ABS, RBA, CoreLogic, and the US economic trading website for the period from 1995Q4–2015Q3. It covers the relatively stable economic environment over the last two decades in Australia, including the most recent housing boom from 2012 to 2015. Use of reputable data providers ensure good quality and valid information for this study. The data frequency is on quarterly basis.

Australian house prices and macroeconmic variables

The data used for measuring housing prices in Australia nationwide and in its largest four cities are the CoreLogic Home Value Hedonic Index series (HP) from 1995Q4 to 2015Q3.

Corresponding with the Equation (4), macroeconomic and dummy variables included in the empirical test are mortgage interest rate, Australian share market index, mining boom index, unemployment rate, average weekly earnings, consumer sentiment, population, a dummy variable for GFC event, large Chinese purchases and purchases through self-managed superannuation funds.

Overall, these variables reflect that the Australian economy has experienced a remarkable performance over the last two decades. The dataset reflects key cyclical trends, including the mining boom and how the exogenous financial shock from the global financial crisis which contributed to peak and trough performances. There is a continued growing trends for average weekly earnings and population increase, which may suggest a higher purchasing power and increased demand for houses. However, the growth rate of these two economic forces is at a much slower than that for house price growth. This could potentially raise affordability problems. These findings are especially important for the policy makers as it shows the importance of setting up reasonable policy infrastructures in order to control the speed of house price growth with the aim of balancing income and economic growth.

From regional perspectives, NSW and Victoria yielded the highest growth rates on Gross value added by 180.72% and 172.16%, respectively, over the time spectrum tested. The results suggested growth and development of the NSW economy in multiple areas linked to trading, manufacturing, finance and distribution over the last two decades. Further, the mining boom contributed to the large growth in WA's economy over the time spectrum covered by the empirical test. NSW and WA had slightly lower unemployment rates than Victoria and Queensland, where rates were mutually comparable.

Summary of China's data

The data used in this research were taken from the China property data provider CitiRE, and the US trading economic website for the period from 2007Q2–2015Q3, incorporating the

prosperity period of the "golden age" (2003 – 2013) and the "new normal" era (2014 onwards) in China's real estate industry (Zhang et al., 2016). Choosing credible data has assured the quality of this research. China house prices at a national level are also credible because of the procedure of calculation is sensible and sound by using principal components methods in the Eviews.

China's house prices and macroeconmic variables

Moving along the time horizon, unemployment in China remained steady at approximately 4% over the estimation period from 2007Q2 to 2015Q3. Furthermore, the income dataset displays a continuous growth trend during the time spectrum tested. While the dataset for GDP reveals a marked rise over the tested spectrum. The dataset for share market performance (CNSHARE) suggests a cyclical trend during the time horizon specified. Annual interest rates ranged between 4.6% and 7.47% during the period, and there were substantial rate cuts after 2008Q2 and 2014Q3, reducing average rates to a record low of 4.60% in 2015Q3. Adjustments to interest rates reflect the government tightening and easing controls on housing prices.

Data limitations

The limitation presented concerns the use of a standard variable mortgage rate in an econometric test. Given the non-availability of an average mortgage interest rate from People's Bank of China, this cannot be avoided.

Furthermore, regional macroeconomic data regarding first - tier and second - tier major cities in China was unavailable, precluding a deeper analysis of regional variations impacting macroeconomic forces to first - tier and second - tier house prices in China. Moreover, the small sample sizes from 2007Q2 to 2015Q3 were a limitation preventing an in - depth analysis to understand regional macroeconomic relationships with house prices in two market segments.

However, although this may not capture the regional macroeconomic variables, in the absence of any alternatives, assigning national macroeconomic variables for the house prices of the most developed first - tier and second - tier cities were judged the best option.

Finally, the selected variables were expected to closely correlate with house prices. However, strong correlations between house prices and the selected economic variables were not alone sufficient to explain the house price dynamics due to the possibility of spurious regression and the possible misleading outcomes.

Concluding remarks

This section reveals details of datasets employed to deliver econometric estimates in both Chinese and Australian housing markets. These datasets were especially useful as they were sourced from reputable data providers and covered novel periods, including that of the most recent housing boom (2012-2015) in Australia, and both China's "golden era" (2003-2013) and "new normal" period (2014 onwards). From theoretical perspective, it is important to understand that the empirical analysis of data sets covering these periods within the Chinese housing market ensure the sensible complete empirical result, This also takes into consideration the rational expectation theory and the housing demand model.

With the detailed analysis of these datasets, attention is now being directed towards the outcomes of an empirical study describing long run co-integration relationships between house prices and macroeconomic variables. In Chapter 6, a detailed analysis updating econometric test results for stationarity and co-integration relationships is performed.

4.7.2 Australian Data

The data used in this research covers the period from 1995Q4–2015Q3; it was taken from ABS, RBA, CoreLogic, and the US economic trading website. Using reputable data providers ensures a quality foundation for the study. The data reveal a relatively stable economic

environment over the last two decades in Australia, and includes the most recent housing boom from 2012 – 2015.

4.7.2.1 National house prices

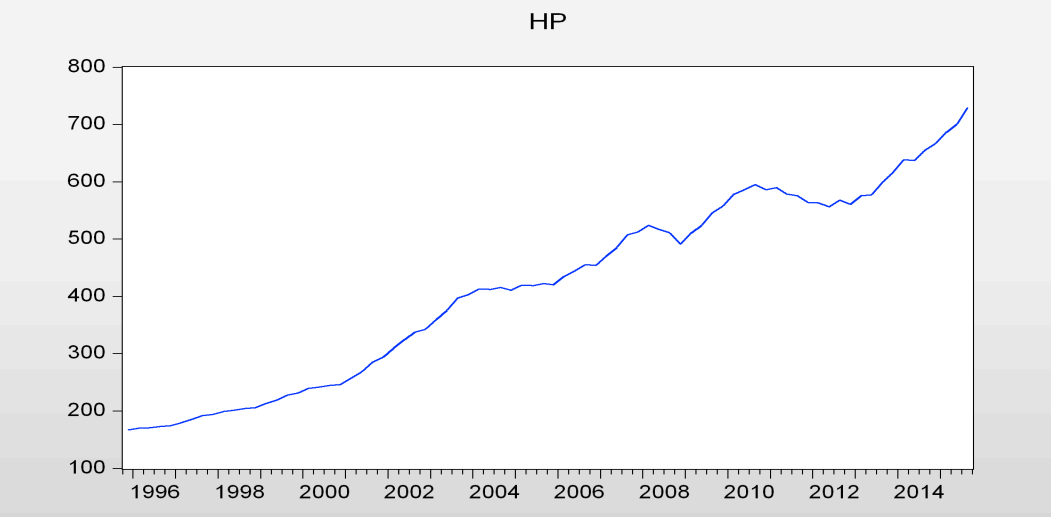

Figure 4.1 CoreLogic home value Hedonic Index (Australia National, 1995Q4-2015Q3)

Source: CoreLogic database, Hedonic Index house prices from 1995 to 2014

The data for measuring housing prices in Australia nationwide is drawn from the CoreLogic Home Value Hedonic Index series (HP) between 1995Q4 and 2015Q3. Figure 4.1 reveals a house price growth of 334.2% over these two decades. From 1995Q4 until 2012, a key feature of the table is that the home value Hedonic Index followed a light cyclical trend. In addition, there was an increase in house prices between 2001 and 2003. But after this time there was a mild downturn. House prices reached their lowest in 2008. The second growth period began in 2008Q4, immediately after the exogenous financial shock of the Global Financial Crisis, and the witnessed growth is principally attributable to the Rudd government's stimulus package. There was then a slow downturn until 2012, a which time a third surge in house prices started and continued until 2015. Interestingly, the speed of growth in the second decade was moderately faster than that in the first decade.

4.7.2.2 Big four cities house prices

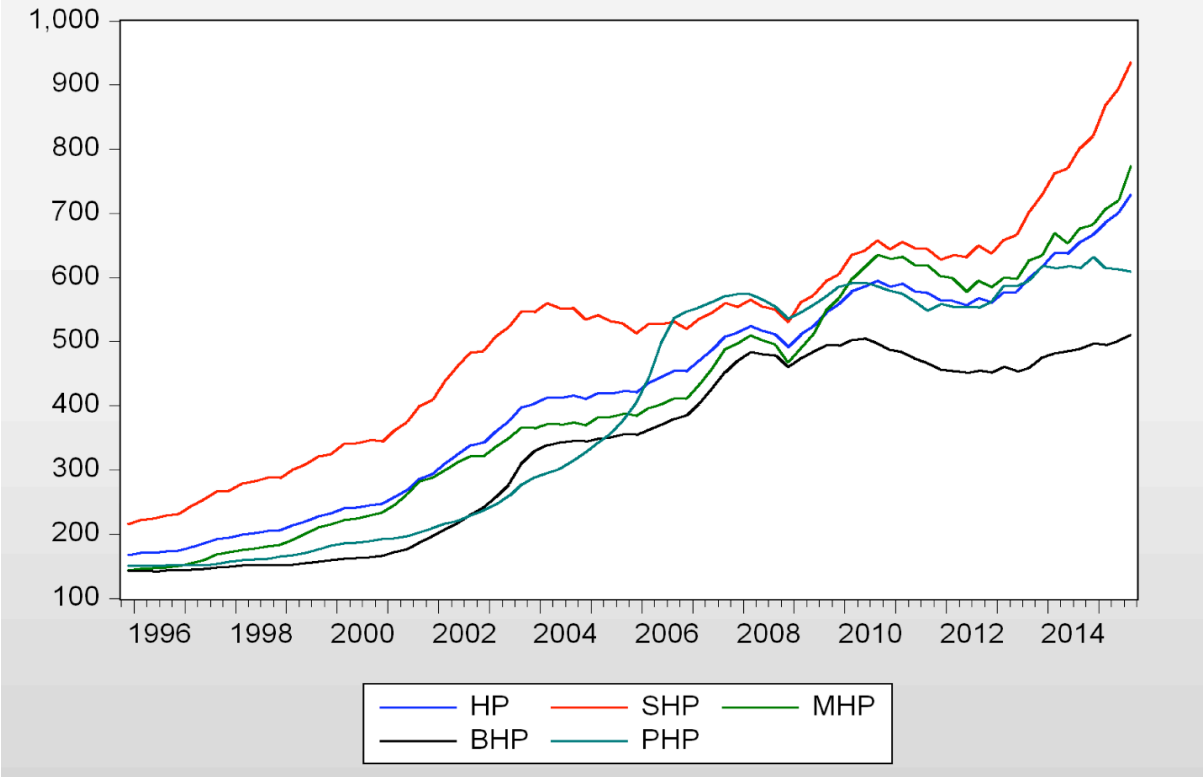

Figure 4.2 CoreLogic home value Hedonic Index. (Sydney, Melbourne, Brisbane, Perth; 1995Q4-2015Q3)

Source: CoreLogic, Regional Hedonic Index house prices from 1995 to 2015.

Sydney, Melbourne, Brisbane and Perth share a special relationship, due to their historical, cultural and business connections, along with their geographical proximity. There is also a significant number of inter migrations between the four cities. Statistics show that 8% to 15% of interstate migrations occur between these four major states in Australia at 2015Q3 (ABS, 2016). There is also a significant amount of business, trade and investment within the major states, and the Gross State Products (GSP) for these four cities accounted for 89% of the country's GDP in June 2016 (ABS, 2016).

Sydney is the most populous city in Australia, as it serves as a gateway to Australia for the country's many international visitors, and is also the highest ranking city in the world for the number of international students.

Researchers at Loughborough University in the UK ranked Sydney amongst the top ten world

cities considered to be most highly integrated into the global economy. The financial and insurance services industry in the city accounts for 18.1% of its gross product, outperforming professional services at 9%, and manufacturing at 7.2%. The creative and technology sectors are critical focus industries Sydney, and represented 9% and 11% respectively of its economic output in 2012. (Tsai, 2014)

Melbourne is the second-most populous city in Australia, and has a highly diversified economy with particular strengths in finance, manufacturing, research, information technology, education, logistics, transportation and tourism. The city is home to Australia's largest and busiest seaport, which handles more than $75 billion in trade annually, including 39% of its natural container trade.

Brisbane is the third - most populous city in Australia. It benefits from information technology, financial services, higher education and public sector administration, petroleum refineries, stevedoring, paper milling industries. Tourism also represents an important segment of Brisbane’s economy and it is one of Australia’s major business hubs, which helps make it the 3rd most important port in Australia in terms of value of goods.

Perth is the fourth - most populous city in Australia and has major mining, petroleum, and agricultural exports. The service industries and manufacturing industry there relate to the resources industry. Due to Perth's relative geographical isolation, its industries in part exist to support its self-sufficiency.

The data set used to measure the big four cities’ house prices are the Core Logic Home Value Hedonic Index series nationwide from 1995Q4 to 2015Q3 for Australia. Figure 4.2 reveals a cyclical trend in Sydney’s house price movements. National house prices, Melbourne house prices and Brisbane house prices all present cyclical trends consistent with that of Sydney.

However, Figure 4.2 also shows a slow rise in Brisbane house prices over the study period, especially during the most recent housing boom from late 2012 to 2015. Notable from the

figures collected is the high growth in Perth's house prices from 2005Q2 to 2006Q3, which reflected the increased purchasing power of Perth buyers during the mining boom (2004-2011) effects. National house prices and the big four cities house prices reached their lowest in 2008Q4, reflecting the exogenous financial shock arising from the impact of the global financial crisis. House prices immediately recovered, however, in response to the stimulus package mentioned above.

Furthermore, what stands out in Figure 4.2 is that there were three surges in Sydney's, Melbourne's and National house prices. There were steady rises in the period from 2001 to 2003, 2009 to 2010, and from the end of 2012 until 2015, during the tested periods. Interestingly, the speed of growth trend in Brisbane was markedly slower than those in Sydney and Melbourne during the most recent housing boom (2012 to 2015). Moreover, the graph shows a marked decline in Perth's house price from 2014 onwards, reflecting the fall in the mining price index over the same period resulting in weaker purchase power among Perth buyers. According to Knight (2017), the house price drop in Perth reflects a general lesser demand for commodities and resources in Perth.

Table 4.1 presents descriptive statistics regarding the macroeconomic conditions that relate to the maximum, minimum, mean, and standard deviation values for key variables included in the sample data. Moving along the time horizon, the Australian economy is found to have entered its twentieth year of remarkable economic growth (Battellino, 2010).

Indeed, since 1991, the economy has grown in almost every quarter. GDP growth rates fell to their lowest at 1.2% in 2009Q3 following the external financial shock caused by the global financial crisis. Further, GDP growth rate peaked at 5.4% in 1997Q2 and 1999Q1 as a result of increased household consumption and housing construction and a strengthening global economy. GDP growth rates reached their second highest levels, of 5.1% in 2007Q2 because of Australia's mining boom (2004 – 2011).

4.7.2.3 Macroeconomic variables

Table 4.1 Key macroeconomic statistics (Australia national, 1995Q4 – 2015Q3)

	Mean	St Dev	Min	Max
IR (%)	7.16	1.08	5.45	10.5
AWE ($)	823.5	191	555.4	1136.9
MINING	87.01	31.93	47.10	151.30
AUSHARE	4014	1150	2164	6568
UNEMPLOY (%)	5.99	1.21	4.1	8.6
GDP (%)	3.24	1.10	1.20	5.40
CS	104.4	8.5	121.5	84.7
Population (mil)	20.63	1.74	18.12	23.87
Inflation (%)	2.60	1.31	-0.40	6.10

Source: ABS, RBA, CoreLogic RP Data, Trading economics database

Legend of variables

1. IR — Mortgage interest rate (Australia)
2. AWE — Average weekly earnings (Australia)
3. MINING — Mining index (Australia)
4. AUSHARE — Australian S&P/ASX 200 stock market index
5. UNEMPLOY — Unemployment rate (Australia)
6. GDP — Gross domestic product (Australia)
7. CS — Consumer sentiment (Australia)

Next, during this period, inflation averaged 2.6%, which was a little above the mid-point of the target range. Over this period, unemployment fell substantially from 8.6% to 4.1%, reflecting economic growth resulting in lessening risk and greater opportunity for people to find work. This led to benefits in terms of income per household, which later rose by a cumulative 30% in real terms (Battellino, 2010). Average weekly earnings then increased from $554.4 per week to $1,136.9 per week over the period 1995Q4 to 2015Q3.

The limitation imposed here is the use of a standard variable mortgage rate as an econometric test. Given the unavailability of an average interest rate, this cannot be avoided. During the period selected, the data show a cyclical trend towards mortgage rate (IR) movement over the last twenty years. This was marked by four substantial rate cuts after 1995Q4, 2000Q4, 2008Q2 and 2011Q3, demonstrating the government's use of monetary policy to control its inflation target (Battellino, 2010). There were 11 consecutive cuts starting from 2011Q3, which was recognised to markedly impact the housing boom (2012-2015).

With regard to the index for commodity prices (MINING), the research data incorporates the Australian commodity index from 1995Q4 to 2015Q3. The mining boom, mentioned above in relation to Perth, began in 2003Q4 and ended in 2011Q3. From its peak of 151.3 in 2011Q3, the index fell by 35.89% to 2015Q3. The end of the mining boom reflects both increased supply and weaker demand for commodity resources in the world market. The mining boom had significant effects on Australia's economy, as shown by the fact that the country largely escaped the effects of the global financial crisis, and had a considerable impact on the growing wealth and improved purchasing power of Australians. For this reason the mining index was included in this empirical test with the mining boom being followed by the burgeoning of housing boom in early 2012.

Another important variable included in our empirical estimations is the Australian S&P/ASX 200 stock market index (AUSHARE), which tracks the performance of 200 large companies

based in Australia. The dataset revealed a cyclical trend in the Australian stock market index over the test period from 1995Q4 to 2015Q3. The index peaked at 6,568 points in 2007Q3, reflecting the contribution from the Australian mining boom. On the other hand, the Australian share index reached a low point of 3582 in 2009Q1, implying an influence from the Global Financial Crisis.

Although it might not wholly capture the performance of the Australian economy, consumer sentiment (CS) is included as an important statistical measurement and economic indicator of the overall health of the economy.

The data applied in the empirical tests considered here are drawn from the Westpac–Melbourne Institute Consumer Sentiment Index taken from the RBA website. The dataset reveals a cyclical pattern over the period from 1995Q4 to 2015Q3. Consumer sentiment peaked in 2007Q2, caused by the mining boom. Consumer sentiment reached a low point in 2008Q2, which was then attributed to the exogenous financial shock of the Global Financial Crisis.

Furthermore, according to the fundamental law of demand, household purchases of properties must be effectively backed by purchasing power. In this study, a series describing average weekly earnings (AWE) for two decades was found upon which to perform an empirical analysis. As time passed, the data revealed a gradual increase in AWE over these two decades, with the level in 2015Q3 being 104.70% of that at the beginning of the test period 1995Q4. Compared with house price growth of 334.5% over the same period, average weekly earnings grew significantly at a slower rate than house price, possibly indicating that issues of affordability affect Australian property buyers.

Finally, this study examined trends in population movement. This dataset revealed a gradual increase in population over the last two decades, equating to 31.73% over the last twenty years.

In summary, this data analysis reveals that the Australian economy has experienced a remarkable improvement in performance over the two decades to 2015. The datasets reflect cyclical trends, the mining boom and the impact of Global Financial Crisis as cause of peaks and troughs in performance. There is a continued growth trend in terms of average weekly earnings and population, which might enhance purchasing power and a further increase in the demand for houses. However, the growth rate of these two economic forces is well below the rate of house price growth, which potentially indicates an affordability issue. The much quicker growth of house prices comparing with income growth in Australia is consistent with that in China (see 5.3.1). This finding suggests the risk of affordability and the difficulty in fulfilments of home ownerships in both countries.

4.7.2.4 Regional macroeconomic variables

Table 4.2 Regional macroeconomic statistics in Australia (1995Q4 – 2015Q3)

	Mean	St Dev	Min	Max
SGDP (mil$)	309,327.1	95,645.63	170,772.5	479,399.0
MGDP (mil$)	267,186.0	44,352.08	186,706.0	336,045.0
BGDP (mil$)	213,036.0	49,632.01	132,709.0	289,474.0
PGDP (mil$)	149,591.6	46,217.06	88,710.00	241,432.0
SUNEMPLOY (%)	5.79	0.88	4.50	7.90
MUNEMPLOY (%)	6.10	1.22	4.40	9.10
BUNEMPLOY (%)	6.40	1.69	3.50	9.70
PUNEMPLOY (%)	5.29	1.34	2.70	7.70
SAWE. ($)	855.20	178.46	585.00	1176.30
MAWE ($)	795.20	169.38	564.20	1073.70
BAWE ($)	802.55	198.87	505.90	1111.10
PAWE ($)	866.25	272.84	550.80	1346.70

Source: ABS, RBA, CoreLogic RP Data

Legend of variables

1	SGDP	NSW Gross value added
2	MGDP	VIC Gross value added
3	BGDP	QLD Gross value added
4	PGDP	WA Gross value added
5	SUNEMPLOY	NSW Unemployment rate
6	MUNEMPLOY	VIC Unemployment rate
7	BUNEMPLOY	QLD Unemployment rate
8	PUNEMPLOY	WA Unemployment rate
9	SAWE	NSW Average weekly earning
10	MAWE	VIC Average weekly earning
11	BAWE	QLD Average weekly earning
12	PAWE	WA Average weekly earning

Table 4.2 summarises the statistics for the regional macroeconomic data for Sydney (NSW), Melbourne (VIC), Brisbane (QLD) and Perth (WA). It reviews the three key aspects of macroeconomic forces, including total gross industry value added.

In June 2015, of all the industries, 13.57% of the NSW industry gross value added was attributable to the financial service industries. Only 2.15% of the total value added related to the mining industry, and approximately 11.22 % of the gross valued added in Victoria related to the financial services industry. The proportion of the mining industry contributing to Victoria's gross value added stood at about 2.04%. Nearly 6.27% of the gross value added in QLD was contributed to by the financial services industry. The percentage contribution by mining industry was 6.93%, and the mining industry was estimated as 26.8% of WA's gross

value added. Almost 3.99% of the WA's gross value added was attributed to the financial service industries. As such, the mining industry mainly contributes to the WA and QLD gross value added, whereas the financial service industries were the main contributors to NSW's and Victoria's economies.

Subsequently, the data for June 2015 shows NSW accounted for approximately 30% of national GDP. almost 20% of which is due to Victoria. Around 18% of national GDP is attributed to Queensland, almost 15% of which is contributed by WA. Meanwhile, in total the big four cities, gross value added accounted for approximately 83% of total GDP. Moreover, Sydney reportedly had the largest economy and Perth the smallest among the big four cities. Melbourne was ranked after Sydney, while Brisbane numbered third ahead of Perth (ABS, 2016)

The datasets show a gradual rising trend in the gross value added for the big four cities over the last two decades.

The notable features of this dataset are that NSW surpassed Victoria's gross value added after 2013Q1. Furthermore, NSW and Victoria yielded the highest growth rates at 180.72% and 172.16% respectively, over the time spectrum evaluated. These results suggest the growth and development of the NSW economy is notable in multiple areas of trade, manufacture, financing and distribution over these last two decades. Furthermore, a mining boom has contributed to the growth in WA's economy during the time frame of our empirical test. In addition, QLD experienced an approximately 118% increase in gross value added, while Melbourne grew by 80% over the same time period according to empirical estimates.

The research has identified regional differences in the unemployment rate between the big four regions where NSW and WA were found to have slightly lower rates than Victoria and Queensland. The unemployment rates in Victoria and Queensland were comparable at just over 6%. Further, the dataset shows a clear cyclical trend over the time spectrum tested. The

most interesting aspects of the findings are that unemployment in WA continually increased after 2012Q2, while all the other regional states followed cyclical curves. These result suggest a lag effect at the end of the mining boom affecting WA's economies. Table 4.2 further highlights the improvement in the unemployment rate over the two decades. For example, the average unemployment rate in 1995Q4 was approximately 8.5%, whereas the average rate for 2015Q3 was 5.5%. This reflects a sound economic performance over these two decades in Australia.

Finally, the dataset shows gradual increases in the four regions' AWE over the time spectrum tested. House prices in NSW, Victoria and QLD are comparable over the empirical periods tested, but the highest growth rate in AWE in WA was from 2006Q2, reflecting increased purchasing power due to the effects of mining boom. The increase in AWE for NSW, Victoria, WA and QLD over the study period were 101.08%, 90.30%, 144.50% and 120% respectively. One important note is there is no macroeconomic data for big 4 cities. The regional data have been employed as the closed estimates to conduct the empirical tests.

4.7.2.5 Correlations between Australian house prices and macroeconomic variables

Table 4.3 Correlations of predictor variables (Australia national, 1995Q4 to 2015Q3)

	HP	CS	IR	AUSHARE
CS	-0.18			
IR	-0.31	0.02		
AUSHARE	0.84	-0.03	-0.11	
UNEMPLOY	0.715	-0.001	0.002	-0.777

Legend of variables

1. IR — Mortgage interest rate (Australia)
2. AUSHARE — Australian S&P/ASX 200 stock market index
3. UNEMPLOY — Unemployment rate (Australia)
4. CS — Consumer sentiment (Australia)

Table 4.3 reports the correlations between selected economic variables, all of which were expected to closely correlate with house prices. However, strong correlations between house prices and the selected variables were not sufficient to explain the house price dynamics, or to establish whether Australia is at risk of a housing bubble. Therefore, a combination of econometric techniques including OLS, Johansen co-integration, VECM, and Granger causality techniques was employed to model house price dynamics with reasonable and more powerful explanations. As suggested by Hui and Yue (2006), the correlation matrix elucidates the interactions between house prices and the macroeconomic variables. However, the evidence is not sufficiently sound to verify the long run equilibrium in house price results. Furthermore, the correlation matrix cannot provide clear insights into the causal relationships between house prices and macroeconomic variables, or feedback the effects from exogenous and endogenous variations and shocks.

To resolve the above limitations of correlation analysis, a combination of econometric methods was utilised to determine the long run equilibrium relationships between Australian house prices and macroeconomic variables, along with the associated spillover effects. The empirical estimations conducted included the Johansen co-integration test, the VECM method, and a Granger causality test to investigate the long run equilibrium in relationships between house prices and macroeconomic variables. The research also explored the spillover effects from house prices in Australia's big four cities by employing variance decomposition and generalised impulse response techniques.

4.7.3 Chinese Data

The data sample for this research describing China's property data was taken from CitiRE, and the US trading economic website for the period from 2007Q2–2015Q3. The selected period incorporates the prosperous "golden age" (2003 – 2013) and the "new normal" era (2014 onwards) in China's real estate industry (Zhang et al., 2016). Choosing these credible data providers assured the integrity of the research.

4.7.3.1 National house prices

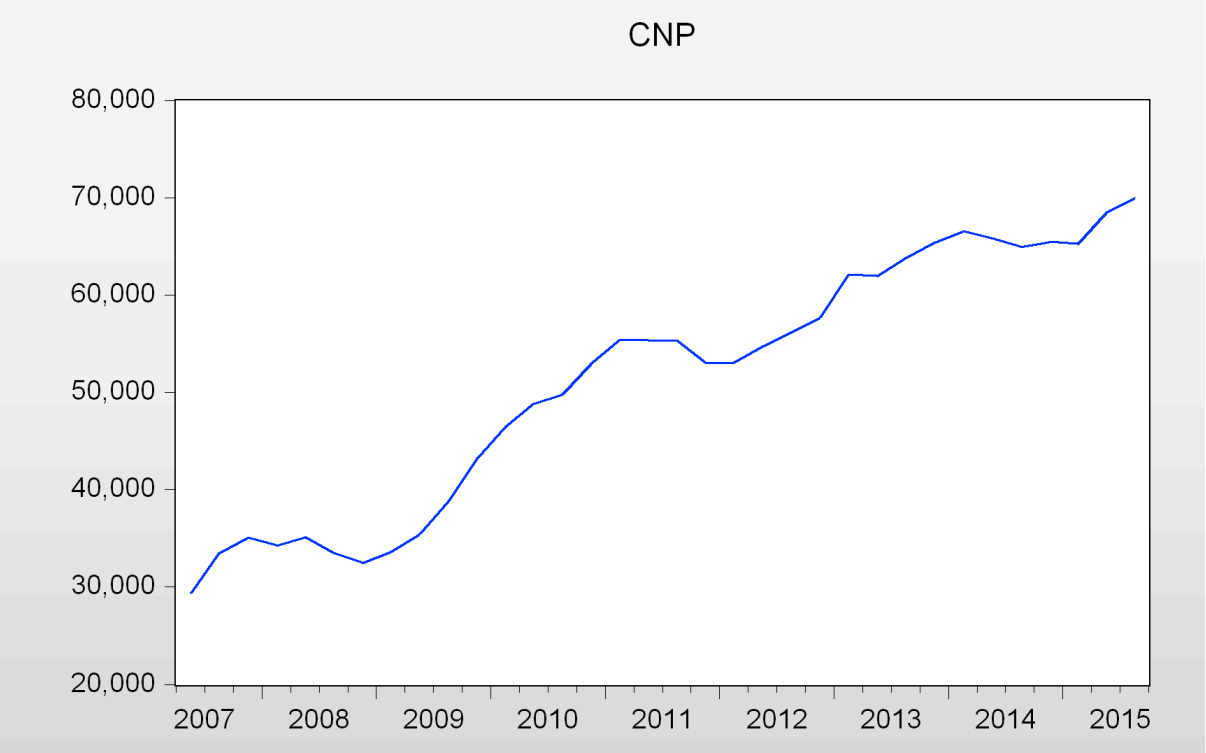

Figure 4.3 China's house prices (National calculated based on top 13 cities, 2007Q2 - 2015Q3)

Source: CitiRE China property data provider

Figure 4.3 reveals a cyclical movement in China's national house prices from 2007Q2 to 2015Q3.

National house prices have been through three troughs during the last eight years. The first trough was in 2008Q4, reflecting the impact of the Global Financial Crisis. Figure 4.3 shows

the gradual increase from 2008Q4 to 2011Q1, which is mainly attributable to the Chinese government's RMB 4 trillion (USD 666.67 billion) investment focused stimulus package, delivering RMB 2.87 trillion (USD 478.33 billion) to boost infrastructure. The scope of the Chinese government's stimulus package was huge, being the third largest implemented by any country (Australian government, 2011).

Figure 5.3 reveals two additional troughs in 2011Q4 and 2014Q3, reflecting the cyclical nature of China's housing markets. Over the eight-year period evaluated, average house prices increased from RMB 29,358 per square meter in 2007Q2 to RMB 70,003 per square metre in 2015Q3, representing an increase of 138.45%.

4.7.3.2 First tier and second tier house prices

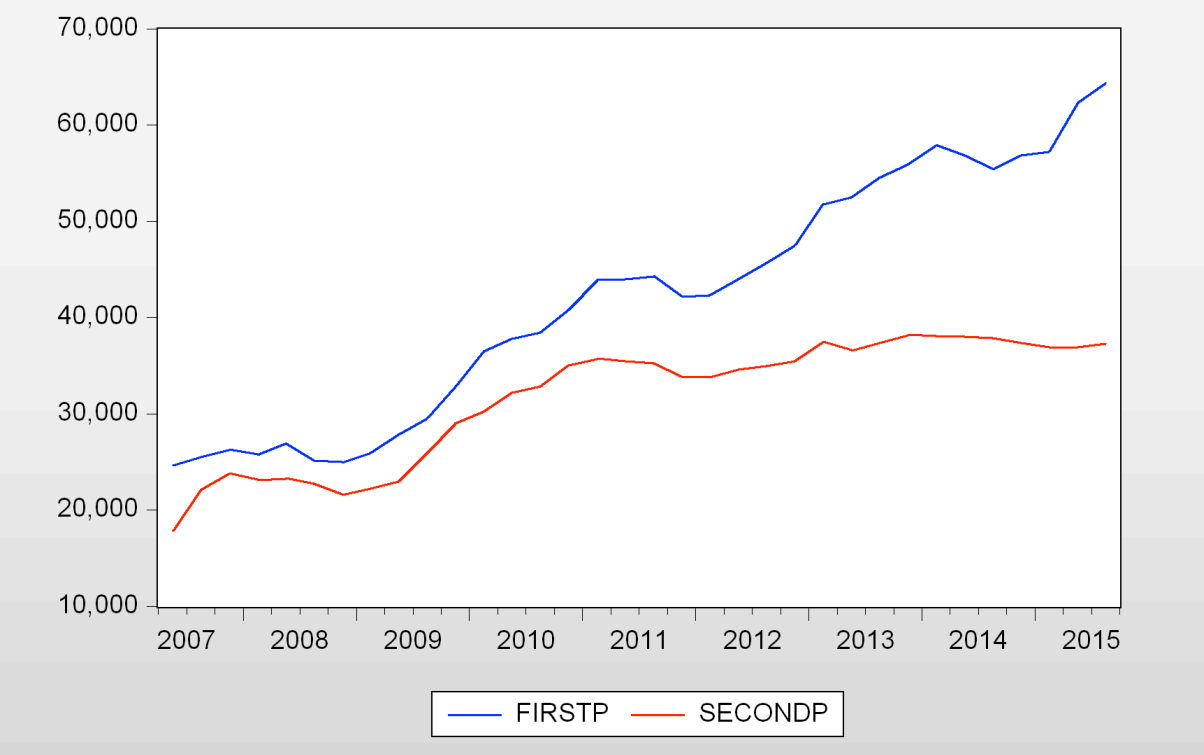

Figure 4.4 China's first and second - tier cities' house prices (2007Q2 - 2015Q3)

Source: CitiRE China property data provider

Figure 4.4 reveals that first and second - tier house prices underwent cyclical movement during the period from 2007Q2 to 2015Q3. Both segments' house prices encountered troughs in 2008Q4 because of the Global Financial Crisis. This graph is interesting as it depicts the

slower growth in house prices in second - tier cities from 2001Q4. It also shows that the increase in house prices in first - tier cities was by 52.39% between 2011Q4 and 2015Q3, whereas the increase in house prices in second - tier cities occurred at the much lower pace of 10.37%. Overall, the first - tier cities' house price rose by 161.32%, whereas the house prices in second - tier cities' rose at a slower rate of 109.63%, that is 51.69% higher in first - tier cities' house prices.

4.7.3.3 National macroeconomic variables

Table 4.4 Key macroeconomic statistics (China national, 2007Q2 – 2015Q3)

	Mean	St Dev	Min	Max
CNIR (%)	6.01	0.75	4.60	7.47
Wages per yr (YMB)	41,115.10	11,643.55	22,966.5	60,862
CNSHARE	2776.30	845.04	1820.8	5552.30
CNUNEMPLOY (%)	4.11	0.09	4.00	4.30
CNGDP (USD billion)	10,076.03	1,764.30	6,767	12,557

Source: Trading economics database

Legend of variables

1. CNIR — Mortgage interest rate (China)
2. CNSHARE — China Shanghai composite stock market index
3. CNUNEMPLOY — Unemployment rate (China)
4. CNGDP — Gross domestic product (China)

Table 4.4 provides key information regarding the macroeconomic variables used in the econometric models. Over the time period, unemployment (CNUNEMPLOY) remains steady at approximately 4%, but, notably, unemployment rates peaked in 2009Q1, reflecting the exogenous financial shock of the global financial crisis. The unemployment rate later started to decrease in 2009Q4, due to the Chinese governments' RMB 4 trillion fiscal stimulus to increase infrastructure.

Furthermore, the income dataset displays a continuous growth trend across the time spectrum tested. Wages per annum increased by 165% from 2007Q2 to 2015Q3, reflecting the large annual GDP growth in China at this time. For example, the average annual GDP growth in China was 7.5% per annum in 2016 (Trading Economics, 2016). The GDP dataset also reveals a marked increase from 2007Q2 to 2015Q3 specifically, estimated as 65.27% over the time horizon tested. This shows that GDP peaked in 2013Q1, having reached a low in 2008Q4. The peak result reflects China's economic expansion, while the downturn resulted from the shock of the Global Financial Crisis.

Also, the dataset for share market performance (CNSHARE) suggests a cyclical trend over the time horizon tested. Peak performance occurred in 2007Q3, while share performance reached its lowest in 2008Q4. Continued GDP growth and the Global Financial Crisis explained the peak and trough performance of China's share index.

Annual interest rates ranged between 4.6% and 7.47% during the period, and there were substantial rate cuts after 2008Q2 and 2014Q3, reducing average rates to a record low of 4.60% in 2015Q3. Adjustments in interest rates reflected the processes of the government tightening and easing controls on housing prices.

The benchmark lending rate of People's Bank of China (CNIR) is also included in our empirical test, and was found to be cyclical. The lending rate peaked in 2008Q2 at 7.47% followed by substantial continuous cuts to reach 5.31% in 2008Q4. The low rate continued

from 2008Q4 to 2010Q3, assisting in the country's recovery from the Global Financial Crisis. A key figure is the low rate of 4.6% at the end of the reviewed period in 2015Q3, reflecting the Chinese government's easing of policies to stimulate economic growth.

It was not possible to collect regional macroeconomic data concerning the first - tier and second - tier major cities in China. These data limitations preclude a deeper analysis of regional variations and impact from macroeconomic forces in China's cities. Furthermore, the relatively small sample sizes from 2007Q2 to 2015Q3 limit the depth of our analysis and subsequent understanding of regional macroeconomic relationships and house prices in the two segment markets. As suggested by Zhang et al. (2016), it is difficult to explain information regarding regional house price relative to macroeconomic growth completely and precisely when it is not possible to capture regional macroeconomic variables.

Thus, in the absence of any alternative, assigning the national macroeconomic variables to house prices for the most developed first - tier and second - tier cities were judged to be a worthwhile endeavour.

4.7.3.4 Correlations between China's house price and macroeconomic variables

Table 4.5 Correlations of predictor variables (China National, 2007Q2 to 2015Q3)

	CNP	IR	CNSHARE	GDP	UNEMPLOY
CNIR (%)	-0.40		0.30	0.24	-0.61
CNSHARE	-0.39	0.30		-0.46	-0.23
CNGDP (USD billion)	0.93	-0.24	-0.46		-0.23
CNUNEMPLOY (%)	-0.22	-0.61	-0.22	-0.23	

Legend of variables:

1.	CNIR	Mortgage interest rate (China)
2.	CNSHARE	China Shanghai composite stock market index
3.	CNGDP	Gross domestic product (China)
4.	CNUNEMPLOY	Unemployment rate (China)
5.	CNGDP	Gross domestic product (China)

The results for the correlational analysis between China's house prices and macroeconomic variables are set out in Table 4.5. The results suggest close relationships between China's houses prices and all macroeconomic variables. However, a correlation should not be assumed to suggest a causal relationship. And interpreting the relationship between dependent variables and independent variables using a correlation matrix alone can result in illusory conclusions and false relationships. Thus, a combination of econometric techniques, were employed including OLS, Johansen co-integration, VECM and Granger causality techniques to understand China's house price dynamics to provide justifiable and more robust explanations. Hui and Yue (2006) identified the problem using a correlational matrix alone to study the relationship between house price and macroeconomic variables, since the evidence is not sufficiently sound to verify the long term equilibrium house price. This finding is consistent with Australian house prices. See Table 4.3 for correlation analysis for the corresponding test on Australian house prices.

Moreover, a correlation matrix cannot provide a clear understanding of causal relationships between house prices and macroeconomic variables, or of the feedback responses from exogenous and endogenous variables and the relative importance of each random innovation influencing the variables contributing to the system.

CHAPTER 5

LONG RUN RELATIONSHIPS AFFECTING HOUSE PRICES AND MACROECONOMIC VARIABLES

5.1 Executive Summary

Purpose and scope

This section summarises the relevant results from the econometric tests that were required to establish co-integrating relationships between house prices and macroeconomic variables at both the national and regional levels in Australia's and China's housing markets.

The aim here is to update the empirical econometric test results for stationarity and co-integrate them to assist with further tests for spillover effect and housing bubbles, analysing results for empirical estimates and their associated implications in depth.

Recognising the importance of house price dynamics to the regional and national economy, this section begins by analysing empirical test results regarding house price variables and macroeconomic variables in Australia's national and largest four cities' housing markets. This is followed by an analysis of empirical test results for house price variables and macroeconomic variables in China's national and two major housing market segments, including the top 13 cities.

Rationale/justification of the case studies:

The case studies of China's housing market include both 1st and 2nd-tier cities, while in Australia they mainly focus on the 1st -tier (capital) cities. Analysis on different tiers' cities in the two countries is because of the larger scope of China's housing market, and therefore it covers more important economic zones. Furthermore, the selected cities in the two housing

markets are all chosen based on its representative important economic positions.

The Tier-1 Chinese cities considered in this research include Beijing, Shanghai, Guangzhou, Shenzhen and Tianjin. They are large densely populated urban metropolises with a huge economic, cultural, and political influence in China. Income levels in these cities are also much higher than the national average, with greater representation of the middle classes, who are developing excessive consumption habits.

The eight Tier-2 Chinese cities discussed include Hangzhou, Nanjing, Jinan, Chongqing, Qingdao, Dalian, Ningbo and Xiamen and comprise provincial capitals, and sub-provincial cities, with cultural and economic influences. Over the past decade, these Tier-2 cities have received additional attention and investment from foreign companies, due to lowered labour costs, less competition, lower operating costs for retailers, and rapidly growing consumer spending habits.

Methodology

Using primary information, empirical test results describing the co-integrating relationships between house prices variables and macroeconomic variables were reported in Chapter 5.

Key findings

1. A long run equilibrium relationship exists between national house prices and the regional big four cities' house prices in Australia.
2. Long run equilibrium relationships are identified by the largest four cities' house prices and macroeconomic variables in Australia.
3. Regional variations in macroeconomic variables are identified for the big four cities' house prices, reflecting the existence of interrelationships between regional housing markets and their local economy, and leading to self-reinforcing patterns of house price development (Muellbauer & Murphy, 1994). Holmans (1990) supports the view

that observed patterns can occur in house prices even when there are no spatial links between housing markets, if key regressors follow similar patterns.

4. Long run equilibrium relationships between major cities Beijing, Shanghai, Shenzhen, Nanjing, Chongqing and Ningbo house prices in China.
5. Long run equilibrium relationships exist between first tier and second tier housing prices and macroeconomic variables.
6. Variances in relationships with the macro-economy were identified for the two major housing markets.

Concluding remarks

The findings reveal the long run relationships between house prices and macroeconomic variables tested in two countries' national and regional housing markets. In particular, a long run relationship between house prices and macroeconomic variables suggest house prices are significantly dependent on macroeconomic variables. In other words, there is a statistically close connection between the dependent variable and independent variables. These findings are especially useful for delivering a strong foundation upon which to base further econometric tests of bubbles and spillover effects. The finding is achieved by employing a theoretical model largely based upon a rational expectation theory, and a housing demand model that applies knowledge that households' purchase decisions are largely based on maximum of utility and the income purchasing power.

This analysis leads on to a detailed analysis of the outcomes from the empirical estimates for house price spillover effects and housing bubbles in China and Australia in Chapter 6 and 7.

5.2 A comparative study of four major Australian cities

5.2.1 Phillips-Perron (PP) test

Table 5.1 Results of PP unit root tests (Regional house prices)

	Level		First Difference	
Variables	t statistics	p	t statistics	p
ln (HP)	-1.52	0.52	-6.25	0.00[a]
ln (BHP)	-1.12	0.70	-3.40	<0.01[a]
ln (MHP)	-1.42	0.57	-6.81	0.00[a]
ln (PHP)	1.08	0.72	-3.25	0.02[b]
ln (SHP)	-1.29	0.63	-7.71	0.00[a]

Note: a, b significant at 1% and 5% levels respectively

Legend of variables

1	HP	CoreLogic Home Value Hedonic Index series
2	BHP	CoreLogic Home Value Hedonic Index series (Brisbane)
3	MHP	CoreLogic Home Value Hedonic Index series (Melbourne)
4	PHP	CoreLogic Home Value Hedonic Index series (Perth)
5	SHP	CoreLogic Home Value Hedonic Index series (Sydney)

Table 5.2 Results of PP unit root tests (regional; macroeconomics)

	Level		First Difference	
Variables	t statistic	p	t statistics	p
ln (BAWE)	-1.89	0.33	-11.81	0.00[a]
ln (MAWE)	-0.20	0.93	-12.00	0.00[a]
ln (MGDP)	-11.16	0.00[a]	-6.62	0.05[b]
ln (MRY)	-1.68	0.44	-7.05	0.00[a]
ln (PUNEMPLOY)	-1.58	0.49	-5.35	0.00[a]
ln (SUNEMPLOY)	-2.18	0.21	-4.84	0.04[b]
ln (AUSHARE)	-1.71	0.42	-7.42	0.00[a]
ln (MINING)	-1.28	0.64	-6.05	0.00[a]
ln (IR)	-2.87	0.05[b]	-5.59	0.00[a]

Note: a, b significant at 1% and 5% levels respectively

Legend of variables

1	BAWE	QLD Average weekly earnings
2	MAWE	VIC Average weekly earnings
3.	MGDP	VIC Gross value added
4	MRY	VIC Rental yield
5	PUNEMPLOY	WA Unemployment rate
6	SUNEMPLOY	NSW Unemployment rate
7	AUSHARE	Australian S&P/ASX 200 stock market index
8	MINING	Mining index (Australia)
9	IR	Mortgage interest rate (Australia)

Tables 5.1 and 5.2 present the results from the Phillips Perron (PP) unit root estimation, which is used for the non-stationarity checks. The aim of meeting the stationarity requirement is for the Johansen co-integration test, which works when variables are stationary for the first differences only. Here, the Phillips Perron unit root test is employed to test the stationarity of regional house price variables and macroeconomic variables (Eviews 8 User Guide, 2014).

As shown in Table 5.1, all the estimations show statistically significant values for the regional and national Hedonic house price indexes at first differences. Thus, the null hypothesis (the first difference for house price variables contains unit roots) can be rejected. This corresponds to previous empirical evidence regarding the stationarity in house prices, as reported in numerous housing markets studies (Liu, 2013; Luo et al., 2007). Furthermore, as illustrated in Table 5.2, the test results suggest statistical significance for the first differences of regional macroeconomic variables. Thereby, the null hypothesis, that the first differences of macroeconomic variables are stationary cannot be rejected. Both tables show the PP unit root test, and suggest unit roots can be identified for variables at all levels. Thus, all the regional and national house prices and macroeconomic variables are at I (1), suggesting the Johansen co-integrating assumptions are met.

5.2.2 Johansen co-integration test

Table 5.3 Results of the Johansen co-integration tests (Regional house prices in Australia)

		λ max		Trace	
		Statistics	p	Statistics	p
Model (1)	r = 0	33.88	0.00[a]	69.82	0.00[a]
	r = 1	27.58	0.00[a]	47.86	0.00[a]
	r = 2	21.13	0.00[a]	29.80	0.00[a]
	r = 3	14.26	0.00[a]	15.49	0.00[a]
	r = 4	3.84	0.97	3.84	0.97
Model (2)	r = 0	27.58	<0.01[a]	47.86	<0.01[a]
	r = 1	21.13	0.28	29.80	0.24
	r = 2	14.26	0.45	15.49	0.46
	r = 3	3.84	0.40	3.84	0.40
Model (3)	r = 0	33.88	0.01[a]	69.82	0.00[a]
	r = 1	27.58	0.07	47.86	0.07
	r = 2	21.13	0.26	29.80	0.42
	r = 3	14.26	0.89	15.49	0.86
	r = 4	3.84	0.37	3.84	0.37

Note: a, b significant at 1% and 5% levels respectively

Table 5.4 Results of the Johansen co-integration tests (Regional house prices in Australia)

		λ max		Trace	
		Statistics	p	Statistics	p
Model (4)	r = 0	27.58	0.00[a]	47.86	0.00[a]
	r = 1	21.13	0.00[a]	29.80	0.00[a]
	r = 2	14.26	0.02[b]	15.49	0.00[a]
	r = 3	3.84	0.00[a]	3.84	0.00[a]
Model (5)	r = 0	33.88	0.00[a]	69.82	0.00[a]
	r = 1	27.58	0.00[a]	47.86	0.00[a]
	r = 2	21.13	0.06	29.80	0.02[b]
	r = 3	14.26	0.13	15.49	0.13
	r = 4	3.84	0.31	3.84	0.31

Note: a, b significant at 1% and 5% levels respectively

Legend of variables

1	Model (1)	National house prices with Sydney, Melbourne, Brisbane and Perth house prices
2	Model (2)	Brisbane house prices with macroeconomic variables
3	Model (3)	Perth house prices with macroeconomic variables
4	Model (4)	Melbourne house prices with macroeconomic variables
5	Model (5)	Sydney house prices with macroeconomic variables

Table 5.3 illustrates the results for model (1) to model (3), giving the results for the maximum eigenvalue, and showing four co-integrating equations could be identified in model (1), suggesting that a long run equilibrium relationship exists among national house prices and regional house prices for the big four cities. Furthermore, co-integrating equations were found in models (2) and (3), reflecting long run equilibrium relationships between Brisbane house prices, Perth house prices and macroeconomic variables (Table 6.3 here). Table 6.4 shows the

empirical test outcomes for models (4) and (5) in which four co-integrating equations were identified in model (4), suggesting that long run equilibrium relationships exist between the Melbourne house prices and macroeconomic variables. Furthermore, two co-integrating equations were found in model (5), reflecting the fact that long run equilibrium relationships exist between Sydney's house prices and key macroeconomic variables.

Furthermore, the results for trace statistics indicate four co-integrating equations could be identified in model (1), suggesting a long run equilibrium relationship exists between national house prices and those in the big four cities and associated regions. Next, one co-integrating equation was found in models (2) and (3), reflecting a long run equilibrium relationship between Brisbane and Perth house prices and the macroeconomic variables. Further, four co-integrating equations were identified in model (4), indicating a long run equilibrium relationship between the Melbourne house price fluctuations and macroeconomic variables. Finally, three co-integrating equations were identified in model (5), suggesting a long run equilibrium relationship between Sydney's house prices and the macroeconomic variables. In summary, the Johansen co-integration test result in model (1) seems to indicate the possibility of a spillover effect, due to the asymmetric behavior of information flow on regional and national housing indexes (Cook, 2005; Stevenson, 2004;). Also, the co-integrating equations identified from Model (2) to Model (5) reflect the close relationship between macroeconomic variables and regional house prices. However, regional variations in macroeconomic variables are identified, suggesting that spatial economic patterns in the regions could determine regional house prices (Meen, 1999). Furthermore, the interrelationships between housing markets and the local economy can produce self-reinforcing patterns of development in regional house prices (Muellbauer & Murphy, 1994).

5.2.3 VECM test

Table 5.5 VECM results (Regional house prices in Australia)

		Coefficient	p	t statistic
Model (1)	D (ln (HP))			
	CoinEq1	-6.675	0.001[a]	3.814
Model (2)	D (ln (BHP)			
	CoinEq1	-0.053	0.039[b]	2.134
Model (3)	D (ln (PHP)			
	CoinEq1	-0.019	0.013[b]	2.574
Model (4)	D (ln (MHP)			
	CoinEq1	-0.091	0.037[b]	2.162
Model (5)	D (ln (SHP))			
	CoinEq1	-0.048	0.000[a]	4.429

Note: a, b significant at 1% and 5% levels respectively

Legend of variables

1	Model (1)	National house prices with Sydney, Melbourne, Brisbane and Perth house prices
2	Model (2)	Brisbane house prices with macroeconomic variables
3	Model (3)	Perth house prices with macroeconomic variables
4	Model (4)	Melbourne house prices with macroeconomic variables
5	Model (5)	Sydney house prices with macroeconomic variables
6	HP	CoreLogic Home Value Hedonic Index series
7	BHP	CoreLogic Home Value Hedonic Index series (Brisbane)
8	MHP	CoreLogic Home Value Hedonic Index series (Melbourne)
9	PHP	CoreLogic Home Value Hedonic Index series (Perth)
10	SHP	CoreLogic Home Value Hedonic Index series (Sydney)

In Table 5.5, the results for the VECM are found. The negative coefficient of the co-integrating vectors measures the speed of adjustment of the endogenous variable towards equilibrium in response to the economic force. Comparing the negative coefficients for the macroeconomic models from Model (2) to Model (5), the highest ECT (-1) estimated coefficient is - 0.091, which suggests that 9% of short-term disequilibrium in Melbourne is corrected within 3 months by economic forces, including income (MAWE), local GDP performance (MGDP), and rental yield (MRY). The lowest ECT (-1) estimated coefficient is - - 0.011 in Perth, which suggests that 2% of the short–term disequilibrium in Perth is corrected within 3 months by macroeconomic economic forces, including that reported on the share market index (AUSHARE), interest rate (IR), mining industry performance (MINING), and income (PUNEMPLOY).

It may be that the Perth housing market was less affected by spillover effects, due to its main economy base being mining, as well the geographical distance from other big cities. The ECT (-1) estimated coefficient for Brisbane and Sydney is -0.053, which suggests that 5% of the short–term disequilibrium in Brisbane and Sydney is corrected within 3 months by macroeconomic economic forces, including share market index (AUSHARE), income (BAWE and SAWE), mining industry performance (MINING), and interest rates (IR). This result shows Sydney undergoes the most significant error correction term with a p-value below 0.01. It was further demonstrated that the two biggest cities in Australia, Sydney and Melbourne, had the most stable housing markets (Ma & Liu, 2013). The optimal periods for Model (1) – (5) are 11, 8, 5, 9, 6 accordingly using the Schwarz information criterion (SIC).

When summarising the key macroeconomic forces and their disproportional asymmetry towards regional house prices variations over the steady macroeconomic environment across this 20 – year period in Australia, income emerges as the most important economic force, impacting on house prices in all the major cities.

This is in line with the housing demand theory, which indicates that income represents the purchasing power of households. A higher purchasing power in all four cities will increase the demand for houses and increase regional house prices. Mining industry performances influence Brisbane's, Perth's and Sydney's house prices as the mining industry informs these three cities economic contributions. Furthermore, Sydney as the largest financial service centre, provides mining related services that are also affected by mining industry performance.

Share market performance influences Perth's and Brisbane's house prices. This could be because Perth and Brisbane have more investors able to invest in both the share market and the housing market than the other two cities. Changes in share market performance will therefore impact their decision to invest in houses. Interest rates are the main economic forces impacting house prices in Perth and Sydney, possibly because Sydney has the largest housing market with the largest number of householders. The large volume of mortgages to service these households is affected by interest rates movements, changes in which also affect exchange rate performance on which the mining industry's performance is heavily reliant . Thus, since the mining industry is the pillar industry in Perth, interest rate movements there affecting the exchange rate are a key determinant of the wealth derived from the mining industry, which influences house prices. Rental yield and local GDP performance are the main economic forces affecting Melbourne house prices, suggesting most buyers in Melbourne are investors.

The local GDP in Melbourne is one of the main economic forces impacting Melbourne house prices that might indicate that economy is also heavily reflected by the economies of the other main cities. This could be further confirmed by the findings from the variance decomposition test, which show that Melbourne's house prices are the most vulnerable, being largely influenced by the spillover effects of other regional and national house prices.

In summary, regional variations affecting macroeconomic variables can be confirmed as factors influencing the big four house prices. Reflecting the interrelatedness of regional housing markets and the local economy can lead to self-reinforcing patterns of house price development (Muellbauer & Murphy, 1994). Holmans (1990), supporting the view that the observed pattern in house prices can occur even when there are no spatial links between housing markets where regressors follow similar patterns.

5.3 A comparative study of China's major first - tier and second - tier cities

5.3.1 Phillip Perron (PP) test

Table 5.6 Results of PP tests (first and second-tier major cities' house prices in China; 2007Q2 – 2015Q3)

	Level		First Difference	
Variables	t statistics	p	t statistics	p
ln (FIRSTP)	-0.53	0.87	-3.96	0.00[a]
ln (SECONDP)	-2.73	0.08	-5.16	0.00[a]
ln (BJP)	-2.04	0.27	-4.45	0.00[a]
ln (SHP)	-0.57	0.86	-7.25	0.00[a]
ln (SZP)	-1.07	1.00	-4.81	0.00[a]
ln (CQP)	-2.85	0.06	-3.00	0.05[b]
ln (NBP)	-2.13	0.23	-3.03	0.04[b]
ln (NJP)	-3.03	0.04	-12.54	0.00[a]

Note: a, b significant at 1% and 5% levels, respectively.

Legend of variables

1	FIRSTP	House price in first–tier housing market in China
2	SECONDP	House price in second-tier housing market in China
3	BJP	Beijing house price
4	SHP	Shanghai house price
5	CQP	Chongqing house price

6	NBP	Ningbo house price
7	NJP	Nanjing house price

Table 5.7 Results of PP test (China national; macroeconomic variables; 2007Q2 – 2015Q3)

	Level		First Difference	
Variables	t statistic	p	t statistic	p
ln (CNIR)	-1.29	0.62	-4.54	0.00[a]
ln (CNUNEMPLOY)	-2.09	0.24	-5.31	0.00[a]
ln (CNSHARE)	-2.15	0.23	-4.59	0.00[a]
ln (CNGDP)	-2.05	0.27	-6.31	0.00[a]

Note: a, b significant at 1% and 5% levels, respectively.

Legend of variables

1	CNIR	Mortgage interest rate (China)
2	CNAUSHARE	China Shanghai composite stock market index
3	CNUNEMPLOY	Unemployment rate (China)
4	CNGDP	Gross domestic product (China)

Tables 5.6 and 5.7 present the empirical results for the PP unit root test to check the stationarity of house price variables and linked macroeconomic variables. Exploring the housing price dynamics for first - tier and top level second - tier cities, this test aims to identify whether the house price variables and macroeconomic variables are stationary, to meet the assumptions of the Johansen co-integration test on long run relationships.

Establishing the stationarity of variables is essential since the Johansen co-integration test only works with variables that are stationary at the first difference only (Eviews 8 user guide, 2014). Table 5.6 reflects the finding that all the house price variables are stationary at the first

differences. As a result, the null hypothesis (the first differences in the house price variables contain a unit root) can be rejected. Furthermore, as is shown in Table 5.7, the results suggest all macroeconomic variables are stationary at the first difference. As a result, the null hypothesis that there is a unit root problem among the first differences of macroeconomic variables is rejected. Overall, the test findings confirm all the data points tested, including regional house prices and first - tier and second - tier house prices are at I(1); thus, the assumption of the Johansen Co-integrating tests is met.

Table 5.8 Results of the Johansen co-integration tests (China house prices; 2007Q2 – 2015Q3)

		λ max		Trace	
		Statistics	p	Statistics	p
Model (1)	r = 0	14.26	0.88	15.49	0.91
	r = 1	3.84	0.81	3.84	0.81
Model (2)	r = 0	40.08	0.00[a]	95.75	0.00[a]
	r = 1	33.88	0.00[a]	69.82	0.00[a]
	r = 2	27.58	0.02[b]	47.86	0.02[b]
	r = 3	21.13	0.50	29.80	0.34
	r = 4	14.26	0.56	15.49	0.39
	r = 5	3.84	0.13	3.84	0.13

Note: a, b significant at 1% and 5% levels, respectively.

Table 5.9 Results of the Johansen co-integration tests (China macroeconomic variables, 2007Q2 – 2015Q3)

		λ max		Trace	
		Statistics	p	Statistics	p
Model (3)	r = 0	33.88	0.00[a]	69.82	0.00[a]
	r = 1	27.58	0.12	47.86	<0.01[a]
	r = 2	21.13	0.19	29.80	0.05[b]
	r = 3	14.26	0.11	15.49	0.10
	r = 4	3.84	0.24	3.84	0.24
Model (4)	r = 0	33.88	0.00[a]	69.82	0.00[a]
	r = 1	27.58	0.03[b]	47.86	0.00[a]
	r = 2	21.13	0.19	29.80	0.07
	r = 3	14.26	0.22	15.49	0.16
	r = 4	3.84	0.16	3.84	0.16

Note: a, b significant at 1% and 5% levels, respectively.

Legend of variables

1	Model (1)	Co-integration between first-tier and second-tier house prices in China.
2	Model (2)	Co-integration among major six cities house prices in China.
3	Model (3)	Co-integration between first – tier cities and macroeconomic variables in China.
4	Model (4)	Co-integration between second – tier and macroeconomic variables in China.

5.3.2 Johansen co-integration test

The Johansen co-integration tests were employed to test the long run relationship between the regional house prices and associated macroeconomic variables. The models are as specified below:

Model 1:

$$LFIRSTP_t = \beta_{0i} + \beta_{1i}\, LSECOND_t + \mu_t \quad (22)$$

Model 2:

$$LBJP_t = \beta_{0i} + \beta_{1i}\, LSHP_t + \beta_{2i}\, LNJP_t + \beta_{3i}\, LSZP_t + \beta_{4i}\, LCQP_t + \beta_{5i}\, LNBP_t + u_t \quad (23)$$

Model 3:

$$LFIRSTP_t = \beta_{0i} + \beta_{1i}\, LCNIR_t + \beta_{2i}\, LCNSHARE_t + \beta_{3i}\, LCNUNEMPLOY_t + \beta_{4i}\, LCNGDP_t + u_t \quad (24)$$

Model 4:

$$LSECONDPt = \beta_{0i} + \beta_{1i}\, LCNIR_t + \beta_{2i}\, LCNSHARE_t + \beta_{3i}\, LCNUNEMPLOY_t + \beta_{4i}\, LCNGDP_t + u_t \quad (25)$$

The results for the Johansen co-integration test on regional house prices, are arranged according to first - tier and second - tier cities' house prices as presented in Table 6.8 and Table 5.9 respectively. The estimations for the maximum eigenvalue test show zero co-integrating equations in model 1, reflecting that the first tier and second tier house prices are not co-integrated. Thus, no long run relationship exists between the house prices in the major two housing market segments. Three co-integrating equations were identified in model 2, suggesting long run equilibrium relationships between the house prices of the major cities Beijing, Shanghai, Shenzhen, Nanjing, Chongqing and Ningbo.

Further, one co-integrating equation was found in model 3, reflecting a long run equilibrium relationship between first - tier cities' house prices and macroeconomic variables, including the interest rate (CNIR), share market index (CNSHARE), unemployment rate (CNUNEMPLOY), GDP performance (CNGDP). Finally, two co-integrating equations were identified in model 4, suggesting a long run equilibrium relationship exists between second

tier cities' house prices and macroeconomic variables including interest rate (CNIR), share market index (CNSHARE), unemployment rate (CNUNEMPLOY), and GDP performance (CNGDP).

Moreover, the results for the trace statistics indicate there are zero co-integrating equations in model 1, suggesting first - tier house price and second -tier house price are not co-integrated. Thus, no long run relationship was found between house prices in the major two tier housing markets in China. Next, three co-integrating equations were found in model 2, reflecting the presence of long run equilibrium relationships between the house prices of major cities Beijing, Shanghai, Shenzhen, Nanjing, Chongqing and Ningbo, also reported above. Further, three co-integrating equations were identified in model 3, suggesting a long run equilibrium relationship exists between first - tier cities' house prices and the macroeconomic variables including the interest rate (CNIR), share market index (CNSHARE), unemployment rate (CNUNEMPLOY) and GDP performance (CNGDP). Additionally, two co-integrating equations were found in model 4, reflecting a long run equilibrium relationship between second - tier cities house prices and the variables listed above.

In summary, the Johansen co-integration test results conclude the null hypothesis for no co-integration can be rejected, indicating the house price variables and macroeconomic variables in model 2, model 3 and model 4 are co-integrated.

These long run equilibrium relationships were identified between regional house prices and house prices, with macroeconomic variables in both first - tier and second - tier cities. However, no co-integrating equations were found between first - tier and second - tier house prices, reflecting any spillover effects could be short run. This finding support a high degree of connectedness between the house prices in China's first and second - tier cities (Zhang et al., 2016).

5.3.3 VECM test

Table 5.10 VECM for bubble testing (China first and second-tier housing markets, 2007Q2 – 2015Q3)

		Coefficient	t statistics	p
Model (3)	Error correction	D (ln (FIRSTP))		
	CoinEq1	-0.149	-2.40	0.03[b]
Model (4)	Error correction	D (ln (SECONDP))		
	CoinEq1	-0.200	-3.06	0.001[a]

Note: a, b significant at 1% and 5% levels, respectively

Legend of variables

Model (3) Co-integration between first – tier cities and macroeconomic variables in China

Model (4) Co-integration between second – tier cities and macroeconomic variables in China

VECM tests were performed on first - tier and second - tier housing prices, with macroeconomic variables represented by Model 3 and Model 4. The results from the VECM test are reported in Table 5.10. In all cases, the parameter estimates for the error correction term (ECT) were significant, delivering the predicted negative sign and indicating the speed at which housing prices return to equilibrium after short-term disequilibrium is corrected by their own economic forces. The economic explanation is that large deviations between variables are not expected to continue. There are tendencies for the difference in house prices and macroeconomic variables to come back together.

Specifically, the ECT (-1) estimating the coefficient for first tier house price is -0.149, suggesting that 14.9% of the short-term disequilibrium corrects within 3 months for first - tier house prices, back to long term equilibrium. Simultaneously, the ECT (-1) estimated coefficient for second - tier housing prices is -0.200, implying that 20% of the short-term

disequilibrium in second - tier house prices correct within three months. Consequently, we find, both first - tier and the top eight second - tier cities house prices have long run steady relationships, with macroeconomic variables including interest rates (CNIR), China share market performance (CNSHARE), unemployment rate (CNUNEMPLOY) and CNGDP in China. Furthermore, second - tier cities housing prices self-correct more quickly than those of first - tier cities. This might reflect the fact that the financial information flow in second - tier cities varies from that in first - tier cities and the transmission mechanism is much simpler than that for the bigger first - tier cities.

In addition, the purchase power indicated by unemployment rate is an important economic force in both first and second - tier house pricing. Share market performance in China also has a large impact on house prices in these two major housing market segments, reflecting that the share market and housing market are two important investment options for Chinese investors. Interest rates are another critical economic force influencing first and second - tier house prices; this reflects that the major proportion of property outgoings on mortgages are positively correlated with short-term interest rates (Koblyakova et al., 2014). In summary, the VECM results confirm close relationships with macroeconomic variables and first - tier and second tier cities' house prices. However, no regional variations in the macroeconomic variables were identified for these two major cohorts' house prices due to the non availability of macroecnomic data for those two cohorts' housing markets in China.

CHAPTER 6

SPILLOVER EFFECTS

6.1 Executive summary

Purpose and scope

This section reports the relevant econometric test results to explain any house price spillover effects. The aim here is to provide detailed updates to understand house price ripple effects between various segments of the housing markets, by reporting findings regard empirical specifications and providing detailed analysis of research outcomes. The research findings are achieved by employing a theoretical model largely based upon a rational expectation theory and housing demand model while applying the knowledge that households make purchase decision with maximum utility and based on their income purchasing power.

Recognising the importance of the implications of house prices spillover effects on national and regional economies, this review begins with a spillover analysis, describing links between the Chinese and Australian housing markets, followed by an in depth explanation and interpretation of the spillover effects within Australian's national and major regional housing markets. It then continues with a thorough spillover analysis of China's major first and second - tier housing markets, including the top 13 cities.

Methodology

Empirical estimate results for house price spillover effects in China's and Australia's housing markets were analysed and reported in Chapter 6 using secondary data.

Key findings

The results for a variance decomposition analysis for Australian house prices and Chinese

house prices indicate Australian house prices have a large effect on China's house prices, especially over the long run, but not vice versa. The results suggest many Chinese buyers are attracted by the steady growth of house prices in Australia, which motivates them to purchase properties in Australia (Valentine et al., 2015).

Furthermore, the test results suggest Australian house prices do not Granger cause Chinese house prices. On the contrary, Chinese house prices Granger cause Australian house prices. Overall, the Granger causality test indicates a short term causal relationship between Australian and Chinese house prices, but no spillover effect could be identified.

Reflecting the empirical test for spillover effects in Australia. The results suggest Sydney's house prices have the largest impact on fluctuations in Australian national house prices in the long-run. This result reflects the house price differential which follows the relative economic gains of the region, in combination with the inelastic supply of housing (Holmans, 1990).

Melbourne has a minimal impact on variances in Australian national house prices over both the short run and long run. Melbourne house price variances are not internally generated, either over the long run or the short run.

In summary, there are house price spillover between Australia's national house market and the major four cities housing markets. The results of the Granger causality test suggest that the Australian housing market is compartmentalised or segmented, and that the price information spread is asymmetric among the big four major cities.

Updates to test results for China's housing markets suggest that among all six first and second - tier cities analysed above, apart from Nanjing, variations of Beijing, Shanghai, Shenzhen, Chongqing and Ningbo, house prices are mainly driven by their economic forces. This could indicate they are a source of spillover. The econometric tests suggest a ripple effects exists among the major first and second - tier cities. The urbanisation trend, information flow and

migration flow combined with geographical convenience across these two segments of the housing markets lead to a ripple effect in regional house prices.

Concluding remarks

The findings reveal that spillover effects are present in the key regional housing markets in both China and Australia. These findings are especially useful for providing a good foundation for policy makers to establish appropriate regional policies that are applicable to regional house price dynamics. From a theoretical perspective, it is important to understand that the implications of the findings are based on the theoretical models of housing demand rational expectation theory and applying the knowledge that households make purchase decisions based on the maximum utility and the income purchase power.

To further clarify house price dynamics, attention turns to an empirical study of the main drivers of house prices in China and Australia, and tests for housing bubbles in Chapter 7.

6.2 Spillover analysis between house prices in Australia and China

6.2.1 Variance decomposition test (VDT)

The empirical findings shown in Table 6.1 suggest that, in the short run (period 2), 96.89% of the variance in Australian house prices (AUP) can be explained by the Australian market itself, while 3.11% can be explained in reference to the house prices in China (CNP). In the long run (period 10), the results show that 99% of the variances in Australian house prices are due to domestic factors, whereas the remaining 1% can be explained by Chinese house prices. The results indicate that house prices in China do not have an impact in either the short or long run on the variances in Australian house prices. This finding confirms our understanding that large Chinese purchase activities in recent years are not the main driver of Australian house price surges (Valentine et al., 2015).

Table 6.1 Variance decomposition on Chinese and Australian house prices (2007Q2 – 2015Q3)

	ln(HP)		ln(CNP)	
	ln(HP)	ln(CNP)	ln(HP)	ln(CNP)
Period 1	100.00	0.00	16.45	83.55
Period 2	96.89	3.11	22.63	77.37
Period 3	98.61	1.39	28.23	71.77
Period 4	99.12	0.88	33.07	66.93
Period 5	99.15	0.85	36.64	63.36
Period 6	99.30	0.70	38.93	61.07
Period 7	99.37	0.63	39.97	60.03
Period 8	99.42	0.58	39.96	60.04
Period 9	99.39	0.61	39.08	60.92
Period 10	99.00	1.00	37.57	62.43

Legend of variables:

1	HP	Australian house prices
2	CNP	Chinese house prices (using principal component methods based on top 13 largest cities)

Empirical findings also reveal that 77.37% of the variance in Chinese house prices in the short run (period 2) are caused by domestic factors, whereas 22.63% can be explained by Australian house prices. This arguably reflects the confidence that Chinese buyers have in purchasing Australian properties, the close business relationships between the two countries, and the anticipated positive housing market and macroeconomic environment in Australia (Battellino, 2010). In the long run (period 10), Chinese house prices are responsible for 62.43% of the house price variance in China, with the remaining 37.57% being explained by Australian house prices. It could be argued that the Australian house prices do not have a causal relationship with Chinese house prices. However, the variance decomposition in Table

6.1 provides information about the relative importance of each random innovation of Australian house prices impacting the Chinese house prices both in the long run and short run Thus, the results of the variance decomposition analysis for both Australian and Chinese house prices indicate that, particularly in the long run, Australian house prices do have a significant impact on Chinese house prices, but the same is not true in reverse.

6.2.2 Generalised impulse response test (GIRT)

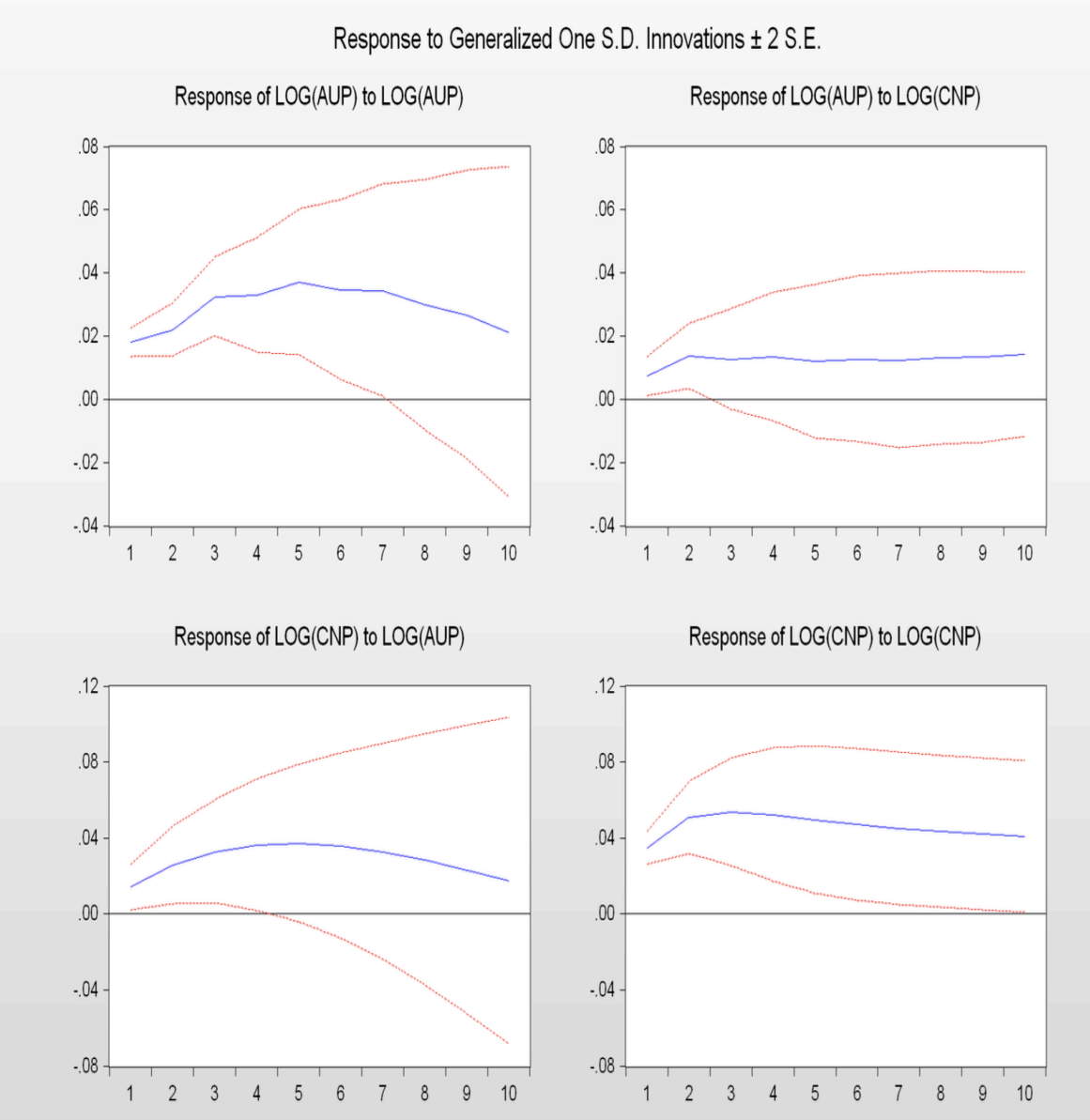

Figure 6.1. Generalised impulse responses (China and Australia)

Legend of variables:

1	AUP	Australian house prices
2	CNP	Chinese house prices (using principal component methods based on the top 13 largest cities.

In Figure 6.1, the empirical findings suggest that a shock of one standard deviation applied to the residual of Australian house prices (AUP), have a more significant positive impact on Chinese house prices (CNP) over the ten quarters tested. On the other hand, the empirical results suggest that a shock of one standard deviation to Chinese house prices would have a positive, but less significant, impact on Australian house prices. The results indicate that many Chinese buyers are attracted by the steady growth of house prices in Australia and are motivated to purchase properties in Australia (Valentine et al., 2015). Conversely, Chinese house prices do not affect the purchase behaviour of Australian buyers. These results demonstrate the existence of a spillover effect from Australia to China. Stevenson (2004) presented evidence showing that the spillover observed within a country can be extended across national boundaries.

6.2.3 Granger causality test (short term)

Table 6.2 Generalised impulse response (Australia national and major four cities)

	Chi-Sq Statistic	p	Result
CNP (VAR, optimal lag1)			
AUP does not Granger cause CNP	1.38	0.71	No
AUP (VAR, optimal lag1)			
CNP does not Granger cause AUP	8.03	0.05	Yes

Legend of variables:

1	AUP	Australian house prices
2	CNP	Chinese house prices (using principal component methods based on the top 13 largest cities)

Furthermore, the test results shown in Table 6.2 suggest that Australian house prices do not Granger cause Chinese house prices. On the contrary, Chinese house prices appear to Granger cause house prices in Australia. This suggests that past values for Chinese house prices should contain information that would help us to predict Australian house prices, since the information contained in Chinese house prices goes beyond what is contained in the past values of Australian house prices alone. However, the influence of China's house prices on Australian house prices is not significant according to the findings from the VDT in Table 6.8 and 6.9 and GIRT in Figure 6.3. The minimal impact could be due to the self-fulfilling nature of Australian housing markets. Furthermore, the causal relationship might suggest the increased demand in Australia is due to large Chinse purchases since 2013. The result may be a consequence of the close business relationships between the Australian and Chinese economies, the attractive educational opportunities in Australia, and an increase in Chinese people's purchasing power that has resulted from China's economic growth. Since 2013, more Chinese buyers have started to purchase properties in Australia, thereby contributing to a surge in house prices in that country. However, large numbers of Chinese people purchasing properties in Australia are not the main driver of the increase in Australian house prices. (Valentine et al., 2015).

Overall, the Granger causality test indicates that there is a short-term causal relationship between Australian and Chinese house prices. Thus, no spillover effect was identified.

6.3 Spillover analysis among the house prices in four major cities and national house prices in Australia

6.3.1 Variance decomposition test

Table 6.3 Variance decomposition results (Australia national and regional house prices; 1995Q4 – 2015Q3)

Dependent Variables	Horizon (quarter)	Percentage of forecast variances				
		HP	BHP	MHP	PHP	SHP
HP	1	100.000	0.000	0.000	0.000	0.000
	2	93.176	2.470	0.002	0.646	3.703
	3	91.384	1.008	1.101	1.663	4.843
	4	86.309	2.163	1.270	2.813	7.444
	5	82.049	5.094	0.829	2.686	9.341
	10	78.257	4.797	1.746	3.600	11.600
BHP	1	53.474	46.526	0.000	0.000	0.000
	2	70.152	27.784	0.685	0.033	1.346
	3	78.932	16.926	0.366	0.155	3.621
	4	82.792	10.555	0.205	0.201	6.247
	5	84.887	6.670	0.206	0.232	8.004
	10	85.007	1.164	0.535	0.139	13.154
MHP	1	64.249	15.744	20.007	0.000	0.000
	2	38.909	41.716	14.589	0.940	3.846
	3	35.145	31.664	25.323	3.252	4.617
	4	24.568	34.198	27.190	8.419	5.625
	5	18.000	44.090	20.870	11.692	5.352
	10	13.647	45.108	8.198	28.338	4.708

Table 6.4 Variance decomposition results (Australia national and regional house prices, 1995Q4 – 2015Q3)

Dependent Variable	Horizon (quarter)	Percentage of forecast variances				
		NHP	BHP	MHP	PHP	SHP
PHP	1	57.513	1.834	12.885	27.767	0.000
	2	60.179	2.479	12.983	22.248	2.121
	3	67.818	2.356	10.929	13.663	5.233
	4	68.583	4.877	7.820	7.900	10.821
	5	68.566	6.249	5.177	4.576	15.432
	10	65.403	10.029	1.470	1.209	21.891
SHP	1	85.090	0.001	9.378	2.457	3.075
	2	94.509	0.002	3.272	0.634	1.583
	3	93.192	1.951	1.718	1.985	1.154
	4	91.442	1.231	1.060	4.590	1.678
	5	90.124	1.631	1.080	4.781	2.384
	10	81.526	1.418	7.415	6.864	2.777

Legend of variables

1	HP	CoreLogic Home Value Hedonic Index series
2	BHP	CoreLogic Home Value Hedonic Index series (Brisbane)
3	MHP	CoreLogic Home Value Hedonic Index series (Melbourne)
4	PHP	CoreLogic Home Value Hedonic Index series (Perth)
5	SHP	CoreLogic Home Value Hedonic Index series (Sydney)

Tables 6.3 and 6.4 present the empirical results of the variance decomposition test, and focus on the issue of whether or not there are spillover effects between national house prices (HP) and those of the big four regional cities. They explore the possibility of periodical changes in favourability towards long-term effects, as the spillover estimation test was disaggregated by ten years. The long term effect implies the regional house prices and national home prices impact each other over the long term spectrum. However, the short term impact is less severe.

In order to determine whether or not there is a persistent tendency towards spillover effects across the four big cities, the Hedonic housing index for national house prices and house prices in four major cities was included. Estimations were performed using the data for the period between 1995Q4 and 2015Q3; this period of time represents the steadiest economic environment in Australia.

As can be seen in Table 6.3, in the short term (period 2), 93.17% of the variances in Australian national house prices can be explained by internal factors, whereas 2.47% and 3.70% can be explained by house prices in Brisbane and Sydney, respectively. Over the short term, house prices in Melbourne had the lowest impact on Australian national house prices.

In the long term (period 10), parameter estimates show that there is a persistent tendency: 78.26% of Australian national house price variances can be attributed to internal factors, whereas 4.80% and 11.60% of those variances can be explained by house prices in Brisbane and Sydney, respectively. Over the long term, house prices in Melbourne had the lowest impact on variances in Australian national house prices.

The results suggest that, in the long run, house prices in Sydney have the largest impact on the variances in Australian national house prices. Melbourne has a minimal impact on this variance over both the short and long term. The findings show that the interrelationships between the Sydney housing market and the local economy can produce self-reinforcing patterns of development (Muellbauer & Murphy, 1994). The fact that Sydney has the

strongest impact on Australian national house prices explains why growth in house prices begins in Sydney.

Furthermore, the results reveal that, in the short run (period 2), 27.78% of the variances in Brisbane house prices are generated by internal factors, whereas 70.15% and 1.35% are generated by Australian national house prices and Sydney house prices, respectively. Perth and Melbourne have minimal impacts on the variances in Brisbane house prices, over both the short and long term. Specifically, the minimal impacts may be due to the far away georgraphical location of Perth and the feature of Melbourne as being the city heavily influenced by spillover innovations.

In the long run (period 10), Brisbane is responsible for 1.16% of its house price variances, while the remaining 85.01% and 13.15% can be explained by Australian national house prices and Sydney house prices, respectively. Perth and Melbourne have minimal impacts on the variances in Brisbane house prices, both in the short run and in the long run. The results reveal that house prices in Sydney have the greatest impact on the variances in house prices in Brisbane, over both the long term and the short term. This results from the flow of financial information from Sydney to Brisbane, rather than physical household flows (Meen, 1999), and is due to the geographical proximity of Sydney to Brisbane. Pollakowski and Ray (1997) presented some evidence in support of the 'positive feedback effect', namely that the recent strength in one local sub-market feeds gradually into other sub-markets, thus creating the ripple effect between house prices in Sydney and those in Brisbane.

The result also validated that, in the short run, 14.59% of the variance in Melbourne house prices are generated by internal factors, while 38.90%, 41.72%, 0.93% and 3.85% of the variances in Melbourne house prices can be explained by Australian national house prices, Brisbane house prices, Perth house prices, and Sydney house prices, respectively.

The results reveal that Australian national house prices, and those in Sydney and Brisbane, are

the dominant factors affecting Melbourne house prices. In both the short and long run, variances in Melbourne house prices are not caused by the Melbourne housing market itself.

As shown in Table 6.4, it was also found that, in the short run, 22.25% of the variances in Perth house prices are generated by internal factors, while 60.18%, 2.48%, 12.98% and 2.12% of the variances in Perth house prices can explained by Australian national house prices, Brisbane house prices, Melbourne house prices, and Sydney house prices, respectively. Meanwhile, in the long run, 1.21% of the variances in Perth house prices are the result of internal factors, while 65.40%, 10.03%, 1.47%, and 21.89% of the variances can be explained by looking at Australian national house prices, and the house prices in Brisbane, Melbourne, and Sydney, respectively.

The results reveal that, aside from spillover effects from Australian national house prices, house prices in Perth are, over the short term, most affected by the spillover effect from Melbourne. In the long term, however, Sydney has the greatest influence on house prices in Perth. This finding suggests that, over time, the financial information process produces a pattern of prices in Perth that is similar to the ripple effects observed between Sydney and Melbourne (Meen, 1999).

The results for Sydney house prices as the dependent variable show that, over the short term, 1.58% of the variance in Sydney house prices is due to internal factors, while 94.51%, 3.27%, and 1.58% are caused by Australian national house prices, Melbourne house prices, and Perth house prices, respectively. Over the short term, Brisbane contributes to a minimal percentage of the variance in house prices in Sydney (0.002%).

In the long run, 2.77% of the variances in Sydney house prices are generated by internal factors, while 81.53%, 1.42%, 7.41% and 6.87% of those variances come from Australian national house prices and house prices in Brisbane, Melbourne, and Perth, respectively.

The results of variance decomposition analysis for Sydney house prices as the dependent variable show that, in both the short and the long term, house prices in Sydney are not affected by those in Brisbane, Perth, and Melbourne. Thus, the findings indicate that Sydney is the source of the spillover of Australian house prices, in addition to being the main influence on Australian national house prices. The result reflects the widening of the house price differential as a result of the relative economic gains of the region, combined with an inelastic supply of housing (Holmans, 1990).

6.3.2 Generalised impulse response test

Figure 6.2 presents the results of the generalised impulse response function (GIRF) test. A shock from the Australian national house prices has a significant positive increasing impact on house prices in Brisbane, Perth, and Sydney. The impact on Melbourne is positive, but steady. This finding is consistent with those of Macdonald and Taylor (1993), and Chen et al. (2011), who found evidence of a differential ripple effect from the base housing market. A shock from house prices in Brisbane had a significantly positive effect on Australian national house prices and on other regions, with the exception of Melbourne. A negative result for the shocks from Brisbane was attributed to house prices in Melbourne. This finding indicates that house prices in Melbourne are more vulnerable to ripple effects from other regions.

A shock from Melbourne house prices leads to an increase in positive movements in the Australian National house price, Brisbane, Perth and Sydney house prices. These results may have reflected the spillover impact of house prices from Melbourne, Australia's second largest housing market.

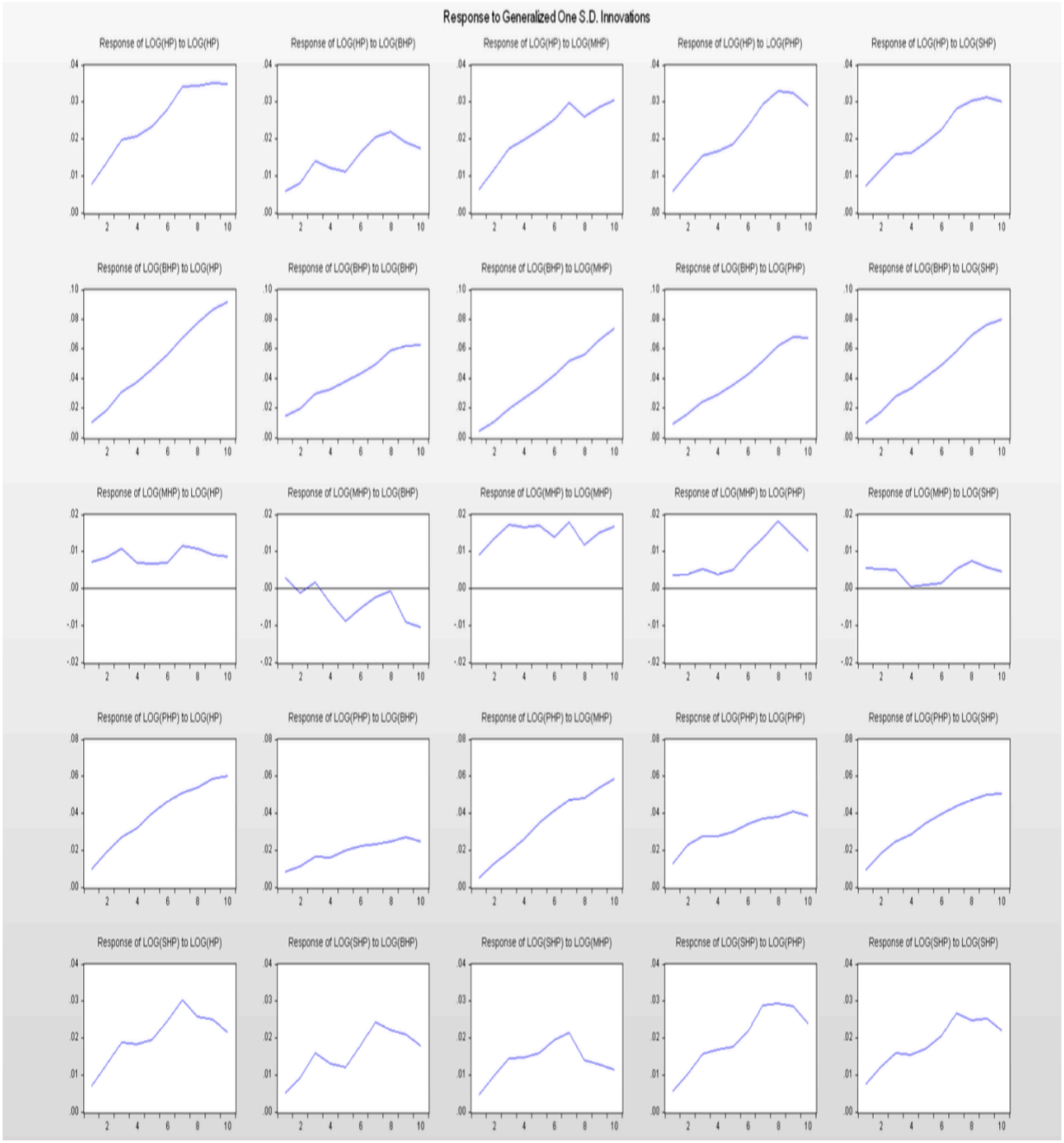

Figure 6.2 Generalised impulse responses (Australia national and major four cities)

Also, a shock from Perth house prices leads to an increase in Australian national house prices, along with an increase in house prices in Brisbane, Melbourne, and Sydney. These results may have reflected the spillover effects on other regions from Perth, the largest mining town in Australia. In particular, the end of the mining boom might have caused increased population movements from Perth to other cities in Australia. Consequently, migration may have contributed to the spillover effect (Meen, 1999).

Furthermore, a shock from Sydney house prices leads to a large increase in Australian national house prices, and house prices in Brisbane and Perth. This could be because Sydney is the source of the spillover of regional housing prices, and has a contagious ripple impact on the house prices in other regions. The impact on house prices in Melbourne is positive, but this impact remains steady over time. The findings indicate that house prices in Melbourne are primarily influenced by the spillover effects from Sydney, Brisbane, and Perth, and also by national house prices.

From the results of the generalised impulse response test, it can be concluded that there are house price spillovers between the Australian national housing market and the housing markets of four major Australian cities. Sydney is the source of the spillover and is not likely to be affected by house prices in other regions. On the contrary, the housing market in Melbourne is primarily affected by spillover effects from other regions, rather than by its own economic forces. The findings are consistent with the conclusions drawn from the variance decomposition test. Similarly, according to Lean and Smyth (2013) and Hui (2010), ripple effects exist among regional states in Malaysia.

Tables 6.5 and 6.6 show the results of the Granger causality tests. The results indicate that house prices in Sydney, Melbourne, Perth and Brisbane do Granger cause the average house prices for Australia. Consequently, past house prices for Melbourne, Perth, and Brisbane can be used to predict Australian national house prices.

Similarly, the result indicates that Australian national house prices, and house prices in Sydney, Perth, and Brisbane, do Granger cause house prices in Melbourne. Therefore, past regional and national house prices should provide information that can be used to predict house prices in Melbourne. This is consistent with the findings obtained by the variance decomposition test in Table 763, which indicates that Melbourne is heavily influenced by spillover effects from other regions, and from national house prices. The local economic forces in Melbourne do not have a significant effect on house prices in that city.

6.3.3 Granger causality test (long and short term)

Table 6.5 Granger causality test (Australian national and regional house prices; 1995Q4 – 2015Q3)

	Chi-Sq Statistic	p	Result
HP			
BHP does not Granger cause HP	27.74	0.00	Yes
MHP does not Granger cause HP	34.43	0.00	Yes
PHP does not Granger cause HP	39.12	0.00	Yes
SHP does not Granger cause HP	28.67	0.00	Yes
BHP			
HP does not Granger cause BHP	6.70	0.81	No
MHP does not Granger cause BHP	7.69	0.66	No
PHP does not Granger cause BHP	8.62	0.57	No
SHP does not Granger cause BHP	5.14	0.88	No
MHP			
HP does not Granger cause MHP	53.84	0.00	Yes
BHP does not Granger cause MHP	53.93	0.00	Yes
PHP does not Granger cause MHP	61.43	0.00	Yes
SHP does not Granger cause MHP	52.46	0.00	Yes

Table 6.6 Granger causality test (Australian national and regional house prices; 1995Q4 – 2015Q3)

	Chi-Sq Statistic	p	Result
PHP			
HP does not Granger cause PHP	19.46	0.03	Yes
BHP does not Granger cause PHP	23.39	0.01	Yes
MHP does not Granger cause PHP	27.72	0.00	Yes
SHP does not Granger cause PHP	14.83	0.14	No
SHP			
HP does not Granger cause SHP	46.73	0.00	Yes
BHP does not Granger cause SHP	35.43	0.00	Yes
MHP does not Granger cause SHP	50.34	0.00	Yes
PHP does not Granger cause SHP	57.25	0.00	Yes

Legend of variables

1. HP — CoreLogic Home Value Hedonic Index series (Australia)
2. BHP — CoreLogic Home Value Hedonic Index series (Brisbane)
3. MHP — CoreLogic Home Value Hedonic Index series (Melbourne)
4. PHP — CoreLogic Home Value Hedonic Index series (Perth)
5. SHP — CoreLogic Home Value Hedonic Index series (Sydney)

Furthermore, the result shows that Australian national house prices, and house prices in Melbourne and Brisbane, do Granger cause Perth house prices. This finding suggests that past values for Australian national house prices, and those for house prices in Melbourne and Brisbane, contain information that can help to predict house prices in Perth. House prices in Sydney were not found to Granger cause those in Perth. This finding indicates that Sydney is

the source of the spillover effect, which has an impact on house prices in Perth, but does not provide information that can be used to predict Perth house prices.

Interestingly, neither the national house prices, nor those in any of the regions, were found to Granger cause house prices in Brisbane. This finding suggests that past values for regional and national house prices do not contain information that can help to predict Brisbane house prices. However, the variance decomposition test suggests that a strong dependence and association exists between house prices in Brisbane, and house prices in both Sydney, and Australia as a whole. However, this was not found to be a causal relationship. This demonstrates that linear relationships exist between Brisbane house prices, Sydney house prices, and national house prices.

Moreover, the Granger causality test reveals the short-term causal relationships that exist among all the regional and national house prices. Further exploration of the long-term relationships between national house prices and those in four big regional cities suggests that there is a long-term causal relationship and dependence associations between all the variables, as the ETC (–1) is negative and statistically significant (see Table 6.7). The optimal period is 11 according to SIC test.

In conclusion, the result of the Granger causality test suggests that the Australian housing market is compartmentalised or segmented meaning that the dissemination or spread of price information dissemination is asymmetric among the four major cities.

Table 6.7 VECM result (Australian national and big four cities' house prices, 1995Q4 – 2015Q3)

		Coefficient	p	t statistics
Model (1)	D(ln(HP))			
	CoinEq1	-6.675	0.001[a]	-3.814

Note: 'a' denotes significant at the 1% level

Legend of variables

1.	HP	National house prices with Sydney, Melbourne, Brisbane and Perth's house prices

6.4 Spillover analysis between first and second - tier major cities' house prices in China

6.4.1 Variance decomposition test

Table 6.8 Variance decomposition results (House prices in major Chinese cities; 2007Q2 – 2015Q3)

Dependent Variables	Horizon (quarter)	Percentage of forecast variances					
		ln (BJP)	ln(SHP)	ln(SZP)	ln(CQP)	ln(NBP)	ln(NJP)
ln(BJP)	1	100.000	0.000	0.000	0.000	0.000	0.000
	2	89.479	0.989	0.239	5.469	3.802	0.023
	3	79.302	0.955	2.339	9.802	7.578	0.025
	4	71.310	1.610	3.810	12.450	10.792	0.028
	5	64.838	1.833	5.538	14.670	13.098	0.024
	10	50.037	2.529	9.525	19.569	18.327	0.013
ln(SHP)	1	10.702	89.298	0.000	0.000	0.000	0.000
	2	15.314	61.539	12.004	8.929	2.115	0.099
	3	15.775	57.674	11.924	9.563	4.440	0.624
	4	17.544	49.502	15.058	11.063	6.230	0.604
	5	16.621	46.388	16.090	12.385	7.892	0.623
	10	14.822	37.837	19.806	15.525	11.482	0.529
ln(SZP)	1	7.911	30.741	61.348	0.000	0.000	0.000
	2	3.460	27.379	67.161	0.837	0.329	0.834
	3	2.830	26.812	68.189	0.524	0.294	1.350
	4	2.292	27.196	68.381	0.395	0.291	1.446
	5	1.963	26.963	68.942	0.328	0.280	1.525
	10	1.335	27.063	69.530	0.170	0.215	1.687

Table 6.9. Variance decomposition results (House prices in major Chinese cities; 2007Q2 – 2015Q3)

Dependent Variables	Horizon (quarter)	Percentage of forecast variances					
		ln(BJP)	ln(SHP)	ln(SZP)	ln(CQP)	ln(NBP)	ln(NJP)
ln(CQP)	1	4.873	0.720	5.223	89.183	0.000	0.000
	2	6.326	0.723	5.583	83.702	3.141	0.524
	3	5.705	0.398	6.697	80.221	6.480	0.499
	4	5.626	0.240	8.209	76.627	8.838	0.460
	5	5.302	0.174	9.334	74.196	10.559	0.435
	10	4.296	0.127	12.144	68.987	14.044	0.401
ln(NBP)	1	19.501	0.965	2.826	0.738	75.970	0.000
	2	17.062	4.006	2.964	2.764	7 3.133	0.071
	3	12.427	4.411	6.097	6.947	70.027	0.090
	4	10.070	4.620	8.316	9.371	67.531	0.092
	5	8.596	4.712	9.851	10.994	65.742	0.105
	10	5.747	4.743	12.880	14.241	62.243	0.146
ln(NJP)	1	31.562	11.082	1.079	6.972	16.426	32.881
	2	26.429	8.124	6.134	18.587	27.430	13.296
	3	39.203	9.119	8.219	12.302	25.326	5.832
	4	37.219	9.861	10.470	12.664	26.489	3.297
	5	34.889	9.639	12.471	13.471	27.364	2.166
	10	28.170	9.463	16.382	15.769	29.514	0.702

Legend of variables

1	FIRSTP	House price in first tier housing market
2	SECONDP	House price in second-tier (top level) housing market
3	BJP	Beijing house price
4	SHP	Shanghai house price
5	CQP	Chongqing house price
6	NBP	Ningbo house price
7	NJP	Nanjing house price

When exploring the possibility of the preferred long-term effects, the spillover estimation period was disaggregated by 10 years. The purpose of this was to establish whether or not there is a persistent tendency towards spillover effects across the first and second-tier two-segment housing markets; the house prices for six out of thirteen major cities were chosen. The six cities were selected on the basis of their importance and significant movements in house prices over the course of the testing period. Estimations were performed using the data for the period between 2007Q3 and 2015Q3; this is the earliest period for which the data were available.

Table 6.8 shows the variance decomposition test results. The results suggest that, in the short-term (period 2), 89.48% of the variances in Beijing house prices can be explained by internal factors, whereas 5.46%, 3.80%, 0.99%, and 0.24% are explained by prices in the second-tier cities Chongqing and Ningbo, and the first-tier cities Shanghai and Shenzhen, respectively.

In addition, the results show that, in the long run (period 10), 50.03% of the variance in Beijing house prices are caused by internal factors, while 19.56%, 18.32%, 2.53%, and 9.52% can be explained by house prices in the second-tier cities Chongqing and Ningbo, and the first-tier cities Shanghai and Shenzhen, respectively.

The results also indicate that house prices in the second-tier cities Chongqing and Ningbo have a greater impact on the variance in Beijing house prices than first-tier cities Shanghai and Shenzhen, both in the long run and the short run. This could suggest a large urbanisation flow from the second-tier cities Chongqing and Ningbo to Beijing. According to Looney and Rithmire (2016), China's urban population has risen from 170 million to 730 million, and the level of urbanisation reached 53.7% in 2013. Meen (1999) states that population changes are an important determinant of house prices, and migration flows may be a factor that contributes to price changes. However, Holmans (1990) argued that migration flows are not quantitatively large enough to lead to the observed price movements.

As can be seen, in the short run (period 2), 61.54% of the variance in Shanghai housing prices can be explained by internal factors, while 15.31%, 12.00%, 8.93%, and 2.11% of the variances can be explained by the house prices in the first-tier cities of Beijing and Shenzhen, and second-tier cities Chongqing and Ningbo.

Furthermore, the results show that, in the long run (period 10), 37.84% of the variance in Shanghai house prices can be explained by internal factors, whereas 14.82%, 19.81%, 15.52%, and 11.48% can be explained by the prices in first-tier cities Beijing and Shenzhen, and those in the second-tier cities Chongqing and Ningbo.

These findings suggest that, in both the short- and long-term, first-tier cities, such as Beijing and Shenzhen, have more impact than second-tier cities, such as Chongqing and Ningbo, on the variances in house prices in Shanghai. This indicates that there are many migrations among these top three first-tier cities. As has been suggested by Meen (1999), the flow of financial information, rather than physical household flow, would produce this result, thereby suggesting 'a positive feedback effect' (Pollakowski & Ray, 1997). This means that, if information from Beijing and Shenzhen is first transmitted to contiguous cites, such as Shanghai, it can be expected that this will produce a ripple effect on house prices.

In the short term (period 2), 67.16% of the variance in Shenzhen house prices can be explained by internal factors, with 3.46%, 27.38%, 0.84% and 0.83% being explained by house prices in the first-tier cities Beijing and Shanghai, and the second-tier cities Chongqing and Nanjing.

In addition, the results show that, in the long run (period 10), 69.53% of the variance in Shenzhen's house prices can be explained by internal factors, while 1.34%, 27.06%, 0.17% and 1.69% of the variance in house prices is attributable to Beijing, Shanghai and second tier cities Chongqing and Nanjing respectively.

The results indicate that house prices in first-tier cities, such as Shanghai, have a huge impact on the variances in house prices in Shenzhen, but this is not true of second-tier cities, either in the short run or the long run. This suggests that there is possibly a large flow of people from Shanghai to Shenzhen, due to the geographical proximity of these two first-tier cites.

Table 6.9 further indicates that, in the short run (period 2), 83.70% of the variance in Chongqing house prices can be explained by internal factors, while 6.33%, 5.58%, 3.14%, and 0.52% of those variances can be explained by prices in first-tier cities Beijing and Shenzhen, and second-tier cities Ningbo and Nanjing, respectively.

The results also show that, in the long run (period 10), 68.98% of the variance in Chongqing's house prices are caused by internal factors, whereas 4.30%, 12.14%, 14.04%, and 0.40% can be explained by the effects from house prices in first-tier cities Beijing and Shenzhen, and second-tier cities Ningbo and Nanjing, respectively.

These results indicate that house prices in first-tier cities, such as Beijing and Shenzhen, have a huge impact on the variance in Chongqing house prices. This suggests that the large urbanisation flow from Chongqing to the first-tier cities Beijing and Shenzhen has led to the flow of financial information between these three cities. According to Meen (1999), if new

information becomes available in Beijing and Shenzhen, and is then transmitted to contiguous cities, such as Chongqing, a ripple effect between Chongqing and the first-tier cities of Beijing and Shenzhen will be produced. Furthermore, Chongqing also accounts for strong influences on its own variances, both in the short and long run. The results suggest that the city is the source of the spillover effect.

In the short run (period 2), 73.13% of the variance in Ningbo house prices can be explained by internal factors, while 17.06%, 4.01%, 2.96%, and 2.76% of those variances are caused by house prices in the first-tier cities Beijing, Shanghai, and Shenzhen, and those in the second-tier city Chongqing.

In addition, the results show that, in the long-run (period 10), 62.24% of the variance in Ningbo's house prices are caused by internal factors, while 5.75%, 4.74%, 12.88%, and 14.24% can be explained by spillover effect from the first-tier cities Beijing, Shanghai, and Shenzhen, and the second-tier city Chongqing.

This indicates that, in the short term, first-tier cities, such as Beijing, Shenzhen and Shanghai, have a huge impact on the variances in Ningbo house prices. In the long term, both the second-tier city Chongqing, and the first-tier city Shenzhen, have a significant influence on the variances in house prices in Ningbo. It also shows that the flow of financial from first-tier cities, including Beijing, Shanghai, and Shenzhen, generates a short-term spillover effect (Meen, 1999). Over the long term, the geographical proximity of Shenzhen, Chongqing and Ningbo is the main reason behind the ripple effect in house prices.

As can be seen in Table 6.9, in the short run (period 2), 13.30% of the variances in Nanjing's house prices can be explained by internal factors, whereas 26.43%, 8.12%, 6.13%, 18.59%, and 27.43% of those variances are explained by house prices in first-tier cities Beijing, Shanghai, and Shenzhen, and the second-tier cities Chongqing and Ningbo, respectively.

The results also show that, in the long run (period 10), 0.70% of the variance in Nanjing's house prices are caused by internal factors, while 28.17%, 9.46%,16.38%,15.77%, and 29.51% can be explained by spillover from first-tier cities Beijing, Shanghai, and Shenzhen, and the second-tier cities Chongqing and Ningbo, respectively.

Over both the short and long term, first-tier cities (e.g. Beijing, Shenzhen, and Shanghai) and second-tier cities (e.g. Chongqing and Ningbo) have a huge impact on the variance in Nanjing house prices. Nanjing house prices are strongly driven by ripple effects from other first and second-tier cities.

With the exception of Nanjing, variations in the house prices of the six first and second-tier cities analysed above are mainly driven by economic forces. This could that indicate these cities are the sources of spillovers.

Figure 6.3 presents the results of the generalised impulse response function (GIRF) test for China 6 major cities. Empirical findings suggest that a shock from house prices in Beijing have a significant positive impact on house prices in Shanghai, Shenzhen, Chongqing, Ningbo and Nanjing. Similar results were found in the other two first-tier cities, namely Shanghai and Shenzhen. This finding is consistent with those of Macdonald and Taylor (1993), Giussani and Hadjimatheou (1991), and Chen et al. (2011), who found evidence of ripple effects with the base region.

In addition, a shock from Chongqing house prices has a positive effect on house prices in Beijing, Shanghai, Shenzhen, Chongqing, Ningbo and Nanjing. Positive effects were found in the other two second-tier cities, namely Ningbo and Nanjing.

6.4.2.Generalized impulse response test (China's major 6 cities)

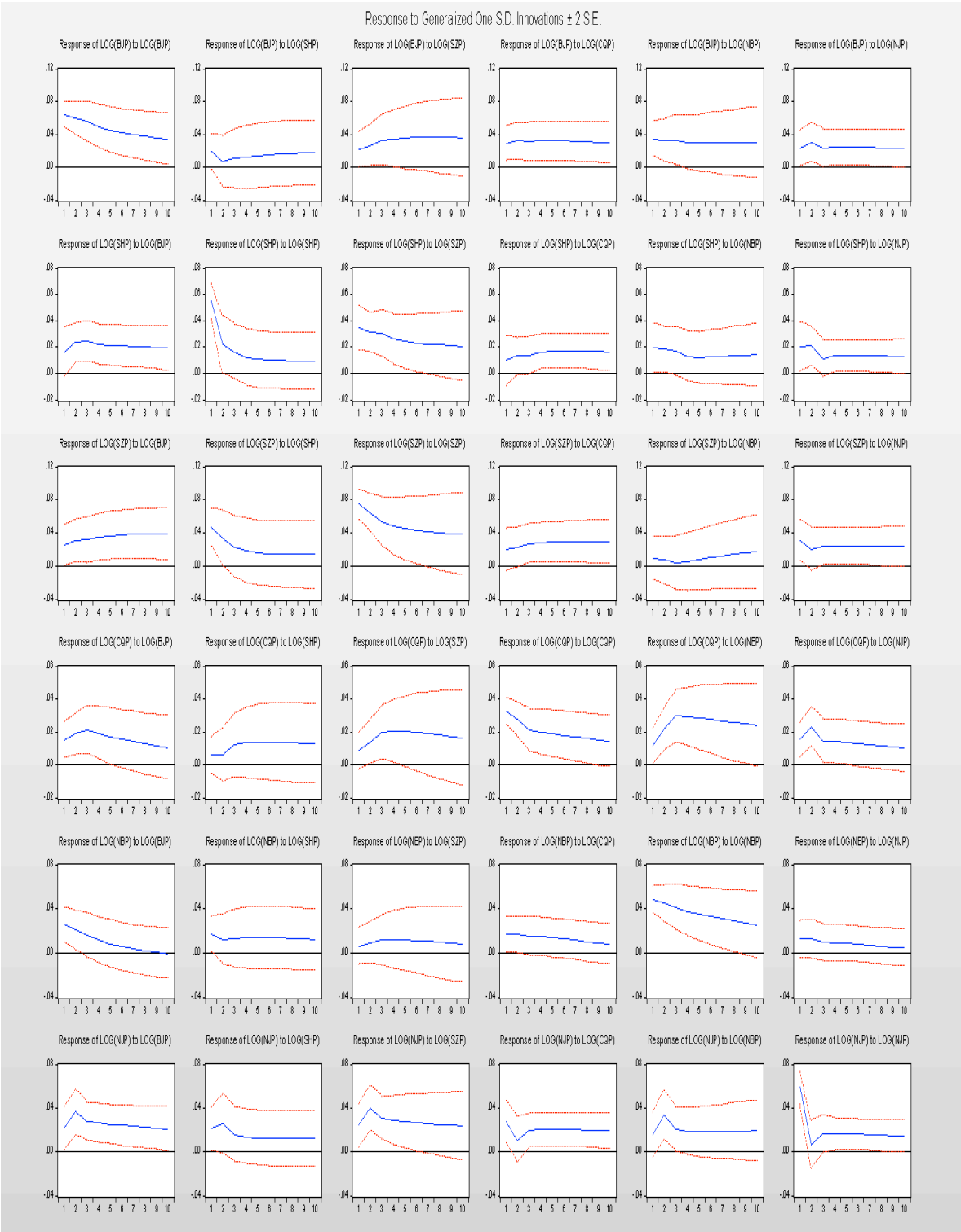

Figure 6.3 Generalised impulse response (China's major 6 cities)

Legend of variables

1	FIRSTP	House price in first tier housing market in China
2	SECONDP	House price in second-tier (top level) housing market in China
3	BJP	Beijing house price
4	SHP	Shanghai house price
5	CQP	Chongqing house price
6	NBP	Ningbo house price
7	NJP	Nanjing house price

The findings of the generalised impulse response test suggest that the ripple effect exists among major first and second-tier cities. The result further confirmed the findings of the variance decomposition test in Table 6.9. Furthermore, Lean and Smith (2013) and Hui (2010) presented similar evidence, demonstrating that spillover effects exist in various states of Malaysia.

6.4.3 Granger causality test (long and short term)

Table 6.10 Results of Granger causality tests (First and second-tier cities house prices in China)

	Chi-Sq Statistic	p	Result
FIRSTP (Model 1)			
FIRSTP does not Granger cause SECONDP	15.62	<0.01[a]	Yes
SECONDP (Model 2)			
SECONDP does not Granger cause FIRSTP	1.98	0.85	No

Note: a' denotes significant at 1% .

Legend of variables

1	FIRSTP	House price in first tier housing market in China
2	SECONDP	House price in second-tier housing market in China

Table 6.11 Results of Granger causality tests (First and second-tier cities house prices in China)

	Chi-Sq. Statistic	p	Result
BJP			
SHP does not Granger cause BJP	0.22	0.64	No
SZP does not Granger cause BJP	0.01	0.91	No
CQP does not Granger cause BJP	4.43	0.04[b]	Yes
NBP does not Granger cause BJP	2.11	0.15	No
NJP does not Granger cause BJP	3.73	0.05[b]	Yes
SHP			
BJP does not Granger cause SHP	1.04	0.31	No
SZP does not Granger cause SHP	5.77	0.02[b]	Yes
CQP does not Granger cause SHP	7.70	0.01[a]	Yes
NBP does not Granger cause SHP	0.89	0.34	No
NJP does not Granger cause SHP	6.24	<0.01[a]	Yes
SZP			
BJP does not Granger cause SZP	5.59	0.02[b]	Yes
SHP does not Granger cause SZP	0.58	0.45	No
CQP does not Granger cause SZP	1.85	0.17	No
NBP does not Granger cause SZP	0.37	0.54	No
NJP does not Granger cause SZP	0.36	0.55	No

Note: a, b significant at 1% and 5% levels respectively.

Table 6.12 Results of Granger causality tests (First and second-tier cities house prices in China)

	Chi-Sq. Statistic	p	Result
CQP			
BJP does not Granger cause CQP	0.03	0.86	No
SHP does not Granger cause CQP	0.57	0.45	No
SZP does not Granger cause CQP	0.19	0.67	No
NBP does not Granger cause CQP	2.42	0.12	No
NJP does not Granger cause CQP	1.93	0.17	No
NBP			
BJP does not Granger cause NBP	0.79	0.37	No
SHP does not Granger cause NBP	0.06	0.81	No
SZP does not Granger cause NBP	0.09	<0.01[a]	Yes
CQP does not Granger cause NBP	4.62	0.03[b]	Yes
NJP does not Granger cause NBP	0.05	0.83	No
NJP			
BJP does not Granger cause NJP	17.54	0.00[a]	Yes
SHP does not Granger cause NJP	3.43	0.06	Yes
SZP does not Granger cause NJP	1.61	0.20	No
CQP does not Granger cause NJP	18.19	0.00[a]	Yes
NBP does not Granger cause NJP	4.82	0.03[b]	Yes

Note: a, b significant at 1% and 5% levels, respectively

Legend of variables

1	FIRSTP	House price in first tier housing market in China
2	SECONDP	House price in second-tier (top 8 cities) housing market in China
3	BJP	Beijing house price
4	SHP	Shanghai house price
5	CQP	Chongqing house price

6	NBP	Ningbo house price
7	NJP	Nanjing house price

Tables 6.10, 6.11, and 6.12 provide the empirical results of the Granger causality tests for the six first and second-tier cities selected for the sample. The estimation procedure analyses ex-post - causal relationships among the three major first-tier cities and the three major second-tier cities, with the aim of analysing the causal effects between the cities in the two tiers. The sample cities, which were selected from a total of 13 first and second-tier cities, are Beijing, Shanghai, Shenzhen, Chongqing, Nanjing, and Ningbo. All of these cities are major economic zones with many urbanisation opportunities, and have all experienced the phenomenon of a surge in house prices. Empirical estimates involve the test of causal relationships between overall first-tier housing prices and second-tier housing prices, and the causal relationships among the six sample cities selected.

As shown in Tables 6.10, 6.11, and 6.12, there is a unidirectional causal relationship between house prices in first-tier cities and those in and top-level second-tier cities. Past values for house prices in first-tier cities should contain information that can help to predict house prices in second-tier cities, and can provide information that goes beyond that contained in the past house price values for second-tier cities. On the other hand, house prices in second-tier cities do not Granger cause house prices in first-tier cities: not only does this suggest the non-existence of a causal relationship, it could also be a sign of a dependence association between the house prices of the two cohorts.

Furthermore, as is shown in Table 6.11, the test result suggests that the second-tier cities Chongqing and Nanjing do Granger cause house prices in the capital city, Beijing. This indicates that past values for house prices in Chongqing and Nanjing should contain information that can be used to predict house prices in Beijing, since the information contained in the values for the two cities goes beyond what is contained in the past house

price values for Beijing alone. The test results possibly reflect the urbanisation trends from small cities to big major cities.

Looney and Rehire (2016) note that, under the new rural-urban dual structure in China, rural residents were allowed to move into cities and towns for work. Thus, the floodgate was opened when the urbanisation of China began from the 1990s.

In addition, the results indicate that the second-tier cities Chongqing and Nanjing, and the first-tier city Shenzhen, Granger cause house prices in the first-tier city Shanghai. The findings suggest that past values for house prices in Chongqing and Nanjing should contain information that can be used to predict house prices in Shanghai, since the information contained in the values for the two cities exceeds the information provided by the past values for house prices in Shanghai alone. The findings could possibly be caused by the convenient information transmission mechanism from Chongqing and Nanjing to Shanghai, due to the geographical proximity of these cities. Moreover, the first-tier city Shenzhen also Granger causes house prices in Shanghai. This suggests that the past values for house prices in Shenzhen should contain information that can help to predict house prices in Shanghai. This may be caused by the fact that many people from Shanghai go to Shenzhen to work, as Shenzhen is a modern metropolis that links Hong Kong to China's mainland. The city is known for its shopping destinations and provides many employment opportunities.

The results also indicate that the first-tier capital city, Beijing, Granger causes house prices in the first-tier city Shenzhen. Thus, past values for house prices in Beijing should contain information that can be used to predict house prices in Shenzhen, since the information contained in the values for the capital city exceeds that which is contained in the values for house prices in Shenzhen alone. This may suggest that many people from Beijing go to Shenzhen to seek employment because of Shenzhen's proximity to overseas countries, and the many opportunities associated with those countries.

Table 6.12 shows that there are no causal relationships between regional first and second-tier cities and the second-tier city Chongqing. Thus, the past values for house prices in regional first and second-tier cities do not contain information that can be used to predict house prices in Chongqing, since the information contained in the values for the five regional first and second-tier cities does not exceed that which is contained in the past values for house prices in Chongqing alone. This may confirm the findings of the variance decomposition test, which found that Chongqing is a source of spillover and is itself largely affected by its own economic forces.

Table 6.12 demonstrates that a causal relationship may exist between the first-tier city Shenzhen, the second-tier city Chongqing, and the second-tier city Ningbo. Consequently, past house price values for Shenzhen and Chongqing contain information could help to predict house prices in Ningbo, as they would provide more information than what is contained in the past values for house prices in Ningbo alone. This may confirm the findings of the variance decomposition test, which revealed that Chongqing and Shenzhen have a significant effect on the variance in house prices in Ningbo.

The finding may reflect the fact that the geographical proximity between Chongqing, Shenzhen, and Ningbo has enabled the easy flow of population and information, which have, in turn, led to the ripple effect on house prices in Ningbo.

Finally, as is shown in Table 6.12, the results suggest the existence of a causal relationship between first-tier cities Beijing and Shanghai and second-tier cities Chongqing and Ningbo, with the second-tier city Nanjing. This would mean that past house price values for Beijing, Shanghai, Chongqing, and Ningbo contain information can be used to predict house prices in Nanjing, since the information contained in the values for Shenzhen and Chongqing is more than the information contained in the past values for house prices in Nanjing alone. This may confirm the findings in the variance decomposition test, which indicated that Beijing,

Shanghai, Chongqing, and Ningbo have a significant impact on the variance in house prices in Nanjing. This result verifies the conclusion that house prices in Nanjing are largely influenced by spillover effects from other regional cities. With regard to Nanjing, the city's own economic force accounts for a lower percentage of the variance in house prices.

In summary, the Granger causality tests in Tables 6.10, 6.11, and 6 .12 illustrate the short term spillover effects of regional house prices between first and second-tier cities. As indicated in Table 7.10, a long term causal relationship exists between the house prices of first and second-tier cities, due to the negative significant coefficient of error correction term. The urbanisation trend, information flow, and migration flow, together with geographically contagious factors affecting the housing markets of these two segments, all contribute to the ripple effect in regional house prices. Previous studies in Malaysia housing market confirmed the long term convergence behaviour (Fereidouni, 2016).

CHAPTER 7

HOUSE PRICE MAIN DRIVERS AND BUBBLE RISKS

7.1 Executive summary

Purpose and scope

This chapter analysed the econometric test results pertaining to housing bubbles and the main drivers of house prices. The aim here was to establish an empirical context in which to update and interpret the estimation results, inform the results of the empirical specifications for econometric estimations and analyse the implications for the current research.

Recognising the importance of house prices main drivers and housing bubbles to the national economies of China and Australia, this section begins by updating results concerning the main drivers of house prices in those countries, before analysing the outcomes of empirical tests for housing bubbles in their housing markets.

Methodology

Empirical estimates of outcomes for house price main drivers, housing bubbles for China's, and Australia's national housing markets were updated in Chapter 7 based on secondary data.

Key Findings

During the OLS empirical estimates, the results of the residual diagnostics showed the assumptions of the classical linear regression model were met, although some factors were identified as somewhat redundant due to moderate multicollinearity.

For house price main drivers in Australia, consumer sentiment (CS), the mortgage interest rate, Australian share market performance (AUSHARE) and the unemployment rate (UNEMPLOY) were all identified as significant. Excluded was the average weekly earnings

(AWE), but include was the interest rate (IR), due to the close correlations between Australian house prices (HP) and AWE. Furthermore, the results suggest an impact from GFC (D408) that will be significant for housing prices (HP). Quarterly dummy variables includes large Chinese buyer purchases (CHD) using self-managed super purchasing properties (SFD) and first home grants (FIRST) were found to be statistically insignificant.

Updating the empirical test results in China's housing markets, the findings suggest a co-integration relationship between China's house prices (CNP) and its four main macroeconomic forces; namely CNGDP, unemployment rate (CNUNEMPLOY), the interest rate (CNIR) and China's share market index (CNSHARE).

Furthermore, the error correction terms for both Chinese and Australian house prices are negatively significant. The empirical results reveal no housing bubbles in either China or Australia, since the house prices there always reach long run equilibrium after a period of self-correction and short-run innovations over time. In conclusion, in accordance with Hui and Yue (2006), as real estate prices can be explained by variations in the macroeconomic variables and so exhibit reasonable shifts, the notion of no housing bubble can be accepted.

Concluding remarks

The findings in this chapter revealed the importance of macroeconomic variables as an influencer of house prices in both China and Australia. These findings were especially useful for providing a good understanding of house price dynamics, and risked housing bubbles for individual households, institutional agents, and policy makers as a means to pursue sensible decisions.

Thus, turning to the concluding chapter of the current research. In Chapter 8, the conclusion to this thesis, a detailed summary is given of the contribution, findings, and policy implications of this research and future research directions proposed.

7.2 Australia's main house price drivers

7.2.1 OLS assumptions

Checks to establish the validity of the OLS assumptions involved in the empirical estimation of house price dynamics indicate the p-value of the residuals is 0.99. As this is greater than 0.05, the null hypothesis that the error term is normally distributed is upheld.

Next, estimations for autocorrelation revealed a Durbin-Watson test statistic of 1.93, which is very close to the critical value of 2. Therefore, the result indicates no similarity of the time series data over successive time intervals. Moreover, we assume no first order linear autocorrelation is present in the regression residuals. The estimation shows the variance for inflation factor (VIF) for the main drivers of housing prices ranges between 1 and 5, suggesting that the variance values for the estimated coefficients of the explanatory variables are inflated by factors between 1 and 5. Therefore, given the moderate multicollinearity identified, some factors might be considered slightly redundant. The estimation using the Glejser test shows p-values are > 0.05 and so statistically significant; therefore, we cannot reject the null hypothesis assuming homoscedasticity.

The results of the residual diagnostics show the assumptions regarding the classical linear regression models are met.

7.2.2 OLS results

Table 7.1 presents the results from the OLS estimations of the main drivers for Australian house prices for the period from 1995Q4 to 2015Q3. All four major drivers are statistically significant with p-values lower than 0.05. The value R^2 at 99%, indicating that 99% of the variation in the value of house prices can be attributed to the four main drivers, as identified in the model (Croucher, 2017).

Table 7.1 Main drivers of Australian house prices (1995Q4 – 2015Q3)

Variables	Coefficient	t statistics	p
CS	0.22	2.11	0.04[b]
IR	-4.0	-4.33	0.00[a]
UNEMPLOY	1.93	1.59	0.12
AUSHARE	0.01	3.13	0.00[a]
HP (-1)	0.99	88.90	0.00[a]
D408	-20.07	-2.61	0.01[a]
C	-12.23	-0.61	0.54
R^2	0.99		
Durbin – Watson	1.93		

Note: a, b significance at 1% and 5% levels respectively.

Legend of variables

1	IR	Mortgage interest rate (Australia)
2	AUSHARE	Australian S&P/ASX 200 stock market index
3	UNEMPLOY	Unemployment rate (Australia)
4	CS	Consumer sentiment (Australia)
5	D408	Quarter 4, 2008, dummy variable indicates GFC

Estimation of the mortgage interest rate (IR) suggested a significant negative influence on house prices, with a coefficient of -4. The results suggest a 1% decrease in IR may generate an increase of 4% in the housing price index, ceteris paribus.

From October 2012, consecutive cuts were made to the RBA cash rates. The effect was to shift mortgage lending rates, with a positive impact on household balance sheets, resulting from the reduction in the mortgage expense. The major proportion of mortgage debt expense correlates positively with short-term interest rates (Koblyakova et al., 2014). Decreased

mortgage expenses might thereby improve households' cash flow liquidities. Also, the probability of increased housing demand could then be explained by the capital gain effect, and the large positive premiums over lower mortgage expenses, which increases house prices.

The estimates based on the Australian S&P/ASX 200 stock market index (AUSHARE) demonstrate statistical significance, as well as a positive coefficient of 0.01; this suggests people are more likely to make property purchase decisions when the market is performing better. According to rational expectation theory, outcomes depend partially on what people anticipate will happen. When the Australian share market performs well, households expect economic growth and so are confident about capital gains. This results in increased housing demand.

Consistent with the theoretical hypotheses, interestingly, estimates regarding the unemployment rate (UNEMPLOY) showed an important impact on Australian house prices, with a positive coefficient of 1.93. A lower unemployment rate is believed to alleviate affordability constraints, because of the increased purchasing power associated with higher income. However, there is typically a direct negative correlation between the unemployment rate and the interest rate, arising from a general government policy to lower interest rates in times of higher unemployment to boost economic growth. Thus, the correlation between the higher unemployment rate and increased house prices is explained.

When including consumer sentiment (CS) as an explanatory variable, the parameter estimate shows a significant positive coefficient of 0.22, suggesting that higher consumer confidence in the economy and the housing market generally makes consumers more likely to purchase properties. In that case, the limited housing stock might then be subject to greater demand, driving up prices, ceteris paribus (Sivitanidou, 2011). This result reflects the assumption that householders' expectations are rational when making property purchasing decisions.

In the econometric estimate, AWE was found to have a positive coefficient that was

significantly correlated with the Australian house price, suggesting household owners with higher purchasing power tend to buy additional properties. As AWE is found to have a strong correlation with IR, this could lead to a higher multicollinearity risk, and so we AWE is excluded include IR as the main driver for house prices.

The results suggest the impact of GFC (D408) is significant for house prices (HP).

Quarterly dummy variables regarding large Chinese buyer purchases (CHD), using self-managed super purchasing properties (SFD) and first home grants (FIRST) are insignificant; Chinese buyers' large purchase activities did not drive up Australian housing prices during the most recent housing boom (Valentine et al., 2015).

7.3 China's main house price drivers

7.3.1 OLS assumptions

Checks for the validity of the OLS assumptions such as normality involved in the empirical estimation of China's house price dynamics indicate the p-values for residuals is 0.99. As this is greater than 0.05, we conclude there is normal distribution of the error term. Estimations of autocorrelation reveal a Durbin-Watson test statistic of 1.72, which is slightly below the critical value of 2. Therefore, we assume there is a minor first order linear autocorrelation in the regression residuals.

This estimation shows the variance inflation factor (VIF) for the main drivers, except for the GDP of the house prices ranges between 1 and 5, suggesting that the variance values for the estimated coefficients of explanatory variables are inflated by factors between 1 and 5. Therefore, given the moderate multicollinearity identified, certain factors are judged slightly redundant. The estimation using the Glejser test shows the p-values are > 0.05 and so statistically significant; therefore, we cannot reject the null hypothesis of homoscedasticity.

The results of the residual diagnostics show that the assumptions for classical linear regression model are met.

7.3.2 OLS results

Table 7.2 Main drivers of China's house prices (2007Q2 – 2015Q3)

Variables	Coefficient	t statistics	p
CNIR	-1552.96	-3.24	0.00[a]
CNGDP	1.41	4.55	0.00[a]
CNUNEMPLOY	-1559.73	-0.38	0.71
CNSHARE	1.13	3.79	0.00[a]
CNP (-1)	0.80	16.75	0.00[a]
C	-1.29	-1.49	0.15
R^2	0.99		
Durbin – Watson	1.72		

Note: a significant at 1% level respectively.

Legend of variables

1	CNIR	Mortgage interest rate (China)
2	CNSHARE	China Shanghai composite stock market index
3	CNUNEMPLOY	Unemployment rate (China)
4	CNGDP	Gross domestic product (China)

Table 7.2 represents the empirical results describing China's main house price drivers. The estimation procedure analyses ex-post house demand and the macroeconomic variables, the results indicating a negative significant relationship between mortgage interest rates (CNIR) and China's house prices (CNP). Under the regime of increasing mortgage interest rates, increased mortgage expenses allow the higher profits from variable rate lending, with an increase in household expenses. The expensive mortgage cost reflects concerns about affordability, thereby reducing the purchase power of households resulting in a reduction in household demand and housing prices. Linking to house price dynamics in our research

questions, house price increases will lead to large households' debts. Higher mortgage expenses from large household debts will contribute to the large portion of household bills. As a result, many households cannot afford to fulfil the dream of homeownership.

Furthermore, the results indicate a positive significant relationship between China's GDP (CNGDP) and China's house prices (CNP). A macroeconomic explanation for this could be that the positive coefficients for CNGDP, reflected in the housing price equation, reveal that healthy economic growth creates consumer confidence, thereby motivating household buyers to purchase more properties. A demand side explanation would be that in an environment of higher CNGDP growth, household buyers might have higher purchase power, thereby increasing the purchase of property and house prices.

The coefficient for unemployment (CNUNEMPLOY) in the main drivers of housing price equations are negative but insignificant, reflecting a reduction in the unemployment rate resulting in increased house prices. The impact of unemployment on China's house prices is not significant, which could be attributable to the stronger correlations between China's house prices and other macroeconomic variables.

Furthermore, the results suggest a positive significant coefficient from China's share market index (CNSHARE). A better share market performance index reflects improved business sentiment. More dividend income is then distributed to shareholders, which may improve their purchasing power, thereby increasing housing demand and China's house prices.

7.4 AU bubble risks

7.4.1 ADF test

An Augmented Dickery-Fuller (ADF) test was conducted to explore the possibility of the stationarity of the variables when describing the first differences for Australian house prices. As shown in Table 7.3, the results reveal none of the variables are stationary at the set levels,

except for the mortgage interest rate (IR) and consumer sentiment (CS). However, when the variables are first differenced significant test statistics are reported in every case. Therefore, the null hypothesis (the variables of first difference contain unit roots) can be rejected in reference to Australian house prices. Since the variables are stationary at the first differences, we can apply the Johansen co-integration test.

Table 7.3 Results of the ADF unit root test (AU national; 1995Q4 – 2015Q3)

	Level		First Difference	
Variables	t statistic	p	t statistic	p
ln(HP)	-0.48	0.99	-3.98	0.00[a]
ln(CS)	-4.28	0.00	-10.60	0.00[a]
ln(IR)	-4.16	0.00	-5.54	0.00[a]
ln(UNEMPLOY)	-2.39	0.15	-5.32	0.00[a]
ln(AUSHARE)	-1.89	0.33	-6.74	0.00[a]

Note: a significant at 1% level

Legend of variables

1. IR — Mortgage interest rate (Australia)
2. AUSHARE — Australian S&P/ASX 200 stock market index
3. UNEMPLOY — Unemployment rate (Australia)
4. CS — Consumer sentiment (Australia)

7.4.2 Johansen co-integration test

Table 7.4 presents the empirical results for the Johansen co-integration test. It shows two co-integration relationships in the trace test and one co-integration relationship in the maximum eigenvalue test at the critical p-value of 5% between Australian house prices (HP) and their main drivers. A co-integration relationship suggests a statistically significant long-run relationship between Australian house prices (HP) and the four main drivers, while all the

variables share common stochastic drift (Abelson et al., 2005). The empirical estimate suggests a lag in the first-differenced terms of 5, using Schwarz Information Criteria (SIC). Since the long run co-integration relationships have been identified, the next step is to conduct the VECM test for housing bubbles in Australia.

Table 7.4 Result of Johansen co-integration test (Australia national ; 1995Q4 – 2015Q3)

		λ Max		Trace	
		Statistics	p	Statistics	p
HP	r = 0	40.38	0.01[a]	91.52	0.00[a]
	r = 1	21.87	0.23	51.14	0.02[b]
	r = 2	18.78	0.10	29.27	0.06
	r = 3	10.48	0.18	10.49	0.24
	r = 4	0.01	0.92	<0.01	0.92

Note: a, b significant at 1% and 5% levels respectively

7.4.3 VECM test

Table7.5 VECM result on bubble testing (AU national; 1995Q4 – 2015Q3)

	Coefficient	t statistics	p
Error correction	D(ln(HP))		
CoinEq1	-0.001	-2.62	0.01[a]

Note: a significant at 1% level.

Legend of variables

1. HP CoreLogic Home Value Hedonic Index

The results of the VECM test for the existence of housing bubbles in Australia are reported in Table 7.5. In all cases, the parameter estimates for the error correction term (ECT) are significant with the expected negative sign, indicating the speed at which house prices return to equilibrium after short-term disequilibrium corrections. Specifically, the ECT (-1) estimated coefficient is -0.001, suggesting that 0.1% of the short-term disequilibrium is corrected within 3 months by its own economic forces. As a result, and according to Hui and Yue (2006), when real estate prices can be explained by variations in macroeconomic variables leading to the conclusion that house price changes are reasonable, the view that no housing bubble exists can be accepted. This factor is important for household to make property investments since the long term health of housing market is the most vital reason for property purchase decisions. The findings suggest the detrimental effects to the economy in the case of irrational investment behaviours.

7.5 China's bubble risks

7.5.1 ADF test

Table 7.6 Results of the ADF unit root test (CN national; 2007Q2 – 2015Q3)

	Level		First Difference	
Variable	t statistics	p	t statistics	p
ln(CNP)	-1.77	0.39	-4.10	0.00[b]
ln(CNGDP) (USD billion)	-1.43	0.56	-7.10	0.00[a]
ln(CNUNEMPLOY)	-1.84	0.35	-5.31	0.00[a]
ln(CNSHARE)	-4.73	0.00	-5.65	0.00[a]
ln(CNIR) (%)	-1.90	0.33	-4.55	0.00[a]

Note: a, b significance at 1% and 5% levels respectively

Legend of variables

1. CNIR — Mortgage interest rate (China)
2. CNSHARE — China Shanghai composite stock market index
3. CNUNEMPLOY — Unemployment rate (China)
4. CNGDP — Gross domestic product (China)
5. CNHP — China house prices

In this study, the Augmented Dickey–Fuller (ADF) unit root test was employed to test the stationarity of the variables affecting China's house price dynamics (Eviews 8 user guide, 2014). As shown in Table 8.6, the results indicate that none of the variables are stationary at the levels given, except for China share market index (CNSHARE). All variables are identified as stationary at first differences, that is at I(1). Thus, the null hypothesis (the variables of first difference contain unit roots) can be rejected in relation to China's house prices. Since the variables do not have unit root problems at the first differences, a Johansen co-integration test can be employed.

7.5.2 Johansen co-integration test

Table 7.7 Results of the Johansen co-integration test (China national; 2007Q2 – 2015Q3)

		λ Max		Trace	
		Statistics	p	Statistics	p
China house price	r = 0	106.08	0.00[a]	166.59	0.00[a]
	r = 1	26.99	0.06	60.51	0.00[a]
	r = 2	20.18	0.07	33.51	<0.01[a]
	r = 3	12.57	0.09	13.33	0.10
	r = 4	0.77	0.38	0.77	0.38

Note: a significant at 1% levels.

Table 7.7 presents the empirical results for the Johansen co-integration test. Three co-integration relationships emerge from the trace test and one co-integration relationship in the maximum eigenvalue test, at the critical p-value of 5%, when comparing China's house prices (CNP) and the main drivers. The results suggest a co-integration relationship between China's house prices and the four main macroeconomic variables; i.e. CNGDP, unemployment rate (CNUNEMPLOY), interest rate (CNIR) and China share market index (CNSHARE). The empirical estimate suggests the lag affecting the first-differenced terms is 4, when using Schwarz Information Criteria (SIC). Since long run co-integration relationships are identifiable, we can proceed to the VECM test for housing bubbles in China.

7.5.3 VECM test

Table 7.8 VECM results for bubble testing (CN national; 2007Q2 – 2015Q3)

	Coefficient	t statistic	p
Error correction	D(ln(CNP)		
CoinEq1	-0.16	-2.93	<0.01[a]

Note: a significant at 1% level.

Legend of variables

1. CNP China house prices

Table7.8 reports the results from the VECM test for the existence of housing bubbles in China. In all cases, the parameter estimates for the error correction term (ECT) are significant with the expected negative sign, suggesting the speed at which housing prices return to equilibrium after short-term disequilibrium correction. In particular, the value of ECT (-1) estimated coefficient is -0.16, suggesting that 16% of the short-term disequilibrium is corrected within 3

months by associated economic forces. As a result, the empirical results reveal no housing bubbles in China, because prices always attain long run equilibrium over time following self-correction of short-run innovations.

Moreover, Case and Shiller (2004) suggest the stability of the relationship between economic forces and house prices is a fundamental factor when determining the existence of a housing bubble. The test here reveals that current house prices always have a stable long run relationship with house prices in China. Thus, the conclusion is that no bubble exists. This finding is of great importance to the housing economy since house prices' main drivers have immediate implication to the economy. GDP growth, the finance and monetary policy setting, the finance landscape setting. Thereby, the finding can be applied to contribute to the appropriate policy setting and better investment, business decisions for key stakeholders in household, government and institutions.

CHAPTER 8 CONCLUSIONS

8.1 Summary of findings

This thesis has investigated the issues of the spillover effects and main macroeconomic drivers of house prices in China and Australia; revealing long term relationships between house prices and the macro-economy and analysing the existence of housing bubbles in either context. A summary of the main findings of the thesis is provided.

No research on the housing market can be complete without an analysis of its structure that was detailed in Chapter 2. This analysis examined how the fundamental economic theory underpinning the housing market could be understood from a wider perspective. The evidence presented appears to suggest that the housing markets in China and Australia move in a pro-cyclical manner that mirrors the rest of the economy. One mechanism through which this operates is that, when the housing market is booming, the demand for consumer durables rises, thereby boosting aggregate demand. Alternatively, rising house prices can result in additional housing equity withdrawal, triggering a subsequent rise in consumption. In addition, pro-cyclicality is generated to a large extent by the operation of monetary policy, which has similar effects on household's durable consumption as it has on housing demand.

Following an overview of the economic demand and supply factors impacting two countries housing market performance, the chapter also focused on special features of the Australian housing market: i) very constricted land supply and extremely onerous planning approval processes; ii) income tax relief through negative gearing; and iii) only recourse loans. House prices and macroeconomic variables such as interest rate, share market performance index, unemployment rate, income, consumer sentiments etc. are chosen to conduct the empirical analysis in both the Chinese and Australian housing markets.

Analysis of contentious issues in the Australian housing markets include: i) using SMSFs to purchase properties; and ii) large purchases by overseas buyers. Furthermore, the chapter highlighted the welfare housing distribution system which was replaced by the openly traded real estate market in 1998 in China. The real estate market there has acted to enhance the competitiveness and efficiency of housing market performance, encouraging new entrants into the market. The surge in the market occurred during China's "golden age" of prosperity, and growth was maintained as house prices slowed down to achieve a "new normal" (2014 onwards).

A review of key literature was reported in Chapter 3, a separate chapter devoted to the significance of spillover effects, macroeconomic relationships and housing bubbles (all of which were then examined in depth in subsequent chapters). The theoretical model employed in the study is derived from a housing demand model, in which the central idea of housing demand suggests effective market demand is backed by purchasing power. In addition, rational expectation theory is applied representing householders' purchase decisions are largely dependent upon people's expectations regarding future property performance and economic conditions.

Chapter 4 examined and estimated the efficiency of models describing house prices dynamics. The OLS and VECM frameworks were used to study house price dynamics and housing bubbles, since these models are less restrictive and easier to apply to both house prices and the macroeconomic data (Jusélius, 2006). Turning to an empirical methodology, the use of the VAR framework to implement the variance decomposition test, the generalised impulse response model and the Granger causality test were all evaluated.

The aim was to determine the relative importance of regional and national house prices as a cause if movements in major cities' house prices, the motivation for which has been the recent

alarming trends in house prices. The estimates given were based on the various time series data sets provided by a number of reputable data providers: ABS, RBA, CoreLogic, the US economic trading website and the CitiRE property database in Section 4.7. However, the availability of appropriate time series data in China definitely limited the empirical test results for China house price dynamics. This measure of expected house price inflation might be considered appropriate.

Chapter 5 developed a formal model for long run macroeconomic relationships affecting house prices, in which tests of house prices always self-correct to long run equilibrium prices under their own economic forces, to identify the co-integrating relationship. The appropriate specification of estimates is especially important, given that the Australian and Chinese housing markets are driven by macroeconomic factors. One cannot simply assume house price dynamics are homogeneous in both markets. The significant finding reported in this chapter was that the heterogeneity of the macro-economy impact on the regional house prices and national house prices in both countries. In other words, the model suggested, the spatial patterns describing house price dynamics lead to asymmetric responses to macroeconomic shocks. Further, the finding identified long run equilibrium relationships between the macro-economy and house prices in major regional housing markets and national housing markets. For example, it was observed that the different speeds of self-correction from short term disequilibrium back to long run equilibrium prices were determined by these macroeconomic forces.

Chapter 6 concentrated on estimating the spillover effects on house prices in regional and national housing markets. The models utilised included variance decomposition, general impulse response and Granger causality tests, revealing that, up to a point, building societies will leave their interest rates unchanged to become more profit oriented.

Following a discussion of the implications of the theoretical models upon which estimations were based, attention was focused upon causal relationships and contagious correlations among various house prices. In particular, the findings suggest that China's house prices may have caused Australian house price movements, while Australian house prices were not found to have caused China's house price changes. Over the long run, no causal relationships were identified.

It was then reported that Sydney is the dominant source of spillover in house prices in Australia's big four cities. The finding shows changes in house prices in Sydney result in contagious spillover, impacting the house prices of the other three main cities due to the transmission of information mechanism. Sydney is also the main driver of the Australian national house price. Meanwhile, Melbourne's house prices are largely influenced by the contagious spillover effects from other regions.

Spillover impacts are found to be among the top thirteen major cities in China. The implications of the spillover effects on the house price variables included in the estimations were discussed at length, and then subjected to rigorous tests for stationarity. We asserted that the econometric models are interpretable when stationarity are conditions met.

Finally, Chapter 7 estimated the equations for the main drivers of house prices in Australia and China. It identified the effects of mortgage interest rate, unemployment rate, and the share market performance index on house price equations are of particular importance for determining both China's and Australia's house prices. The GDP was found to be the main driver affecting Chinese house prices while consumer sentiment was identified as the key factor driving Australian house prices. After this, the next largest and most significant effect derives from mortgage interest rates, along with the share market performance index variables in both countries.

Furthermore, turning to conclusions regarding the existence of a housing bubble; the final estimated long run equation highlights the importance of self-corrections of short term disequilibrium when determining the long run equilibrium of house prices. A negative significant Error Correction Term (ECT) on the house price variable indicated short-term disequilibria can always be corrected to a balanced house price equilibrium over the long run by economic forces in China. The error correction terms for the VECM were found to be significantly negative, and 16% of the short-term disequilibrium corrected within 3 months under its own economic forces in China's housing market, compared with 0.1% of short-term disequilibrium, which corrected within 3 months in Australia. These results demonstrate the rapid speed of adjustment in the Chinese housing market. The quicker speed of adjustment in China is important, since the quick economic condition changes might result in rapid changes in house price performance due to the responses of household purchase decisions.

8.2 Research contribution and recommendations for future research

The principal contribution of this research is that it has been the first to rigorously study the Chinese and Australia housing markets in both national and key regional cities. It has also contributed significantly to the general literature about house price dynamics and housing bubbles. The housing market set-up and significance of housing economies in China and Australia provide us with unique opportunities to study the relationships between house prices and macroeconomic variables. Further contributions of this paper include the evaluation of those main factors impacting regional house purchase decisions. These findings help key users including households, institutional investors, financial institutions, real estate businesses, and construction industry insiders to make better decisions when engaging in strategic planning and corporate resolutions. These issues and findings are therefore of profound significance. This research also aspires to focus on how risk management helps households and institutional investors in local markets minimize risk and improve the risk management

process. The outcomes focus on substantial issues that are likely to benefit the level of understanding in real estate literature globally (Chan, Hardin, Liano and Yu, 2008).

These empirical findings are consistent with regional economic trends, suggesting its asymmetric impacts on households' purchase decisions. In contrast with previous research the results reported herein demonstrated the house price dynamics from three perspectives: 1) spillover effects; 2) macroeconomic relationships; and 3) main drivers.

The results provide broad implications, which are applicable to markets such as the United States, the United Kingdom and New Zealand. All of these have seen sustained house price movements in the last decade. Furthermore, the research presented several new pieces of evidence having employed an integrated strategy to introduce a comprehensive set of indicators, such as interest rates, consumer sentiment, income and the share market index to identify housing bubbles, the main drivers of house prices, house price spillover and associated macroeconomic relationships. The findings will contribute to a better understanding of the two largest housing markets in China's and Australia's national housing markets and in their major regional housing markets.

This research also proposed and demonstrated an enhanced framework for detecting real estate bubbles, by investigating distinct features of house price dynamics, incorporating econometric methodologies, such as the Granger causality test, and general impulse response analysis, the variance decomposition method, VECM, OLS, and principal component methods. Chief distinctive features are represented by calculating the aggregated China's main 13 cities' house price, using the principal component method in *Eviews*. The econometric test was then conducted from both correlational and causal aspects. These lead to multidimensional analysis, rather than a redefinition of a single dimensional analysis. This results in a better understanding of house price performance over different important phases of housing cycles. These macroeconomic variables are better proxies than classical demand,

and supply fundamental factors, which are proven to denote stronger estimation outcomes. These in-depth tests allow further refinement of house price models, improving model fit and robustness and adding extensions to existing empirical methods for predicting house prices.

By evaluating the role of changes in macroeconomic conditions (such as the interest rate, per capita income, employment, and share market performance), the econometric method presented provides an effective control mechanism for assessing house price dynamics, and this is thereby expected to significantly reduce the probability of false identification, while facilitating definite conclusions about bubble existence and house price dynamics.

With regard to the objective of estimating house price dynamics in 13 major regional cities in China, the author encountered a number of barriers, specifically the lack of reliable data concerning regional macroeconomic variables. Thus, it is suggested that a larger dataset be used to evaluate the situation in China, preferably covering a longer period than that examined in this thesis. Extending the time frame would improve the accuracy and reliability of the findings obtained. However, considering the transparency and availability of the data applied when performing an econometric test of the Australian housing market, the conclusion associated with the test results meant it was possible to meet potential challenges, such as data credibility, reliability and comparability.

The empirical results attained provide new insights, evaluating economic policies and assessing prospective economic activity. These findings are especially relevant to policy makers, because they highlight how the economic benefits of house price growth can be channeled into growth in the construction sector, as the health of financial institutions and other industries is associated with property. This transmission channel is governed by the management of significant economic policies, such as monetary policy. Additionally, the study raises awareness that monetary policy can be a blunt instrument when employed to manage the country's financial stability. It is necessary to design a balanced and

complementary combination of financial policies and embark on monetary policy decision making that will improve the country's financial health overall. Key policy implications

presented in this research, include the need for governmental affordability programs, especially for young people and first-time homeowners.

In addition, concern is raised in using monetary policy and fiscal policy managing housing market performance. Conventional monetary policy may cover symptoms rather than addressing causes, and potentially even escalating imbalances. A policy response which over-focuses on narrow financial levers, and not sufficiently on the institutional or broader environmental drivers, risks exacerbating rather than reducing stability concerns. The right policies will help rebalance the housing market in a sustainable way, not just over an electoral or economic cycle while minimizing the emerging division between those in the lane of home ownership with those who feel stuck in the other lane. This research adds concrete implications to assist household purchase decisions, business institutional decision making process, strategic planning and government policy making decisions.

Furthermore, given the significance of the regional perspective in the data, regional affordability programs and housing policies are suggested to compensate for regional variations in house price dynamics. The theoretical contribution on spillover effect analysis have large implications on regional household purchase decisions, developing regional economic development policies and long term economic resilience outcome.

Future research might usefully assess a broad range of supply factors, to establish the extent to which they correspond with the country's urban economic policies. Further analysis of the effects of the recent boom in apartment construction in Australia might also consider the significance of demographics, specifically the aging Australian population. An additional dimension to explore might relate to the possibility of an empirical investigation regarding tests for bubbles, employing real time methods. Comparative studies with other countries are

also suggested as potentially beneficial, to encourage the sharing of experiences and to test the implementation of apposite policies.

APPENDIX 1 ABBREVIATIONS

1	AUSHARE	Australian S&P/ASX 200 stock market index
2	AWE	Average weekly earning
3	BAWE	QLD average weekly earnings
4	BGDP	QLD gross value added
5	BJP	Beijing house price
6	BUNEMPLOY	OLD unemployment rate
7	CNGDP	Gross domestic product (China)
8	CNIR	Mortgage interest rate (China)
9	CNP	China house prices (using principal component methods based on top 13 largest cities)
10	CNSHARE	China Shanghai composite stock market index
11	CNUNEMPLOY	Unemployment rate (China)
12	CQP	Chongqing house price
13	CS	Consumer sentiment (Australia)
14	D408	Quarter 4, 2008 \, dummy variables indicates GFC
15	FIRSTP	House price in first tier housing market in China
16	HP	CoreLogic Home Value Hedonic Index series
17	IR	Mortgage interest rate (Australia)
18	MAWE	VIC Average weekly earnings
19	MGDP	VIC Gross value added

20	MHP	CoreLogic Home Value Hedonic Index Series (Melbourne)
21	MINING	Mining index (Australia)
22	MRY	VIC Rental yield
23	MUNEMPLOY	VIC Unemployment rate
24	NBP	Ningbo house price
25	NJP	Nanjing house price
26	PAWE	WA Average weekly earning
27	PHP	CoreLogic Home Value Hedonic Index series (Perth)
28	PGDP	WA Gross value added
29	PUNEMPLOY	WA Unemployment rate
30	SAWE	NSW Average weekly earning
31	SECONDP	House price in second – tier (top 8 cities) housing markets in China
32	SGDP	NSW Gross value added
33	SHP	CoreLogic Home Value Hedonic Index series (Sydney)
34	SUNEMPLOY	NSW Unemployment rate
35	SAWE	NSW Average weekly earning
36	SECONDP	House price in second – tier (top 8 cities) housing markets in China

REFERENCES

Abelson, P., Joyeux, R., Milunovich, G. and Chung, D. (2005). Explaining house prices in Australia: 1970– 2003. *Economic Record*, 81(255), 96 - 103.Doi: 10.1111/j.1475-4932.2005.00243.x

Abelson, P. & Joyeux, R. (2007). Price and efficiency effects of taxes and subsidies for Australian Housing. *The Economic Society of Australia*, 26(2), 147-169. Doi: 10.1111/j.1759-3441.2007.tb01013.x

Abraham, J.M. and Hendershott, P.H. (1995). Bubbles in metropolitan housing markets. *Journal of Housing Research,* 7(2), 191-207.

ABS. (2017a). 5220.0 - Australian National Accounts: State Accounts. Retrieved from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5220.02014-15?OpenDocument

ABS. (2017b). 3101.0 Australian Demographic Statistics. Retrieved from http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0

Adams, Z. and Füss, R. (2010). Macroeconomic determinants of international housing markets. *Journal of Housing Economics*, 19 (1), 38–50, https://doi.org/10.1016/j.jhe.2009.10.005

Alexander, C. and Barrow, M. (1994). Seasonality and co-integration of regional house prices in the UK. *Urban Studies*, 31(10), 1667–1689.

Andrews, D. (2010). *Real house prices in OECD countries: the role of demand shocks and structural and policy factors.* (Report No. 831). Paris, France: OECD Economics Department Working Paper.

Apergis, N. and Rezitis, A. (2003). An examination of Okun's law: evidence from regional areas in Greece. *Applied Economics*, 35(10),1147–1151. DOI: 10.1080/0003684032000066787

Apergis, N. and Rezitis, A. (2003). Housing prices and macroeconomic factors in Greece: prospects within the EMU. *Applied Economics Letters*, 10(9), 561 – 565. DOI: 10.1080/1350485032000100260

Applied Economics and Travers Morgan. (1991) *Determinants of the prices of established housing.* Housing Cost Study, Volume 3. Canberra, Australia: Australian Building Research Grants Scheme.

Arku, G. and Harris, R. (2005). Housing as a tool of economic development since 1929. *International Journal of Urban and Regional Research*, 29(4), 895 – 915.DOI: 10.1111/j.1468-2427.2005.00627.x

Aron, J. and Muellbauer, J. (2010). *Modelling and forecasting UK mortgage arrears and possessions.* (Report No. DP7986). London, UK: *CEPR Discussion Paper.*

ASIC's Money Smart. (2017). Self-managed super fund. Retrieved from https://www.moneysmart.gov.au/superannuation-and-retirement/self-managed-super-fund-smsf

Assenmacher-Wesche, K. and Gerlach, G. (2008). Can monetary policy really be used to stabilize asset prices? Retrieved from http://voxeu.org/article/why-monetary-policy-cannot-stabilise-asset-prices

ATO. (2016). Capital gain. Retrieved from https://www.ato.gov.au/general/capital-gains-tax/

Australian Housing and Urban Research Bulletin (2004), *Housing futures in an ageing Australia*, 43, ISSN 1445-3428.

Baffoe-Bonnie, J. (1998). The dynamic impact of macroeconomic aggregates on housing prices and stock of houses: a national and regional analysis. *Journal of Real Estate Finance and Economics*, 17(2), 179- 97.

Battellino, R. (2010). Twenty years of economic growth, address to Moreton Bay regional council, RBA in speeches. Retrieved from http://www.rba.gov.au/speeches/2010/sp-dg-200810.html

Berry, M. and Dalton, T. (2004). Housing prices and policy dilemmas: a peculiarly Australian problem? *Urban Policy and Research*, 22(1), 69-91. DOI:10.1080/0811114042000185509

Blanchflower, D.G. and Oswald, A.J. (2013). *Does high home-ownership impair the labour market?* (Report No. 19079). Cambridge, UK: NBER working paper. (DOI):10.3386/w19079

Bleby, M. (2015, May 28). Property now Australia's biggest industry, Property Council says. *Australian Financial Review*. p39.

Bodman, P.and Crosby, M. (2004). Can macroeconomic factors explain high house prices in Australia? *Australian Property Journal*, 38(3), 175–179.

Bourassa, S. C. and Hendershott, P.H. (1995). Australian capital city real housing prices, 1979–1993. *The Australian Economic Review*, 111(3), 16–26. DOI: 10.1111/j.1467-8462.1995.tb00990.x

Canavan, G. (2017). Why Australia's housing bubble will only get worse. Retrieved from https://www.marketsandmoney.com.au/why-australias-housing-bubble-will-only-get-worse/2017/03/07/

Case, K. E. and Shiller, R. J. (1987). The efficiency of the market for single-family homes. *American Economic Review*, 79(1), 125-137.

Case, K. E. and Shiller, R.J. (1990). Forecasting prices and excess returns in the housing market. *American Real Estate and Urban Economics Association Journal*, 18(3), 253-273.DOI: 10.1111/1540-6229.00521

Case, K.E. (2000). *Real estate and the macro-economy. Brookings Papers on Economic Activity*. (Report No. 2). Retrieved from: https://www.brookings.edu/bpea-articles/real-estate-and-the-macroeconomy/

Case, K.E. and Shiller, R.J. (2004). *Is there a bubble in the housing market?* (Report No. 1089). Yale University, US: Cowles Foundation for Research in Economics.

Chan, H.L., Lee, S.K., and Woo, K.Y. (2001). Detecting rational bubbles in the residential housing markets of Hong Kong. *Economic Modelling*, 18 (1), 61-73. DOI: 10.1016/S0264-9993(00)00030-4

Chen, P. F., Chien, M. S. and Lee C. C. (2011). Dynamic modelling of regional house price diffusion in Taiwan. *Journal of Housing Economics,* 20(4), 315–332. DOI: 10.1016/j.jhe.2011.09.002

Chernomas, R. and Hudson, I. (2017). *The Profit Doctrine, Economists of the Neoliberal Era* . London, UK: Pluto Press.

Chittenden, P. (2013, March 28). Asian investors keen on Australian inner-city units. Retrieved from http://www.propertyobserver.com.au/forward-planning/investment-strategy/economy-and-demographics/20342-cny-peter-chittenden.html

Cho, D. and Ma, S. (2006). Dynamic relationship between housing values and interest rates in the Korean housing market. *Journal of Real Estate Finance and Economics,* 32(2), 169-184.DOI: 10.1007/s11146-006-6013-6

Clapp, J. M. and Tirtiroglu, D. (1994). Positive feedback trading and diffusion of asset price changes: evidence from housing transactions. *Journal of Economic Behaviour and Organization,* 24(3), 337–355. DOI**:** 10.1016/0167-2681(94)90040-X

Clarke, A. (2015). *See how the one-child policy changed China*. US: National Geographic. Retrieved from http://news.nationalgeographic.com/2015/11/151113-datapoints-china-one-child-policy/

Cook, S. (2003) The convergence of regional house prices in the UK, *Urban Studies*, 40, 2285–2294. DOI**:** 10.1080/0042098032000123295

Cook, S. (2005). Regional house price behaviour in the UK: application of a joint testing procedure. *Physica A: Statistical Mechanics and its Applications*, 345(3-4), 611–621. DOI: 10.1016/j.physa.2004.07.031

Cooper, A. and Cowling, A. (2015). *China's property section.* RBA Bulletin, Mar 2015.

CoreLogic. (2016). CoreLogic housing and economic update Nov 2016. Retrieved from: https://www.corelogic.com.au/reports/chart-pack.html

Croucher, J.S. (2017). *Quantitative Analysis for Management* (4e). Sydney, Australia: McGraw-Hill.

Davis, M. and Heathcote, J. (2003). *Housing and the business cycle*. US: Federal Reserve publication. Retrieved from https://www.federalreserve.gov/pubs/feds/2004/200411/200411pap.pdf

Delmendo, L.C. (2016). Australia's housing market weakens. retrieved from http://www.globalpropertyguide.com/Pacific/Australia/Price-History

Diamond, D.B. and Lea, M.J. (1992). Housing finance in developed countries: an international comparison of efficiency. *Journal of Housing Research,* 3(1). Special issue.

Diba, B. T. and Grossman, H. I. (1988). Explosive rational bubbles in stock prices? *The American Economic Review*, 78 (3), 520 - 530.

Diebold, F.X. and Yilmaz, K. (2012). Better to give than to receive: forecast-based measurement of volatility spillovers. *International Journal of Forecasting*, 28(1), 57-66.

https://doi.org/10.1016/j.ijforecast.2011.02.006

Donald Jud, G. & Winkler, D.T. (2003). The Q theory of housing investment. *Journal of Real Estate Finance and Economics*, 27(3), 379–392. https://doi.org/10.1023/A:1025846309114

Drake, L. (1995). Testing for convergence between UK regional house prices. *Regional Studies,* 29(4), 357–366.DOI: 10.1080/00343409512331349023

Engle, R.F. and Granger, C.W.J. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica*, 55(2), 251-276.DOI: 10.2307/1913236

Englund, P. and Ioannides, Y.M. (1997). House price dynamics: an international empirical perspective. *Journal of Housing Economics*, 6 (2), 119–136.DOI: 10.1006/jhec.1997.0210

Fernández-Kranz, D., and Hon, M. T. (2006). A cross-section analysis of the income elasticity of housing demand in Spain: is there a real estate bubble? *The Journal of Real Estate Finance and Economics*, 32 (4), 449 - 470. DOI: 10.1007/s11146-006-6962-9

Fereidouni, H. G., Al-Mulali, U., Lee, J. Y. M. and Mohammed, A. H. (2014). Dynamic relationship between house prices in Malaysia's major economic regions and Singapore house prices. *Regional Studies*, 50(4), 657-670.DOI: 10.1080/00343404.2014.928408

Foreign Investment Review Board. (2017). FIRB Annual Report, 2013. Retrieved from http://firb.gov.au/about/publication/

Flood, R. P. and Hodrick, R. J. (1986). Asset price volatility, bubbles, and process switching. *The Journal of Finance*, 41(4), 831-842. DOI: 10.1111/j.1540-6261.1986.tb04551.x

Flood, R.P. and Hodrick, R. (1990). On testing for speculative bubbles. *Journal of Economic Perspectives*, 4(2), 85–101 DOI: 10.1257/jep.4.2.85303

Frost, R and Lim, W. (2013, July 13). China Stocks World's Worst Losing $748 Billion on Slump. Bloomberg, Retrieved from http://www.bloomberg.com/news/2013-07-30/china-stocks-world-s-worst- losing-748-billion-on-slump.html

Giussani, B. and Hadjimatheou, G. (1991). Modelling regional house prices in the United Kingdom. *Papers in Regional Science*, 70(2), 201–219.DOI: 10.1111/j.1435-5597.1991.tb01728.x

Glaeser, E.L. and Nathanson, C.G. (2014). *Housing bubbles* (Report No. 20426). Cambridge, UK: National Bureau of Economic Research.

Goodhart, C. and Hofmann, B. (2008). House prices, money, credit and the macro-economy. *Oxford Review of Economic Policy*, 24 (1), 180-205.

Gordon, I. (1990). South divide in: J. Ermisch (Ed). *Housing and labour market constraints on migration across the North* (pp 75-89). Housing and the National Economy, Aldershot & Avebury.

Green, R. K. and Wachter, S. M. (2005). The American mortgage in historical and international context. *Journal of Economic Perspectives*, 19(4), 93-114. DOI: 10.1257/089533005775196660

Guillaume, R.B. & Guillaume, J. (Dec 2009). *Urbanization and real estate investment in China*. France: IFRI Centre. Retrieved from https://www.ifri.org/sites/default/files/atoms/files/av22rougierjeannetgb.pdf

Gujarati, Damodar N.; Porter, Dawn C. (2009). *Basic Econometrics* (Fifth ed.). New York: McGraw- Hill Irwin. pp. 692–698. ISBN 978-0-07-337577-9.

Gupta R. and Miller S. M. (2012) The time-series properties of house prices: a case study of the Southern California market, *Journal of Real Estate Finance and Economics* 144, 339–361. DOI: 10.1007/s11146-010-9234-7

Harley, R. (2016, Nov 19). The Australian financial review's Rob Harley: lessons from a life in property. *Australian Financial Review.* Retrieved from http://www.afr.com/real-estate/the-australian-financial-reviews-rob-harley-lessons-from-a-life-in-property-20161114-gsowu5

Hatzvi, E. and Otto, G. (2008). Prices, rents and rational speculative bubbles in the Sydney Housing Market. *Economic Record*, 84(267), 405-420. DOI: 10.1111/j.1475-4932.2008.00484.x

Hilbers, P., Hoffmaister, A.W., Banerji, A. and Shi, H. (2008). *House price developments in Europe: a comparison.* (Report No. WP/08/211). International Monetary Fund Working Paper.

Holly, S., Pesaran, M.H. and Yamagata, T. (2011). The spatial and temporal diffusion of house prices in the UK. *Journal of Urban Economics,* 69(1), 2–23. DOI: 10.1016/j.jue.2010.08.002

Holmans, A. (1990). *House prices: changes through time at national and sub-national level*. (Report No. 110). UK: Government Economic Service Working Paper, Issue 110.

Holmes, M. J. (2007). How convergent are regional house prices in the United Kingdom? Some new evidence from panel data unit root testing. *Journal of Economic and Social Research*, 9(1), 1-17.

Holmes, M.J. and Grimes, A. (2008). Is there long-run convergence among regional house prices in the UK? *Urban Studies*, 45(8), 1531–1544.DOI: 10.1177/0042098008091489

Hou, Y. Z. (2010). Housing price bubbles in Beijing and Shanghai? a multi-indicator analysis. *International Journal of Housing Markets and Analysis*, 3(1), 17-37. DOI: 10.1108/17538271011027050

Hui, E. and Yue, S. (2006). Housing price bubbles in Hong Kong, Beijing and Shanghai: A comparative Study. *Journal of Real Estate Finance and Economics*, 33(4), 299-327.DOI: 10.1007/s11146-006-0335-2

Hui, E.C.M., Liang, C., Wang, Z.Y., Song, B.T. and Gu.Q. (2012). Real estate bubbles in China: a tale of two cities. *Construction Management and Economics,* 30(11), 951–961.DOI: 10.1080/01446193.2012.739369

Hui, H. C. (2010). House price diffusions across three urban areas in Malaysia. *International Journal of Housing Markets and Analysis,* 3(4), 369–379. DOI: 10.1108/17538271011080664

IHS Global Inc. (2014). *Eviews 8 User Guide*. CA, US: IHS Global Inc.

Iacoviello, M. and Neri, S. (2010). Housing market spillovers: evidence from an estimated DSGE Model. American Economic Journal, Macroeconomics, 2(2), 125-64. 305

Juselius, K. (2006) The Co-integrated VAR Model: Methodology and Applications. Oxford University Press, New York, NY.

Kuethe T. H and Pede V. O. (2011) Regional housing price cycles: a spatio-temporal analysis using U.S. state level data, *Regional Studies* 45, 563–574. DOI: 10.1080/00343400903497897

Lean, H. H. and Smyth, R. (2013). Regional house prices and the ripple effect in Malaysia*, Urban Studies*, 50(5), 895–922. DOI: 10.1177/0042098012459582

Li, J.H. (2013, Oct 10). Why China's property market isn't in a bubble? Retrieved from http://www.marketwatch.com/story/why-chinas-housing-market-isnt-in-a-bubble-2013-10-10

Mccarthy, N. (2014, Dec 5). China used more concrete in three years than the U.S. used in the entire 20th century. Retrieved from https://www.forbes.com/sites/niallmccarthy/

Käfer, B. (2014). The taylor rule and financial stability – a literature review with application for the Eurozone. *Review of Economics*, 65(2),159 -192.

Karaganis, A.N. (2011). Seasonal and spatial hedonic price indices. *Journal of Property Investment & Finance*, 29(3), 297-311.DOI: 10.1080/14616710110091561

Kasparova, D. and White, M. (2001). The responsiveness of house prices to macroeconomic forces: a cross-country comparison. *European Journal of Housing Policy,* 1(3), 385–416. DOI: 10.1080/14616710110091561 DOI: 10.1080/14616710110091561

Kearl, J. R. (1979). Inflation, mortgages, and housing. *Journal of Political Economy*, 87(5), 1115-38.

Kearns, J. (2012). The outlook for dwelling investment. Address to the Australian business economists' lunchtime briefing, RBA. Retrieved from http://www.rba.gov.au/speeches/2012/sp-so-131112.html

Kehoe, J. (2016, Oct 9). No more RBA interest cut. *Australian Financial Review.* Retrieved from http://www.afr.com/news/scott-morrison-no-more-rba-interest-rate-cuts-20161008-gry2ar

Kenneth, R. (2011). China's housing bubble past, and its future. Retrieved from http://www.forbes.com/sites/kenrapoza/2011/11/08/chinas-housing- bubble-past-and-its-future.

Kim, K.H. (2013). China home prices hit fresh records in challenge to government reform plans. *Reuters*, Retrieved 17 Dec 2013 from http://www.reuters.com/article/2013/11/18/us-china-property-prices- idUSBRE9AH02P20131118

Kim, K.H. and Suh, S.H. (1993). Speculation and price bubbles in the Korean and Japanese real estate markets. *Journal of Real Estate Finance and Economics*, 6(1), 73-87.DOI: 10.1007/BF01098429

King, L. (1984). *Central place theory.* Beverly Hills: Sage.

Knight, E. (2017, Jan 3). Australia's new five speed property market. *Sydney Morning Herald*. Retrieved from http://www.smh.com.au/business/the-economy/australias-new-five-speed-property-market-20170103-gtl4y0.html

Koblyakova, A., Hutchison, N. and Tiwari, P. (2014). Regional differences in mortgage demand and mortgage instrument choice in the UK. *Regional Studies*, 48(9), 1499-1513.DOI: 10.1080/00343404.2012.750426

Koblyakova, A. and White, M. (2016). Supply driven mortgage choice. *Urban Studies*, 54(5), 1194–1210.

Kohler, M. and Merwe, M.V.D. (2015). *Long-run trends in housing price growth.* RBA Bulletin, Sep 2015.

Leamer, E.E. (1983). Let’s take the con out of econometrics. *American Economic Review*, 73(4), 31-43.

Lean, H.H. and Smyth, R. (2013). Regional house prices and the ripple effect in Malaysia. *Urban Studies*, 50(5), 895–922. DOI: 10.1177/0042098012459582

Legalaid. (2017). Your home and the age pension. Retrieved from: http://www.legalaid.nsw.gov.au/publications/factsheets-and-resources/your-home-and-the-age-pension307

Levin, E.J.and R.E. Wright.(1997).Speculation in the Housing Market.*Urban Studies*, 34:1419–1437.

Leung, C. (2004). Macroeconomics and housing: a review of the literature. *Journal of Housing Economics,* 13(4), 249-267. DOI: 10.1016/j.jhe.2004.09.002

Looney, K. and Rithmire, M. (2016). *Urbanization with Chinese characteristics? China's gamble for modernization.* (Report No.16-083). US: Harvard Business School.

Lu, X and White, H. (2014). Robustness checks and robustness tests in applied economics. Retrieved from https://ideas.repec.org/a/eee/econom/v178y2014ip1p194-206.html

Luo, Z.Q., Liu, C.L., and Picken, D. (2007). Housing price diffusion pattern of Australia's state capital cities. *International Journal of Strategic Property Management*, 11(4), 227-242. http://dx.doi.org/10.1080/1648715X.2007.9637571

Ma, L. and Liu, C.L. (2013). A panel error correction approach to explore spatial correlation patterns of the dominant housing market in Australian capital cities, *International Journal of Housing Markets and Analysis*, 6(4), 405 – 421.DOI: 10.1108/IJHMA-03-2013-0021

Macdonald, R. and Taylor, M.P. (1993). Regional house prices in Britain: long-run relationships and short- run dynamics. *Scottish Journal of Political Economy*, 40(1), 43-55.DOI: 10.1111/j.1467-9485.1993.tb00636.x

Macrobusiness. (2017). Australian property bubble on a scale like no other. Retrieved from https://www.macrobusiness.com.au/2016/10/australian-property-bubble-scale-like-no/

Madsen, J.B. (2012). A behavioural model of house prices. *Journal of Economic Behaviour & Organization,* 82(1), 21-38. https://doi.org/10.1016/j.jebo.2011.12.010

Maisel S.J., Burnham J.B., and Austin J.S. (1971) The demand for housing, *Review of Economics and Statistics*, Vol. 53, pp. 410–413.

Manchester, J. (1987). Inflation and housing demand: A new perspective. *Journal of Urban Economic Literature*, 21(1), 105-125. DOI: 10.1016/0094-1190(87)90025-8

Mankiw, N.G. and Weil, B.N. (1989). The baby boom, the baby bust, and the housing market. *Regional Science and Urban Economics*, 21(4), 547-552.DOI: 10.1016/0166-0462(89)90005-7

Meen, G. (1996). Spatial aggregation, spatial dependence and predictability in the UK housing market. *Housing Studies*, 11(3), 345 – 372, DOI: 10.1080/02673039608720862

Meen, G. (1996). Ten propositions in UK housing macroeconomics: an overview of the eighties and early nineties. *Urban Studies*, 33(3), 425 - 444. DOI: 10.1080/00420989650011843.

Meen, G. (1999). Regional house prices and the ripple effect: a new interpretation. *Housing Studies,* 14(6), 733-753*,* DOI: 10.1080/02673039982524

Mikhed, V. and Zemcik, P. (2009). Testing for bubbles in housing markets: A panel data approach, *Journal of Real Estate Financial Economics*, 38(4), 366-386. DOI: 10.1007/s11146-007-9090-2

Miles, D. (1993). House prices, personal sector wealth and consumption: some conceptual and empirical issues. *The Manchester School of Economic and Social Studies,* 61(0), 35-59.DOI: 10.1111/j.1467-9957.1993.tb01466.x

Muellbauer, J. and Murphy, A. (1994). *Explaining regional house prices in the UK.* (Report Paper. 94/21). Dublin: University College Dublin, Department of Economics.

Muth, J.F. (1961). Rational expectations and the theory of price movements, *Econometricia*, 29(3)

Nanda, A. and Tiwari, P. (2013). *Sectoral and spatial spillover effects of infrastructure investment: a case study of Bengaluru, India.* UK: Royal Institution of Chartered Surveyors.

Needham, K. (2019, May 9). Chinese buying Australia real estate tops foreign investment, report says. *Sydney Morning Herald online.* Retrieved from http://www.smh.com.au/national/chinese-buying-australian-real-estate-tops-foreign-investment-report-says-20170509-gw0t9v.html

Odland, J.D. (1988). *Spatial autocorrelation*. New York, US: Sage Publications.

Oikarinen, E. (2008). *Empirical application of the housing market no-arbitrage condition: problems, solutions and a Finnish case study.* (Report Paper. 39). Turku, Finland: Aboa Centre for Economics Discussion.

Oikarinen, E. (2004). The diffusion of housing price movements from centre to surrounding areas. *Journal of Housing Research*, 15(1), 3–28. https://doi.org/10.5555/jhor.15.1.7w1528476k7nu4j5

Okunev, J., Wilson, P. & Zurbruegg, R (2000). The causal relationship between real estate and stock markets. *The Journal of Real Estate Finance and Economics,* 21(251) , DOI: 10.1023/A:1012051719424

Otto, G. (2007). The growth of house prices in Australian capital cities: what do economic fundamentals explain? *Australian Economic Review*, 40(3), 225-238. DOI: 10.1111/j.1467-8462.2007.00453.x

Panagiotidis, T. and Printzis, P. (2015). *On the macroeconomic determinants of the housing market in Greece: a VECM approach*. (Report No. 88). London, UK: Hellenic Observatory Europe Institute.

Peng, R. and Hudson-Wilson, S. (2002). *Testing real estate price bubbles: an application to Tokyo office market*. Proceedings of 7th AsRES Conference in Seoul.

Peterson W., Holly S. and Gaudoin P. (2002) *Further Work on an Economic Model of the Demand for Social Housing.* Report to the Department of the Environment, Transport and the Regions, London.

Piesse, E. (2017, Mar 21). WA housing prices to fall as oversupply hits. *ABC News.* Retrieved from http://www.abc.net.au/news/2017-03-21/wa-housing-prices-to-fall-as-oversupply-hits-state/8373564

Pollakowski, Henry O. and Traci S. Ray. (1997). Housing price diffusion patterns at different aggregation levels: an examination of housing market efficiency. *Journal of Housing Research*, 8(1), 107-24.

Quan, Z.X. (1991). Urbanisation and health in China. *Urban Studies*. 28(1)

Rahman, M.M. (2008). Australian housing market: causes and effects of rising price. (Unpublished PhD Thesis). University of Southern Queensland, Australia. Retrieved from https://student.unsw.edu.au/citing-different-sources-apa-referencing

Rapoza, K. (2013). China real estate lending tops $2.3 trillion, Forbes. Retrieved from http://www.forbes.com/sites/kenrapoza/2013/10/24/china-real-estate- lending-tops-2-3-trillion/ 310

Richards, A. (2009). Conditions and prospects in the housing sector, Address to the 4th Annual Housing Congress, RBA. Retrieved from http://www.rba.gov.au/speeches/2009/sp-so-260309.html

Richards, T. (2009). Housing market developments. Talk to CEDA Housing Forum: A National Round-up, RBA. Retrieved from https://www.rba.gov.au/publications/bulletin/2009/oct/pdf/bu-1009-4.pdf

Peters, J. (2013). HIA - Cordell construction outlook breakfast. Retrieved from http://economics.hia.com.au/media/Construction%20Outlook%20Sydney% 202013.pdf

Phillips, P.C.B., Shi, S.P. and Yu, J. (2013). *Testing for multiple bubbles 1: historical episodes of exuberance and collapse in the S&P 500.* Research Collection School of Economics.

Pillaiyan, S. (2015). Macroeconomic drivers of house prices in Malaysia. *Canadian Social Science*, 11(9), 119-130.

Pigou, A.C. (1930). The statistical derivation of demand curves. *The Economic Journal*, 40(159), 384–400. DOI: 10.2307/2224431

RBA. (2012). Supply - side issues in the housing sector. RBA Sep 2012 Bulletin, Retrieved from http://www.rba.gov.au/publications/bulletin/2012/sep/2.html

RBA. (2013). Financial Stability Review Sep 13. Retrieved from http://www.rba.gov.au/publications/fsr/

Real Estate Institute of Australia. (2010). Australian house prices: bursting the bubble myth. Retrieved from: http://www.wealthwithin.com.au/news-media/articles/australian-house-prices--bursting-the-bubble-myth/

Sargent, T, J. (2013). *Rational expectations and inflation (3e)*. US: Princeton University Press.

Schnure, C. (2005). *Boom-bust cycles in housing: the changing role of financial structure.* (Report No. 05/200). Washington DC, US: International Monetary Fund. 311

Shappard, D.D. (2013). Will SMSFs cause a property market bubble? Retrieved from http://www.fool.com.au/2013/10/02/will-smsfs-cause-a-property- market-bubble/

Shi, S.P. (2016). *Speculative bubbles or market fundamentals? an investigation of US regional housing markets.* (Report No. 46/2016). Canberra, Australia: Centre for Applied Macroeconomic Working Paper, Australian National University.

Shih, Y.N., Li, H.C. and Qin, B. (2014). Housing price bubbles and inter-provincial spillover: evidence from China. *Habitat International*. 43, 142-151. DOI: 10.1016/j.habitatint.2014.02.008

Shiller, R.J. (2000). *Irrational Exuberance*. Princeton: Princeton University Press.

Siegel, J. J. and Thaler, R. H. (1997). The equity premium puzzle. *Journal of Economic Perspectives,* 11(1), 191–200.

Sivitanidou, R.M. (2011). Market analysis for real estate (unpublished manuscript). Copyright 2011 by Petros Sivitanides, US: University of Southern California.

Smith, B.A. and Tesarek, W.P. (1991). House prices and regional real estate cycles: market adjustments in Houston. *Real Estate Economics*, 19(3), 396-416.DOI: 10.1111/1540-6229.00559

Stein, J.C. (1995). Prices and trading volume in the housing market: a model with down payment effects. *Quarterly Journal of Economics*, 110(2), 379-405.

Stevenson, S. (2004). House price diffusion and inter-regional and cross-border house price dynamics. *Journal of Property Research*, 21(4), 301-320.

Stevenson, S (2008). Modeling housing market fundamentals: empirical evidence of extreme market conditions. *Real Estate Economics*, 36(1), 1-29. DOI: 10.1111/j.1540-6229.2008.00204.x

Stiglitz, J.E. (1990). Symposium on bubbles. *The Journal of Economic Perspectives*, 4(2), 13-18. DOI: 10.1257/jep.4.2.13

Tan, S.L. (2016, Dec 30). New foreign land tax surcharge to hit on January 1. *Australian Financial Review*. Retrieved from http://www.afr.com/real-estate/new-foreign-land-tax-surcharge-to-hit-on-january-1-20161230-gtjqv4

Tang, Z.J., Xu, H.J. and Ba, S.S. (2010). Impact of the real estate fluctuations on the China's macroeconomics. *Statistical Research,* 2, 15–22.

Teng, H.J., Chang, C.O. and Chau, K.W. (2013). Housing bubbles: a tale of two cities. *Habitat International,* 39(3), 8-15. https://doi.org/10.1016/j.habitatint.2012.10.009

Thistleton, R. and Lenaghan, N. (2013, Nov 16-17). Asian investors push up CBD land prices. *The Australian Financial Review*. Retrieved from http://www.afr.com/real-estate/commercial/asian-investors-push-up-cbd-land-prices-20131115-iyus7

Henckel, T. (2017, Apr 3). Housing bubbles: What economics has to say about the 'b' word. *Australian Financial Review.* Retrieved from http://www.abc.net.au/news/2017-04-03/housing-bubbles-what-economics-has-to-say/8410606

Tsai, I.C. (2015). Spillover effect between the regional and the national housing markets in the UK. *Regional Studies*, 49(12), 1957-1976.DOI: 10.1080/00343404.2014.883599

Tsatsaronis, K. and Zhu, H.B. (2004). What drives housing price dynamics: cross country evidence? *BIS Quarterly Review*, Available at SSRN: https://ssrn.com/abstract=1968425

Tsolacos, S., Kim, K.M. and Peng, R. (2009). Panel modelling of retail yields in Asia-Pacific cities. *Journal of Property Investment & Finance*, 27(3), 224-237. DOI: 10.1108/14635780910951948

Tu, Y. (2000). Segmentation of Australian housing markets: 1989-98. *Journal of Property Research*, 17(4), 311-327.DOI: 10.1080/09599910010001420

Valentine, T., Croucher, J. S. and Wang, J. (2015). Is there a Chinese property splurge? *Australia and New Zealand Property Journa*l, 2, 54-57.

Valentine, T. and Garrow, N. (2013). *Economic Context of Management* (2e). Sydney, Australia: Pearson.

Vansteenkiste, I. and Hiebert, P. (2011). Do house price developments spillover across Euro area countries? Evidence from a global VAR. *Journal of Housing Economics*, 20(4), 299–314. DOI: 10.1016/j.jhe.2011.08.003

Wang, J.Q. and Xie, D.J. (2012). Empirical analysis of housing prices in Chinese Market. *International Journal of Trade, Economics and Finance,* 3(5), 388-392, DOI: 10.7763/IJTEF.2012.V3.233

Westpac economics. (2010). Australian housing: the bubble myth. Retrieved from http://www.r4propertygroup.com.au/userfiles/file/AustralilanHousing_October2010.pdf

Which Real Estate. (2013). Oct 2013 Property Market Update. Retrieved from http://whichrealestateagent.com.au/australian-property-market-weekly-update-9-october-2013/

Williams, S. (2017). Affordable housing providers 'not being used to their full capacity', report says. Retrieved from https://www.domain.com.au/news/affordable-housing-providers-not-being-used-to-their-full-capacity-report-says-20170420-gvop89/

Wilson, P.J., Okunev, J. and Zurbruegg, R. (2002). Relationships between Australian real estate and stock market prices — a case of market inefficiency. *Journal of Forecasting,* 21(3), 181–192.DOI: 10.1002/for.825

Wooldridge, J. M. (2012). *Introductory econometrics: a modern approach (5e)*. South-Western, Mason, USA: Cengage learning.

Worldometers. (2017). China population. Retrieved from http://www.worldometers.info/world-population/china-population/

Xiao, S. and Lundstrom, S. (2010). Is there a bubble in China's housing market? Retrieved from https://www.kth.se/polopoly_fs/1.127757!/Menu/general/column-content/attachment/31.pdf

Yates, J. (2002). Housing implications of social, spatial and structural change. *Housing Studies*, 17(4), 581–618. DOI: 10.1080/02673030220144367

Yu, H. and Huang, Y.F. (2016). Regional heterogeneity and the trans-regional interaction of housing prices and inflation: Evidence from China's 35 major cities. *Urban Studies*, 53(16), 3472–3492. 314

Zhang, H., Li, L.J., Hui, E.C.M. and Li, V. (2016). Comparisons of the relations between housing prices and the macro-economy in China's first-, second- and third-tier cities. *Habitat International,* 57, 24-42. http://dx.doi.org/10.1016/j.habitatint.2016.06.008

Zhu, H.B. (2003). *The importance of property markets for monetary policy and financial stability*. Washington DC, US: Conference Paper, IMF-BIS conference.