House Price Appreciation and Housing Policy: A Study of Housing Affordability and Tenure Choice in China

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List of Abbreviations

ABC	The Agriculture Bank of China
ARMs	Adjustable Rate Mortgages
BOC	The Bank of China
CBRC	China Banking Regulatory Commission
CCB	China Construction Bank
CHFS	China Household Finance Survey
CBRC	China Banking Regulatory Commission
ECH	Economical and Comfortable Housing
GFC	Global Financial Crisis
GMM	Generalised Method of Moments
HPF	Housing Provident Fund
ICBC	The Industrial and Commercial Bank of China
LTV	Loan to Value Ratio
LIML	Limited-Information Maximum Likelihood
MOHURD	Ministry of Housing and Urban-Rural Development of the People's Republic of China
MOF	Ministry of Finance of the People's Republic of China
NBS	National Bureau of Statistics
OLS	Ordinary Least Squares
PBOC	People's Bank of China
2SLS	Two-Stage Least Squares

Abstract

The last decade has been witnessed by the rapid development of the Chinese housing system, and this is both a significant element, and a crucial indicator of the entire Chinese economic system. Over the past decades, housing privatisation and commercialisation have transformed the Chinese allocative housing system into a dynamic market-based system. This has accelerated the demand for housing alongside the urbanisation, which has translated into continuous house price appreciation. Consequently, this has led to an aggravation of housing affordability issues, leading to an increasing number of households struggling to enter the homeownership market. Therefore, the central government has issued a number of policy initiatives to minimise the issues of housing affordability, in which comprises the establishment of the housing provident fund (HPF) scheme, the supply of economical and comfortable housing (ECH), and the cheap rental housing. The HPF is a compulsory saving scheme that absorbs monthly deposits and grant low-rate housing debt, aimed at reducing the housing affordability problems encountered by Chinese households.

This current research employed macroeconomic, microeconomic and policy variables to capture the factors influencing housing affordability and tenure choice decisions. Macro and micro level data was collected and employed in the empirical models, which is aggregate level model and household level model. The empirical model based upon aggregate level data employed the 2SLS estimation technique, aiming to capture the effects on housing affordability followed by government policy interventions. The household level model examines factors influencing housing affordability and tenure choice decisions by the use of 2SLS and probit technique, and forms a two-reduced forms simultaneous equations model. When conducting the empirical investigation by using the household level model, particular attention was also directed towards regional differences in housing affordability and tenure choice decisions. Furthermore, cross sectional variations in housing affordability and tenure choice decision across different groups were also explored, the data sample was disaggregated into four sub-groups, including location, age, income, and educational achievement. This is achieved based upon a life cycle perspective, incorporating concerns that

some households might be liquidity constrained, experiencing difficulties of paying for down payment or entering the homeownership market.

The empirical results indicated that housing affordability is influenced by demand and supply side factors, combined with demographic factors and liquidity constraints. The government policy regarding the HPF was found to be effective at reducing the difficulties of housing affordability in both the aggregate level model and the household level model; while also was evidenced to be effective at increasing the likelihood of achieving homeownership in the household level model. Cross sectional variations were captured among different regions and different disaggregated groups, evidencing that the HPF is a promising housing policy with the effect to diminish housing affordability problems, thereby reducing the housing inequality gap.

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Chapter 1 Introduction

1.1 Background

Housing affordability as an economic issue within an economy in which house prices are rising more rapidly than household income, thus affecting living standards and housing tenure decisions. Linneman and Megbolugbe (1992) stated that primary factors with a negative impact on housing affordability include income inequality, boom and bust house prices, and fluctuating macroeconomic conditions. Therefore, as an economic issue, housing affordability influences households' utility, expenditure, family assets and access to homeownership. A continual rise in housing costs results in a deterioration in the level of housing affordability, affecting a range of social issues associated with the well-being of householders; e.g. health, happiness, and welfare, and housing inequality (Gabriel et al., 2005).

Thus, the term 'housing affordability' is employed to measure housing difficulties, such as the ability of households with a given income level to afford housing expenditure. Previous studies have observed that housing affordability refers to ''the ability to gain access to housing'' and ''the capacity of a household to afford housing'' (Thorns, 1988, p.29). As previously noted, this discussion highlights two important components, which is income level relative to housing costs, revealing that housing affordability issues relate to house price dynamics and the level of housing expenditure. In relation to lifecycle theory, it is stated that younger households experience more severe housing affordability difficulties than mature ones, because of shortages in their family wealth and income (Linneman and Megbolugbe, 1992, p.370).

As Thorns (1988, p.29) stated that housing affordability is defined as the ability and capacity to both access, and afford, the ongoing costs of housing. Thus, ability is closely related to the extent of a family's capacity of entering the homeownership market and meeting the down payment requirement associated with a housing purchase. In terms of entering homeownership market, households need to have sufficient capacity to support any relevant housing expenditure, such as the down-payment requirement, and the mortgage payments.

For low-income households, as a result of shortages in income and savings, excessive housing costs result in an inability to maintain their current housing expenditure, creating difficulties related to housing affordability, with extreme cases resulting in homelessness (Gabriel et al., 2005). Therefore, it can thus be seen that issues of housing affordability occur due to a lack of income, insufficient financial capacity, and an imbalance between housing expenditure and household income.

In addition, housing affordability has been widely discussed in relation to the amount of residual income to meet non-housing expenditure, after the deduction of housing costs (Whitehead, 1991; Bourassa, 1996; Chaplin and Freeman, 1999; Stone, 2006). Bramley (1990) discussed housing affordability in the following terms:

> Households should be able to occupy housing that meets well-established norms of adequacy at a net rent which leaves them enough income to live on without falling below some poverty standard. (Bramley, 1990, p.16)

A similar definition was also given by Grigsby and Rosenberg (1975), who suggested that the level of income remaining after paying out housing expenditure should be sufficient to meet the benchmark of after-housing poverty. The poverty benchmark varies in accordance with household composition, specifying that larger sized households might require both a higher level of non-housing expenditure and a larger sized house to meet basic housing demands. Thus, housing affordability is not only an economic issue focusing on the relationship between housing expenditure and household income, it is also related to a social issue concerning whether residual income can exceed the social poverty standard. Thus, an increase in housing costs raises the risks of having affordability difficulties for those on limited incomes. In particular, this effects young households and low-income households, as affordability issues become aggravated when there is insufficient residual income to meet a household's budget for non-housing necessities (Burke and Ralston, 2003).

Early research into housing affordability failed to provide a universal theoretical scale. The literature states that housing affordability can thus be defined in terms of the relationship between housing expenditure and household income, which, in much of the literature, has

been conceptualised as the ratio of housing expenditure to household income (Linneman and Megbolugbe, 1992; Bramley, 1994, 2012). Consequently, a range of acceptable housing expenditure to income ratios was proposed, spanning from 0% to over 50%. In 19th century, the ratio in relation to housing affordability was adopted with the expression that one week's income representing one month's rent (Gilderbloom, 1985; Hulchanski, 1995). Similarly, the National Housing Federation (NHF) of the UK defined acceptable housing affordability as the number of employed householders with a rent-to-income ratio of below 25% (Randolph, 1992). Another threshold scale identifying 30% as an acceptable level housing affordability has been documented in a considerable number of the literature (Bourassa, 1996; Bogdon and Can, 1997). Historically, the thresholds for the housing affordability ratio have been set variously at 25%, 30%, 40% and 50%. Thereafter, as stated in much of the existing studies on housing affordability, the most commonly used threshold for the housing expenditure to income ratio is agreed as being no more than 30%, otherwise households would be regarded as likely to experience housing affordability difficulties (Maclennan, et al., 1990; Linneman and Megbolugbe, 1992; Chaplin et al., 1994; Hulchanski, 1995; Thalmann, 2003).

The issues of housing affordability have attracted considerable attention from policy makers in many countries, in particular relative to the provision of affordable housing and the implementation of housing assistance policies. Housing policy in many countries is regulated by government interventions, in particular packages targeting groups experiencing issues with housing affordability. Governments in different countries variously define the levels of social rents and the amount of housing subsidies, as well as setting cut-off points, excluding higher income households from housing assistance (Hulchanski, 1995, Linneman and Megbolugbe, 1992; Kim, 1993).

Many countries have implemented 'affordable housing' schemes to provide housing assistance, supporting householders' demand for housing by supplying low costs of housing, in co-operation with various housing policies and programs. The term 'affordable housing' encompasses an aspect of government responsibility aimed at mitigating housing affordability difficulties entered by poor and low-income households, thereby encouraging demand for housing. It has been widely accepted in a number of countries that it is a necessary to sustain a proportion of affordable housing within the housing market

(Demographia, 2017). However, because commitment to this objective, and perceptions of scale and cost vary between countries, there is no universal definition of what comprises affordable housing. For example, in Australia, affordable housing is defined as ''appropriate for the needs of a range of low and moderate-income households; and priced so that households are able to meet other essential basic living costs'' (Abelson, 2009, p.28). In the UK, affordable housing is the primary method of implementing public housing provision, which is intended to meet the requirement for ''housing need'' through the provision of public rental housing to low-income households (Paris, 2007). In China, affordable housing is governed by the ECH scheme (see Chapter 2, section 2.2-2.3), which provides low-cost housing to qualified low-income households. The price of affordable housing is required to set below 20% to 25% of the market price, and the size of any affordable housing is required to be less than sixty square metres in total.

In addition, a number of initiatives have been undertaken in different countries to resolve issues of housing affordability. Canada implemented an income redistribution programme to assist those unable to take up paid employment (Skaburskis, 2004), while also creating an affordable housing strategy for homelessness and those low-income households most at risk of becoming homelessness (Laird, 2007). UK housing policy has considered housing affordability issues since 1970s; it includes the provisions of housing subsidies to local authorities, to enable them to set acceptable social rentals that can be reasonable met by tenants (Whitehead, 1991). Housing policy in China is associated with housing reforms and the implementation of the Housing Provident Fund (HPF), which focuses on delivering financial support and providing cheaper-rate housing debt to enable housing purchase (Wang and Murie, 1996; Rosen and Rose, 2000; Mostafa et al., 2006).

In China, the housing market is still developing, and thus housing affordability remains an emerging issue in comparison to other countries (i.e. the UK, the US, and Australia). Between 1949 and 1998, urban residential houses in China were public ownership and administrated centrally (Putterman, 1995; Zhao and Bourassa, 2003; Chen et al., 2013). This resulted in the mechanism of the housing market being dominated by the welfare allocation housing system, which is fully planned by the government, allowing work units to dominate housing construction and housing allocation. Under the allocation system, employees with a formal

employment contract of in excess of one year's duration were eligible for the allocation of a house, upon payment of a management fee only. The size of each house, and the order in which they were allocated related to the potential occupiers' professional title, length of service and the size of their household (Wang and Murie, 1996, 1999; Zhao and Bourassa, 2003).

However, households began to become over-reliant on this housing allocation, resulting in a series of housing affordability difficulties. Firstly, there was the issue of housing inequality occurring between employees, as a result of corruption, with access to housing remaining problematic for those members of the underclass, who had to experience lengthy before being allocated a dwelling (Zhou and Logan, 1996; Chen et al., 2013). Secondly, under the welfare housing system, housing conditions were generally very poor, with overcrowded living spaces and inappropriate living spaces that married couples sharing a room with their parents and /or teenage children. The allocated dwellings remained in public ownership (i.e. ownership by the state), and the people living in them had no rights of ownership. Housing allocation thus weakened a family's wealth position, obstructing access to homeownership, by preventing households from purchasing, reselling, inheriting, or exchanging the allocated houses (Zhao and Bourassa, 2003).

Following the period of the welfare allocation, a structural shift took place within both the national economic environment and the housing market, because of the success of the housing reform. A market-dominated housing market was developed alongside a national housing reform, involving the implementation of the housing mortgage and the housing assistant policy (i.e. HPF). Thus, since this time, housing investment associated with economic development has played a significant role in China's national economy. Furthermore, increasing urbanisation in China has improved employment prospects, stimulating increased house prices, because of the rapid growth in the demand for housing.

1.2 Motivation

As stated previously, house price appreciation has accelerated in China due to increases in urbanisation, the growth of economy, and growing housing demand. Consequently, issues related to housing affordability have also been amplified. The *Demographia Survey* (2016) stated that the theoretical upper threshold of 'affordable' is 3.0 and under; while the 'severely unaffordable' housing is when the median house price to income multiple exceeds 5.1. However, as reported, the median house price to income multiple in China has gone far beyond the theoretical upper threshold point, reaching 10.2 at the end of the third quarter of 2016 (Demographia, 2016). This has generated considerable concern about housing affordability issues in China, raising questions about what would constitute the relevant housing assistance required to mitigate housing affordability difficulties. This has also led to a need to collate background data regarding to the Chinese housing market, detailing the process of housing reform, and employing relevant figures to illustrate the development of the housing market, the housing finance market, and associated relevant housing policies. This will provide a theoretical understanding and an overview of the Chinese housing market.

The previous decade was characterised by a rapid development in the Chinese housing system, as housing served as an indicator and a significant component of the overall Chinese economic system. In recent years, the Chinese economy has maintained this rapid pace of development, simultaneously contributing to a boom in the housing market resulting from considerable investment. The progress of both urbanisation and industrialisation attract continuous employment to urban areas, suggesting a rapid rise in housing demand, leading to a surge in house prices. In addition, the development of the housing finance market, along with the increase in money supply, improves the accessibility of mortgages. This has, in turn, fuelled housing demand, resulting in continually increasing house prices, especially in response to the recent financial crisis. This current thesis, therefore, examines factors influencing housing affordability, in combination with a number of factors, including those related to macroeconomics, supply and demand side factors, demographics, and life cycle theory.

The performance of the over-heated housing market combined with the volatility of the mortgage market, have raised concerns in relation to housing affordability in many countries (MacLennan and Williams, 1990; Bramley, 1994). Chaplin and Freeman (1999) suggested that the factors leading to a deterioration of housing affordability have changed over time, and now include macroeconomic factors and income growth; thereby, raising concerns about issues of housing affordability into discussions regarding housing policy. Since the implementation of its national housing reform, the Chinese government has issued a number of housing and monetary policies designed to regulate the overheated housing market, providing policy engines to facilitate issues related to housing affordability, targeted in particular at those on low incomes. Accordingly, the HPF was introduced to the market alongside the national housing reform, to provide low-rate housing debt to assist with housing purchases, as well as rental payments and relevant housing expenditure. However, the limited accessibility of HPF has resulted in many households in need being unable to benefit from this housing policy, meaning it is inhibiting an increasing number of low and middle-income households from embarking on homeownership. This necessitates an examination of the effectiveness of the housing policy to understand how best to assist households in need to achieve homeownership.

Choice of housing tenure is associated with the levels of housing expenditure, which ultimately lead to potential homebuyers being unable to access homeownership due to the high level of housing costs for owner-occupation. According to lifecycle theory, the possibility of entering housing market for low-income and younger cohorts is lessened by income inequality and the lack of financial capacity (Leece, 2004). The current thesis therefore focusses on extensive research concerning housing affordability and tenure choice among a number of different groups, also examining a number of demographic subgroups.

Regional diversification informs variances in wealth and affordability concerns, as a result of differing levels of economic development and uneven implementation of policy. It is therefore necessary to examine the existence of regional differences that relate to housing affordability and tenure choice, to enable enabling policy makers to mitigate the difficulties concerning housing affordability related to regional development (Koblyakova et al., 2014).

Existing studies concerning housing affordability issues have primarily focused on theoretical discussions, and so lack empirical investigation. Based on an extensive interpretation of the background to the Chinese housing market, along with a comprehensive theoretical discussion concerning the factors influencing housing affordability, this current thesis firstly employs a quantitative research approach to investigate those factors influencing housing affordability and tenure choice, in combination with data concerning both the aggregate level and household level. Secondly, it explores issues related to housing affordability in depth, to establish the effectiveness of housing policy, and offer evidence concerning regional differences in relation to housing affordability and tenure choice. The empirical results are expected to contribute policy implications for policy makers, while also improving the effectiveness of the housing assistance project.

1.3 Research Aims and Objectives

This thesis develops two econometric models based upon theoretical discussions, examining variables influencing both housing affordability and tenure choice within the Chinese housing market. Two types of data are employed in the thesis: time series data and cross-sectional data. Prior to further discussion, it is essential to establish the research aims and questions, which are as follows:

1.3.1 Research Aims

1. To provide an overview of market performance in China.

Housing reform has played a significant role in transforming the welfare-based housing system into a market-dominated housing market. This thesis firstly, establishes an overview of market performance in relation to housing reform, and secondly, establishes a conceptualized background, identifying how issues related to housing affordability problems arise in China.

2. To form an econometric model to empirically examine the main factors influencing housing affordability in China based on aggregate level data.

3. To conduct an empirical investigation of the main factors influencing housing affordability in China based on household level data.

The empirical investigations employ theoretical implications asserted in previous studies, and focus on examining factors influencing housing affordability within the Chinese housing market, employing data from both the national and household level, respectively. Choice of housing tenure relates to the level of housing expenditure, and this thesis therefore examines the simultaneity between housing affordability and tenure choice decisions, investigating those factors influencing housing affordability ratios and the likelihood of achieve home-owner occupation based upon the theoretical life cycle approach.

4. To empirically evaluate the effectiveness of housing policy in relation to housing affordability.

This forms a significant aim of this current thesis. The inclusion of theoretical discussions ensures that housing policy factors are employed in the econometric model, examining the effectiveness of housing policy as a mechanism mitigating housing affordability issues and increasing homeownership rate.

5. To explore regional differences in housing affordability and tenure choices empirically within the Chinese housing market.

Differing economic conditions and political implications have led to a potential imbalance between the different regions. This current thesis, therefore, considers regional variations in the housing and housing finance market, to capture regional deviations in relation to housing affordability and tenure choice, by including three regional dummies within the household level model.

1.3.2   Research Objectives

1. To illustrate the background to the Chinese housing market.

The housing market in China has recently been transformed from a welfare housing system into a market-dominated system. This thesis, therefore, first offers an overview of the market, presenting the circumstances of the macroeconomic environment, and detailing the performance of housing and housing finance markets through the historic periods to the present. Therefore, discussions on the housing market background are illustrated in Chapter 2, including the signs of housing reform, the development of the housing finance market, and the performance of the housing market. This establishes a theoretical understanding of the interconnections between the macroeconomic market, housing market and the housing finance market, explaining how these markets impact on housing affordability in China. In addition, this thesis discusses the HPF, providing theoretical insights concerning the impact of housing policy on housing affordability and household tenure choice.

2. To build up a theoretical foundation and to identify those factors influencing housing affordability and tenure choice.

This is a key step in developing empirical specifications and appropriate estimation techniques. It is important for the theoretical discussions in this thesis to conceptualise how housing affordability should be measured, as well as specifying the relationship between housing affordability and tenure choice decisions. Theoretical discussions concerning housing affordability and the development of the macroeconomic and the housing finance market take place prior to the empirical analysis, to identify the key factors influencing housing affordability and tenure choice.

3. To empirically examine and interpret the impact of driving factors on housing affordability.

4. To empirically examine and explain how these factors influence the probability of households choosing to enter the homeownership market.

This aspect forms the significant contribution of this thesis, bridging the gap between theoretical discussion and empirical investigation. Econometric modelling, and the related issues arising from the empirical investigation are discussed prior to establishing the empirical results. In relation to the previous research objective, the empirical results are therefore interpreted, with the intention of establishing the contribution of this current thesis and specifying the implications of this study.

5. To empirically examine whether existing housing policy in China delivers effective assistance to overcome housing affordability issues and to facilitate a homeownership pathway.

In relation to discussions concerning the market overview, the HPF is regarded as an important housing policy aimed at fulfilling housing demand in China, as well as reducing issues associated with housing affordability. This is of central interest in this current thesis, which examines whether housing policies are utilised effectively, in particular, mitigating housing affordability difficulties in China, and improving the homeownership rate.

6. To empirically explore the existence of regional differences in relation to housing affordability and housing tenure.

Regional differences may arise from differences in economic conditions, the distribution of population, policy implications and geographical location. This current research therefore focuses on evidencing the existence of regional variations in relation to housing affordability and tenure choice within the Chinese housing market. In combination with household level data, three regional dummies were employed in the household level model, which is Beijing, Shanghai and Guangdong. This established evidence relating to regional differences in housing affordability and tenure choice

1.4 Methodology

This thesis employs a quantitative method, in order to examine factors influencing housing affordability. In addition, hypotheses are proposed that relate to the research questions. The reason for employing a quantitative research approach is that this requiring a well-developed theoretical understanding of the theories associated with a research topic; notably, demanding high-quality data in combination with advanced estimation technique to establish highly reliable results. The data employed in this thesis comprises data collated pertaining to national and household levels, and are introduced below.

1.4.1 National Level Data

In relation to the stated research objectives, this thesis examines factors influencing housing affordability in combination with data at the aggregate level. Theoretical variables are identified based on the theoretical discussions. Thus, national level data concerning macroeconomic and housing policy are therefore obtained from multiple sources, e.g. the CEIC database; the World Bank, and national statistics. This dataset spans the period between 2000 Q1 and 2015 Q1, encompassing 61 periods, offering a sufficient quantity of data upon which to perform a time series regression. In order to ensure statistically reliable results, the data sample needs to be as large and representative as possible in a quantitative study, utilising econometrics techniques (Saunders et al., 2009; Bryman and Bell, 2015).

1.4.2 Household Level Data

The data utilised in the household level model were obtained from the China Household Finance Survey 2011 (CHFS). This is a representative micro level survey undertaken during the summer of 2011, using face-to-face questionnaires comprised of closed-end questions. This dataset contains information concerning household wealth capacity, mortgages, tenure choice, demographics, housing policy and regional locations. The CHFS is therefore a representative micro household finance survey in China, which covers the entire population with random sampling. The sample size for this survey encompassed 8438 households across

twenty-five provinces, with an overall refusal rate of 11.6%. The employment of CHFS 2011 in this current thesis enhances understanding of how micro data reflects household family expenditure and household assets, providing high quality and representative data at the individual and household level.

The dataset was obtained from an online archive, integrating two different levels of data with three separate files, one of which referred to data at the household level, and the other two concerning individuals within households. A specific technique is required for capturing information concerning household income, household formation, regional location, and other households' heterogeneity factors. Accordingly, data files at the individual level are merged with that at the household level by selecting the 'key variable' within both files. Consequently, a merged file was created, attaching the data file at the individual level to that at household level. This file linkage emerged as a reasonable approach to capturing the entire value of the dataset, while providing additional valuable information to develop an empirical model at the household level.

1.4.3 Method

When employing the quantitative approach, statistical testing forms a crucial aspect of quantitative research, applying research questions and economic data to econometric modelling, and testing hypotheses by means of empirical investigation. This current thesis employs the following research methods: Firstly, descriptive statistics for both types of data employed in the econometric modelling. Statistical description is a quantitative method widely employed to present the basic features and numerical summaries of data. This allows the values of means, maximum, minimum and standard deviations to be tabled, depending on the feature of the variables. Secondly, empirical regression for econometric models at the aggregate and household levels.

Econometric methodology is a broadly employed application utilising a number of different empirical techniques to examine the economic relationship between theoretical variables and economic theories (Wooldridge, 2009). This enables a significant level of clarification when rejecting a hypothesis in an econometric analysis, and also confirms the validity of the

research findings (Saunders et al., 2009). This current thesis employs the significance level of 5% for the empirical results, presenting the results by *** for a p-value of <5%.

1.4.4   Estimation Techniques

This current thesis employs econometric methodology to perform the econometric models empirically, to both answer the research questions and test the hypotheses. Two econometric models, encompassing four equations, were developed, to examine factors influencing housing affordability and the likelihood of households choosing tenure choice. The Two-Stage Least Squares (2SLS) estimation was employed in this current thesis, due to the existence of endogeneity issue. This resulted from omitted variables, measurement errors, or simultaneity, resulting in the error term in the model being unexpectedly correlated with the explanatory variable. Consequently, the OLS estimation was inconsistent and biased, and therefore not considered appropriate for the empirical investigation, as a number of the effects involved in the error term could be attributed to the regressor (Wooldridge, 2009; Stock and Watson, 2015). The 2SLS technique encompasses the advanced econometric investigations, and helps resolve endogeneity issue, generating consistent and unbiased results.

The employment of the 2SLS technique in the regression requires validity checks for the instruments. Wooldridge (2009) and Stock and Watson (2015) identified relevant approaches towards testing the validity of the instruments: Firstly, the rank condition and order condition was applied to the identification of the instrumental variable, requiring the number of instruments variables to be at least equal to the number of explanatory variables. Secondly, the instrumental variable should be correlated with the endogenous variable, while also being uncorrelated with the error term. In addition, the value of the first-stage F-statistic is utilised to identify the validity and efficiency of the instruments, stating that the variables are effective if the value of the first-stage F-statistic is greater than 10, indicating the empirical results are meaningful.

Additionally, this research employed a binary choice model to examine those factors influencing the probability of households choosing to achieve homeownership. Tenure choice was modelled as a probit model in which '1' refers to the probability of a household choosing

owner-occupancy, while '0' refers to the probability of a household choosing to rent. The Maximum Likelihood Estimation (MLE) technique is employed to estimate the probit model, and the marginal effects were employed to interpret the estimation results. The statistical package STAT 14.0 was employed to undertake the regressions and obtain empirical results, offering specific techniques to address the econometric issues arising in this thesis.

1.5   Thesis Structure

This thesis aims at examining factors influencing housing affordability and tenure choice within the housing market in China. The structure of this thesis is as follows:

Chapter 1 has introduced the background to the research, as well as the motivations, aims, objectives, and methods employed in this current thesis. Chapter 2 provides a detailed overview of market performance, including discussions relating to the housing market, housing finance market and the macroeconomic environment. Discussing the nationwide housing reform, this chapter also illustrates the importance of housing reform, acting as a turning point in the Chinese housing market, bringing about a transformation from a welfare housing system to a market-dominated housing system. Meanwhile, discussions relating to the achievement of the housing reform are stated, specifying the recent rapid development of the market-dominated housing market and the housing finance market, through the inclusion of relevant economic data. In addition, the introduction and development of the HPF are detailed in this chapter, detailing its aims and operations across China, and providing theoretical understandings of how policy indicators influencing housing affordability and tenure choice.

Chapter 3 forms the literature review, and discusses essential points related to housing affordability, including definitions and measurements of affordability, and differences in the literature regarding suggested measurements. This serves to define housing affordability and makes it possible to compare each of the most commonly employed measurements, revealing a lack of any universal definition and measurement for housing affordability, along with a growing acknowledgment of the need to develop a more comprehensive understanding of

housing affordability. A key proportion of the discussion in this chapter focusses on factors influencing housing affordability, in relation to discussions concerning macroeconomic performances, the housing market, household income, and lifecycle theory, providing a theoretical understanding of the development of the econometric model and interpreting the empirical results.

Chapter 4 introduces the methods employed in the econometric models, including the research methodology and instruments. Chapter 5 interprets the data employed in the econometric model, including discussions about data features, data management, and the working data file. Furthermore, this chapter demonstrates the uniqueness of the dataset, and illustrates the actions when merging data at different levels into one level.

Chapters 6 and 7 present econometric modelling for different types of data, in combination with the theoretical discussions in Chapters 2 and 3. Chapter 6 interprets the econometric model at the aggregate level, employing national level data spanning 2000Q1 and 2015Q1. In addition, descriptive statistics describing key variables tabulated in this chapter. Factors influencing housing affordability at the aggregate level are examined by means of the 2SLS estimation technique, and the effectiveness of the housing policy is evaluated by employing the HPF borrowing rate within the model. In addition, this chapter further forms a group-based estimation, including subgroups prior to, and following 2007, in order to captures the periodical changes resulting from the financial crisis of 2007, and in particular the variation in housing policies and housing finance factors influencing housing affordability.

Chapter 7 employs household level data to undertake an empirical investigation to obtain intensive answers concerning factors impacting housing affordability, followed by an examination of factors influencing a household's tenure choice. A two-reduced form of simultaneous equations model is developed in this chapter, in order to perform the empirical investigation and answer the research questions. The effectiveness of housing policy indicators in relation to housing affordability and tenure choice is also of interest in this model. This chapter examines the existence of regional differences in relation to housing affordability and tenure choice by employing three regional dummies within the household level model,

focussing specifically on the differences related to regional economic development and policy implementation. This aspect represents the significant contribution of this current thesis.

Chapter 8 discusses the main findings and implications of this thesis, indicating potential further subjects of research related to this current study.

Chapter 2 Housing Market Developments

2.1   Introduction

This chapter provides an overview of development in the housing market in China. It begins by describing the specific features of the economic transition from a planned economy to a market economy (see section 2.2). Furthermore, it illustrates housing reform as a component of economic reform, as manifest by the transition from a welfare-dominated housing system to a market-dominated housing system. Then section 2.3 discusses the HPF system, a key housing assistance policy launched alongside the housing reform process, aiming at resolving housing difficulties and improving the homeownership rate in China. The role of the HPF, and its impact upon housing affordability are therefore discussed, providing a theoretical understanding of the empirical results for this research. The following section (section 2.4) discusses the development of the housing finance market, evaluating the development of China's emerging mortgage market, describing how housing finance assists housing purchases in China, and how the government regulates the performance of the housing finance market.

Any research concerning housing affordability in China demands a discussion about how the Chinese housing market and macroeconomic environment operates; and the extent to which the performances of the housing market influence housing affordability. Thus, in order to answer these questions, section 2.5 describes the development of the economic environment, incorporating relevant contextual economic data, revealing how the macroeconomic market influences housing affordability. National economic data is drawn from the CEIC and World bank database pertaining to the macroeconomic environment, the finance market and the housing market. As a result of the varying availability of the data, some figures are displayed on an annual basis, while others are only recorded from 2007 onwards. Section 2.6 considers regional variations in the economic conditions throughout China, and discussions concerning regional differentials are illuminated to variations in house price, household income and GDP across three regions: Beijing, Shanghai and Guangdong. These three regions are the most developed in terms of their economic condition, labour mobility and sources of financing. The

discussions concerning regional differences correspond to the empirical investigations conducted for this research (see Chapter 7), and serve to clarify the reasons for regional variations in housing affordability and households' tenure choices.

2.2 The Path to Chinese Housing Reform

2.2.1 China's Economic Reform: From Planned Economy to Market Economy

Prior to discussing the housing market in China, it is necessary to offer a broad overview of the economic mechanisms that have been in place since China (PRC) was founded in 1949. Between 1949 and 1978, China functioned as a planned economy consistent with the socialist ideology, which is characterised by overwhelming public ownership administrated centrally (Putterman, 1995; Zhao and Bourassa, 2003; Chen et al., 2013). A planned economy is a system in which the state or government takes economic decisions, rather than relying on variation and balance being achievable through interactions between consumers and economic activities. This differs from a market economy, in which the decisions made by producers are governed by economic activities (namely demand). Within a centralised planned economy, the state dominates all sources of production, exercising complete control over pricing, fiscal policies, monetary policies, and ownership. The land that comprises China's mainland is collectively owned by the state, and non-agricultural activities are also controlled by governments at various levels.

In a planned economy, the role of collective ownership is a particularly significant feature, as all production resources and achievements belong to all members of society. Collective groups, known as work units, served 'Danwei'[1] (employer) (Francis, 1996; Wu, 1996; Chen et al., 2011), which is not only an employer, but also a welfare provider, who extends a variety of support opportunities to employees, including housing allocations (Zhao and Bourassa, 2003; Burell, 2006; Yang and Chen, 2014). In this context, housing was regarded an object

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[1] Work units comprise of government institutions and SOEs in a planned economy, and subsequently involve all kinds of employers in the economic reform; i.e. private and joint corporations, social institutions, and government public-sector organisations (Deng et al., 2015). Self-employed and freelance workers are excluded from the context of work units.

allocated under welfare provision, rather than a commodity with a market value and price (Angel, 2000).

In 1978, China launched a massive economic reform,[2] aimed at establishing a market economy. The market economy is an economic system, in which decisions about investment, production, and distribution are based on the interconnectedness of supply and demand, which determines prices. The first target of the economic reform sought to introduce market principles to the economy, opening the country up to foreign investment, and encouraging entrepreneurs to set up private businesses. It aimed at developing privatisation across the nation, i.e. transference of the ownership of enterprises, production institutions, public services, or public property from centralised state control to the private sector (Wang and Murie, 2000). The process of economic reform led to the establishment of an enormous foundation fuelling economic development, and contributing to extraordinary economic growth in China.

2.2.2   The Welfare Allocation Housing System: Spanning 1949 to 1978

China's housing market has operated according two different systems since 1949: (1) from 1949 to 1998, it took the form of an allocation-based welfare system, functioning as a component of government provision; and (2) after 1998, it became a market-oriented housing system, following implementation of the housing reform. The economic system, which was marked by transition to a market-based system, has had a significant influence on the housing system; thus, the development of the housing system is now intertwined with the Chinese economy overall.

During the period of the planned economy, houses in urban[3] areas were covered by the welfare allocation housing system. This system required the government to plan its operations, allowing work units to dominate housing construction and housing allocations.

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[2] This is termed 'Gai Ge Kai Fang' (改革开放) in Chinese.

[3] The house in rural area is regarded as homestead, and cannot be transacted because it is owned by the rural collective economic organisations.

Employees with a formal employment contract of in excess of one-year length were eligible for the opportunity to be allocated to a house (Wang and Murie, 1996, 1999; Zhao and Bourassa, 2003). Houses were allocated to employees free of charge, according to employees' professional titles, their length of service and the size of their households. The housing allocation in China assigned two persons to a one-bedroom house, three to five persons to a two-bedroom house, and six to eight persons to a three-bedroom house (Friedman, 1983; Zhou and Logan, 1996, p.400). There were no market transactions, and no market prices were set to obtain the allocated house; however, employees that had been allocated a house were required to pay maintenance fees administered by the government the planning system (Wang and Murie, 1999; Chiu, 1996). The maintenance fee for the allocated houses was 1 per cent overall of the average employee's annual income (Yang and Chen, 2014). As a key feature of the country's socialist organisation, the welfare housing system to some extent met employees' housing needs[4] during the 1950s.

It should be noted here that the allocated houses were thought of as public housing, and control and ownership of all houses belonged in the hands of the state (Zhao and Bourassa, 2003), which took on the role of landlord. Thus, people living in the allocated houses were not homeowners, and were not allowed to purchase, resell, inherit, or swap the allocated houses. This is important, as homeownership affords economic benefits to families, enabling them to accumulate family wealth. An owner-occupied home is a financial investment, enabling families to build financial security as equity over the long term (Pollakowski et al., 1991). Therefore, public ownership weakened families' wealth position, obstructing family investment in housing (Zhao and Bourassa, 2003), something that can be identified as one of the main disadvantages of the system. According to figures cited in the available literature, private homeownership in urban areas was lower than 20 per cent at the beginning of the 1980s (Wang and Murie, 2011), and the majority of private houses were either self-build houses or older properties. The share of public houses was around 75 per cent (Chen et al., 2013, p.16). Figure 2-1 presented below shows the proportion of homeownership in the early

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[4] In the context of socialist ideology, housing is regarded as a basic need and is right for allocation by the government, rather than a commodity with a market value and a price (Angel, 2000).

1980s in China, illustrating that a dominant share of the housing stock was devoted to public housing.

Figure 2-1: Proportions of Homeownership in the early 1980s
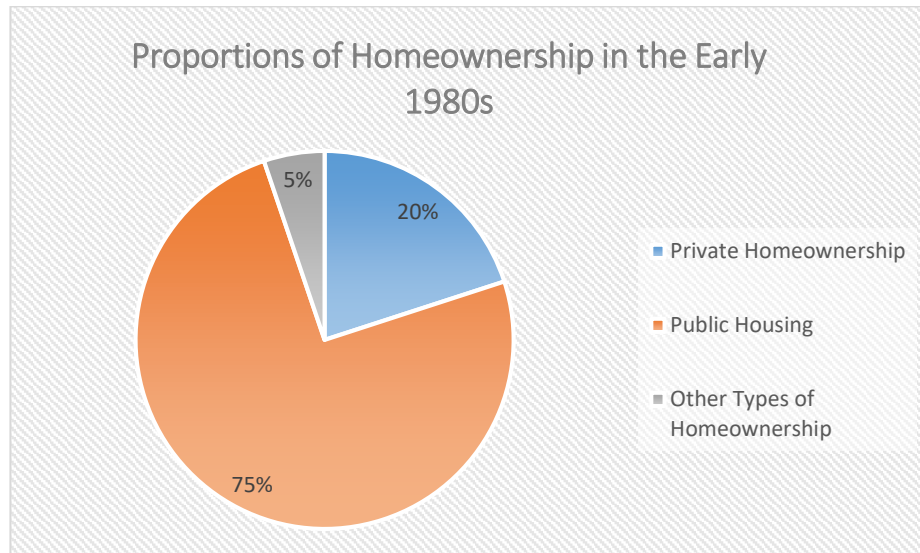
(Sources: Wang and Murie, 2011, p.240; and Chen et al., 2013, p.16)

Despite the principles of equity underpinning it, the allocation system generated serious housing inequalities, due to housing supply shortages and inequitable allocation. In the context of a welfare-dominated housing system, housing supply responds to the allocation of public houses and relies on centralised planning mechanisms. This differs from a context of the market-dominated housing system, where housing supply responds directly to housing demand. Within the housing allocation system, a housing supply shortage arose because housing allocation was planned and limited by the government, as houses are scarce resources (Zhou and Logan, 1996), and not everyone was eligible to receive one. Moreover, the process of allocation within the housing system only applied in urban areas, with accessibility to allocated houses being restricted in rural areas by the introduction of the 'hukou'[5] system in 1958 (Chen et al., 2013). Additionally, the system proved unequal, even

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[5] 'Hukou' System is a specific household registration system in China, controlling the free movement of residents from rural to urban (Chan and Buckingham, 2008). 'Hukou' registration identifies if a person has a local residence permit. In addition, 'hukou' system is linked to housing allocation under the planned economy. Now it is linked to social welfare benefits (Barth et al., 2012)

amongst urban registered employees, as corruption affected allocation and inefficiency became rooted in the welfare housing system because of the regulatory failure of work units and the government (Zhou and Logan, 1996; Chen et al., 2013). A person entrusted with a position of authority, as a member of the privileged class, would typically be allocated a larger sized house in a better condition, while members of the underclass were not given access to such privilege (Zhou and Logan, 1996). The consequence of this corruption was huge housing inequality among employees, with access to housing remaining a challenge for those of members of the underclass, who had to queue for a long time to be allocated a dwelling.

In addition to what was discussed, housing conditions generally across the nation were very poor under the welfare housing system. According to a survey conducted by the China State Statistical Bureau in 1985, about 27.6 per cent of households (including at both city and town levels), lived in crowded conditions (a per capita dwelling space of less than 4 m^2). A total of 7.41 per cent of households (including at both city and town levels) lived in inconvenient housing (married couples sharing a room with their parents and teenage children), and 2.06 per cent of households (including city and town levels) were located in non-residential structures (World Bank, 1992). Correspondingly, the average living space had fallen sharply over time; i.e. "from 4.5 per square metre capita in the early 1950s to 3.6 square metres in 1970s" (Chiu, 1999, pp.562). To some extent, issues with housing inequality and unequal allocation under the housing allocation system reveal the drawbacks of a planned economy. Furthermore, the nation's housing stock developed into a financial burden for the government and work units, eventually becoming an obstacle to the development of the Chinese economy.

2.2.3   Chinese Housing Reform: The Trial Stage Spanning 1978 to 1988

In 1978, China's central government established a national economic reform and an opening-up policy, aimed at transiting the planned economy to a market economy (Gao, 2010). Alongside economic reform, housing reform was regarded as one of the chief indispensable components (Wang and Murie, 1996; Li and Yi, 2007). Based on existing studies concerning housing reform in China, Figure 2-2 below graphs the development of market-based housing

system, visualising the timeline of China's housing market, showing how it developed over the previous decades (Wang and Murie, 1996; 19999; 2000). In relation to what was presented in Figure 2-2, the key milestones of the housing reform were summarised in Table 2-1, illustrating the main actions associated with the housing reform between 1978 and 1998, and delivering an understanding of the housing reform process.

Figure 2-2: Timeline for Housing Market Development and Housing Reforms in China (From 1949 to present)
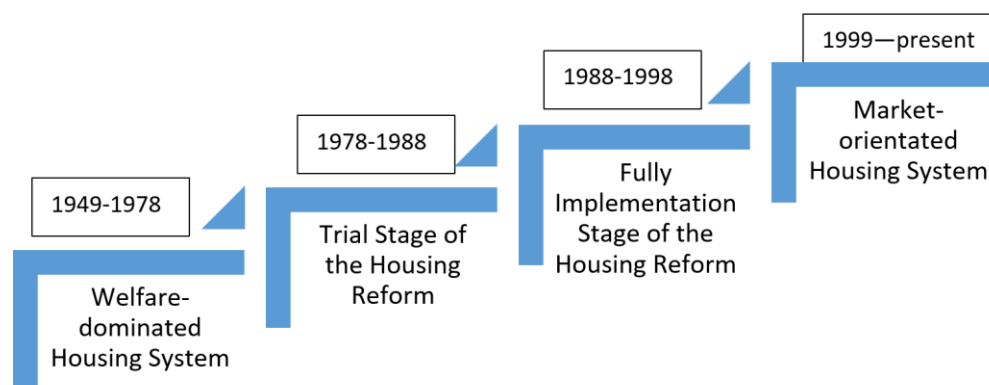
(Source: Author's Own Diagrammatic Representation)

Table 2-1: Key Actions Comprising the Housing Reform: from 1978 to 1998

Date	Objectives and Actions
1980	Speech by Deng Xiaoping, 'urban households are allowed to construct their own houses; allocated houses are to be sold; rentals for allocated houses should be adjusted; low-income households are to be subsidised, housing allowances to be granted for housing purchase'
June 1980	The '*Proposals on The National Construction Works'* promoted the commercialisation of housing in urban areas, through the sale of allocated houses, and increased numbers of rental properties.
1982	Four cities selected as pilot cities to launch the housing reform: Siping, Changzhou, Zhengzhou, and Shashi.
1982--1985	Homebuyers allowed to pay one-third of total housing costs to obtain the allocated houses, while their employers would be required to subsidise the residual two-thirds. At this stage, instalments were proposed as a payment method, requiring one-third of the housing costs in one lump sum.
1986--1988	The coverage of the housing reform expanded to 1604 cities across the nation.

	The instalment plan was modified, allowing employees to pay 30 per cent of total housing costs in the first instalment; the residual part was then to be paid off in instalments within a set duration of 10 to 15 years.
1991	HPF was firstly introduced to Shanghai. The Second Session of The Nationwide Housing Reform Conference raised rentals for public housing.
1992	Beijing and Guangzhou launch the HPF system.
1993	In the Third Session of The Nationwide Housing Reform Conference: the main target of housing reform at this stage was selling allocated houses, and the building of market-priced houses, as well as the allocation of public houses to a small number of groups.
1994	The official document, '*Decision on Deepening the Reform of Urban Housing System*' further clarifies that the target of the housing reform was establishing a new urban housing system in accordance with the transition to a market economy, including promoting housing communalisation, engaging in building houses, improving living standards, and satisfying the increasing housing demand for urban households. The Economical and Comfortable Housing scheme (ECH) proposed: targeting low-income households.
1998	The state council promulgated '*the Circular of the State Council on Further Deepening the Urban Housing System Reform and Accelerating Housing Construction*' (No. 23 [1998] of the State Council), indicating that housing allocations should be completely terminated after the second half of 1998, supplying economically affordable houses, and establishing an organised housing and housing finance system.

(Source: Author's Own Diagrammatic Representation)

With the introduction of the housing reform, the government has been employing a gradual experimental approach, adapting programs over time to meet their aims. As shown in Figure 2-2, the period spanning 1978 to 1988 was a trial stage in terms of implementation of the housing reform. It involved a three-stage reform by experiment, selecting some cities as trial cases, to transit houses from the classification 'welfare subsidy' to a market-based good [6] (Wang and Murie, 2011; Huang, 2004).

Firstly, it has been suggested that the sale of publicly allocated houses at one-third of the building's cost per square metre, based on the dimensions of a typical publicly allocated

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[6] Also termed 'privatisation' in many existing sources (Huang, 2004; Li and Yi, 2007; Wang and Murie, 2011)

house was approximately 56 square metres. The cost of a typical house was equivalent to 10-20 years of an employees' income (Wang and Murie, 1996). The cities of Xi'an and Nanning were selected as pilot case studies. However, the selling price was deemed too high for the majority of potential homebuyers to afford, and the payment method was not flexible, as there were no instalment plans, hence the implementation of the reform occurred at a slow pace (Wang and Murie, 1996). Additionally, there were some terms and conditions associated with the purchase of public houses, requiring that houses could not to be resold, due to ongoing state-owned homeownership; this thereby reducing the attractiveness of their purchase for potential homebuyers. These steps were formally rescinded in 1982, because it was recognised that they did not sufficiently further the housing reform.

Secondly, in order to stimulate the demand for purchasing publicly allocated houses, a second stage of the experimental reform was launched in 1982, providing housing subsidies to employees as a form of housing assistance to obtain publicly allocated houses. At this point, additional cities were selected to conduct further pilot studies (see Table 2-1). The breakthrough aspect of this stage was that homebuyers were expected to pay just one-third of total housing costs, while employers were required to subsidise the residual two-thirds. Moreover, homebuyers were encouraged to pay the housing costs in 'one lump sum', through the incentive of an authorised property-tax-reduction for a period of 5 years (Wang and Murie, 1996). This action differentiated these changes from those in the first stage, mitigating the financial difficulties encountered by most homebuyers, and thereby accelerating the transition from public-allocated houses to market-orientated houses. In addition, the existing tenants of public-allocated houses were also allowed to purchase the house they lived in, although the house size designated for a family of three was under 45 square metres (Wang and Murie, 1996). On this basis, 10.9 million square metres floor spaces had been sold in the trial cities in 1985, equivalent to around 200 000 units (Wang and Murie, 1996, p.975). The second stage of the housing reform could therefore be considered to have progressed successfully, contributing to accelerating the growth in the homeownership rate, but also inducing heavily financial difficulties for subsidies providers.

In the third stage of the experimental reform, a formal official organisation was established to oversee the housing reform regulation. In addition, further opportunities were added for home purchasers, providing not only housing subsidies, but also introducing payment by instalment scheme. As regards the housing subsidy, in 1987, Yantai, the pilot city, issued coupons for housing subsidies, equivalent to 23.5 per cent of tenants' monthly income (Wang and Murie, 1996). However, the coupon was exchangeable for housing costs only. Building on the actions of the housing reform introduced in the previous stage, people who had already been allocated public houses were encouraged to purchase those houses at a discounted rate; i.e. 50 per cent of the market value (Lee, 2000). Meanwhile, an instalment plan was proposed, allowing employees to pay 30 per cent of the housing costs as a first instalment; with the residual part paid off in instalments over a specified duration of 10 to 15 years (Wang and Murie, 1996). This action marked the dawn of a new finance market in China, because it was the first time that the concept of instalment plan had been introduced and adopted in the housing market, helping those with difficulties making a one-off payment.

By the end of 1988, the three-stage experimental housing reform had been launched successfully into the Chinese housing market, covering 1604 cities and 300 towns in total across the nation (see Table 2-1). The success of the experimental stage of the housing reform accelerated its transformation from a public-allocated housing system to a market-orientated housing market, generating invaluable experience as a basis from which to guide further reforms. Meanwhile, the government and work units were no longer considered responsible for housing allocations, which reduced the financial burdens arising from the housing allocation (Lee, 2000).

2.2.4   Chinese Housing Reform: The Fully Implemented Stage Spanning 1989 to 1998

The trial housing reform progressed successfully, providing an open environment to pave the way for future extensive housing reform nationwide. Indeed, the Central government chose to launch a fully implemented housing reform in 1989. This extended the housing reform nationwide, and ended the allocation housing system, bringing about a market-dominated housing system, and the establishment of a housing finance market and a housing assistance

policy. Under this intensive nationwide housing reform, the primary objective was to sell more public houses to sitting tenants, to reduce the supply of allocated houses. Accordingly, proposals to offer financial assistance to people wishing to own their own home were proposed by the central government; this led to the HPF[7] was initially established in Shanghai in 1991 (Lee, 2000; Wang and Murie, 1996).

The HPF is a compulsory savings scheme, requiring employees and employers to deposit a given percentage of their income in the HPF account; whereas the benchmark interest rate for savings is applicable to the HPF deposits. More specifically, if the working units participated in the HPF scheme, those employees who had signed a contract for over one year would be required to deposit a given percentage[8] of their income into their housing saving accounts on a monthly basis, and employers would be required to deposit an equivalent amount of savings for their employees. The contributory rate for paying HPF varies regionally, and the officially required rates in some regions are tabled below:

Table 2-2: The Officially Required Contributory Rate for Paying HPF in Seven Cities: 2003-2013 (%)

Year	Beijing	Shanghai	Tianjin	Chongqing	Guangzhou	Wuhan	Hangzhou
2003	8	5-13	8	7-15	5-8	7	8-10
2005	8-10	7-15	8	7-15	5-20	8	8-12
2007	8-12	7-15	10	7-15	5-20	8	8-12
2009	12	7-15	11	7-15	5-20	8-12	12
2011	12	7-15	11-15	7-15	5-20	8-12	12
2013	12	7-15	11-15	7-15	5-20	8-12	12

Note: The officially required rate for paying for HPF presented in this table presents the unilateral contribution to the HPF in which obligation rates on only one party.

(Source: Chen and Deng, 2014, p.994)

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[7] The HPF was originally named *'Zhu Fang Gong Ji Jin'* (住房公积金) in Chinese and is based upon the structure of Singapore's central provident fund, but only contributes to housing consumption (Lee, 2000). Detailed information on HPFs will be discussed in section 2.3.

[8] With regard to the deposit proportion of HPF, 5 per cent was suggested in 1991, and this figure was increased to 7 per cent, 8 per cent and 10 per cent in subsequent years (Wang, 2001; Li, 2010). In 2016, the Ministry of housing and urban-rural development of the People's Republic of China requires this proportion be no more than 12 per cent.

Table 2-2 shows the officially required deposit proportion rate for HPF, revealing the one-sided nature of the contribution, and noting that the aggregate contributory rate should be doubled. According to Table 2-2, it is clear that the rate varies substantially between cities in China. Guangzhou has the most flexible range of deposit proportion rates when compared with other cities, also it is the city with the lowest contribution rate after 2003. Beijing had a constant proportion rate since 2009, requiring HPF participation and the employer to deposit 12% of a participant's income to the HPF. This reveals the management and supervision of HPF are substantially decentralised. The implementation of the contribution rate for paying HPF is based on the base rate issued by the central government; the local authorities responsible for setting up a range within the base rate for paying HPF. The actual amount of HPF deposit for both employer and employee depends on the level of average local income, requiring that this does not exceed a given proportion of the individual's monthly income. For instance, some cities such as Beijing and Shanghai require that the maximum HPF deposit should not exceed three times the average local income; while cities such as Guangzhou, Xi'an require that level should not exceed five times the average local income (Chen and Deng, 2014, p. 945). This requirement to some extent aims to alleviate HPF inequality, but is not a thorough solution to resolve the problem of HPF inequality that arises from income inequality.

Subsequently, comprehensive changes to the housing reform were proposed in 1994, when the market-based housing market was developed, and newly-built houses were sold onto the market at market price. Homeowners then extended full ownership of their properties, and were permitted to resell their houses (Deng et al., 2009). In addition, the ECH[9] project is engaged was initiated to help resolve housing difficulties for low and middle-income households (Li and Yi, 2007; Wang and Murie, 2011). The ECH scheme is a housing assistance scheme designed assists low-income households to overcome the barriers to achieving homeownership, providing economical and comfortable houses supplied by local authorities and housing investors at affordable prices (Rosen and Ross, 2000). The qualification rules for

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[9] The ECH scheme is originally named 'An Ju Gong Cheng' (安居工程) in Chinese language, this is the major source of affordable house in China, which represents the help-to-live programme for urban residents (Gao, 2010).

obtaining economical affordable houses are strict, and applicants should be registered with a local 'hukou' record, and their household income should remain in the low-income level; moreover, the house should not be transacted within the first 5 years after purchase. However, there are challenges implementing this; since the project involved government subsidies and reduced developers' profits, the supply of economically affordable housing has been limited. In 2010, the supply of affordable housing was 3 per cent of the entire newly-built housing stock (Barth et al., 2012). The proposal put forward in 1994 represented a milestone in the housing reform process in China, indicating a comprehensive framework for housing reform, outlining further actions by which to develop the finance market.

2.2.5   After the Housing Reform: Achievements (1999 to present)

The progress of the nationwide housing reform was completed 1998, finally transforming the Chinese housing market into a market-orientated housing market, leading to a market-based housing market that functioned in a systematic way, and establishing the development of an HPF system and a mortgage market. The success of the housing reform provides affordable houses and purchase pathways for low-income groups, stimulating homeownership in China, and diversifying the housing types available on the housing market. Consequently, the household's tenure choice in urban areas can be grouped into two categories, as classified in Figure 2-3. Owner-occupied houses now comprise different types of houses, including houses transferred from allocated houses under the housing reform, and newly-built houses sold at market price. As introduced above, affordable housing is a housing assistance project, making housing available to qualified households, and assisting low-income households to overcome housing difficulties. In terms of renting houses, social rented houses were introduced to the public housing sector alongside the housing reform, in order to satisfy housing demand for those who unable to enter the housing market.

Figure 2-3: Residential Housing Types in China Housing Market
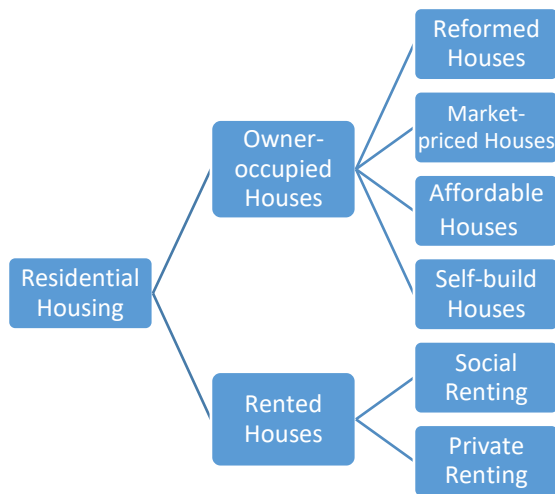
(Source: Author's Own Diagrammatic Representation)

The housing reform in China led to an enormous surge in the homeownership rate, because of the large numbers of allocated houses transferred to their occupiers, upon receipt of the specified purchase cost (Burell, 2006; Barth et al., 2012). Consequently, the homeownership rate in China is now higher than that in the UK and the US. According to figures cited in the existing literature (see Figure 2-1), the homeownership rate for owner-occupied houses in urban areas was less than 20 per cent at the beginning of the 1980s (Wang and Murie, 2011), but by 2000, this figure had increased to more than 70 per cent (Huang, 2004). A further 30 per cent of urban homeowners were purchasing their formerly allocated houses under the housing reform (Huang and Jiang, 2009). By the end of 2010, the proportion of private owner-occupied houses had risen to 80.3 per cent in the Chinese housing market (Wang and Murie, 2011; Barth et al., 2012); and in 2011, the homeownership rate stood at 89.3 per cent (Chen et al., 2013), which has an unprecedented increase when compared with that in the 1980s. More importantly, 40.1 per cent of this homeownership rate was due to the transition to publicly owned houses during the reform period from 1998 to 2000 (Shi et al., 2016). In addition, the housing reform improved living conditions for many urban households, resulting in average living spaces for urban households increasing to 20.3 per head by 2000 (NBS, 2010), when compared with 7.18 per square metres per head in 1980s (Tang, 1989).

The market-dominated housing system has developed rapidly since the implementation of the housing reform. House prices have witnessed a continuous increase and there has been an accompanying growth in housing demand over time, prompted by the housing reform. However, the growth in income has not kept pace with house price appreciation, with the result that a growing number of households, especially those on low-income level, experiencing the difficulties of buying a house. Many Chinese households have had to postpone their purchase plans, and so housing affordability is of great concern, influencing tenure choices, and preventing more and more low and middle-income households from achieving homeownership.

2.3   The Housing Assistance Policy: Housing Provident Fund

2.3.1   Performance of the Housing Provident Fund

The HPF project was initially introduced as a pilot in Shanghai in 1991, which was designed as a tool for obtaining funds for housing investment, absorbing the aggregated quantity of the HPF funds to 45 million Yuan. Subsequently, it was introduced to Beijing, and Guangzhou in 1992, reflecting its success. It has since also been used to provide policy loans for SOEs and investors seeking to build houses. In addition, the HPF was targeted at funding housing developments under the economical affordable housing project, between 1994 and 1998. After the implementation of the nationwide housing reform in 1998, the central government halted the pilot stage of the HPF, endorsing it as a fully implemented legal policy to assist in managing housing difficulties for individuals (Burell, 2006). The dedicated HPF Management Provision was enacted to regulate and operate the HPF (Burell, 2006). From that point onwards, the HPF was no longer used as a tool for raising funds under the economical affordable housing project, it became instead a tool for financing housing purchases at lower-rates, as a means to stimulate home ownership rates among individuals. Consequently, the HPF has now been widely introduced across the nation, in cities above the country administrative level.[10] In total, 200 cities have launched the HPF system, and by 2004, the

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[10] Currently, the administrative divisions of China have consisted of five practical levels of local government, which is the provincial level (1st level), prefecture level (2nd level), county level (3rd level), township level (4th

majority of cities with a population of 5 million or more had implemented the HPF system successfully (Wang and Murie, 1999; Burell, 2006).

The function of the HPF has been transited to a significant housing policy tool, enabling households to save deposits for housing purchases, to resolve housing difficulties and improve housing affordability. Firstly, this is a compulsory saving scheme, requiring employees from SOEs, government institutions, and public agencies to deposit a given percentage of their monthly income in a designated HPF account, after they have been employed for over a year (Wang and Murie, 1996; 1999; Ying et al., 2013; Tang and Coulson, 2017). All enterprises, including private companies, joint ventures, government institutions, public sectors and social organisations were required to contribute an equivalent proportion of their employees' income to the HPF account. Secondly, the HPF deposit could be withdrawn after one-year of saving, and utilised for housing related purposes, such as home purchasing (either economically affordable or commodity houses), self-building, home improvement, or decorating. In addition, the HPF was designed to provide housing debt at a lower interest rate, homebuyers could apply for HPF housing debt in conjunction with a mortgage (Wang and Murie, 1996; Barth et al., 2012).

The formula displayed below shows the calculation for monthly savings under a HPF:

Monthly savings for HPF = monthly Income Base × (required depositing proportion
for employee + required depositing proportion for an employer)
where,
Monthly Income Base= monthly average income of the previous year

The deposit proportion of HPF was set at 5 per cent of the employees' monthly income in 1991; this figure was later raised to 7 per cent, 8 per cent and 10 per cent over time (Wang, 2001; Li, 2010). The monthly savings of working people in the HPF should be calculated

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level), and village (5th level). The country level contains autonomous counties, county-level cities, banners, autonomous banner, and City districts. In the end of 2015, there is total of 2,850 regions at county-level in Mainland China (China Statistical Yearbook 2016, Ch. 1-1 'Divisions of Administrative Areas in China').

according to the second-month's income or actual monthly average income. According to official announcements, the upper limit for total monthly HPF savings was 4654 Yuan in 2016, when the amount deposited should not exceed 12 per cent.[11] The HPF is exempt from personal income tax, and the employer's contribution to the HPF is deducted before tax.

2.3.2 Contributions of the Housing Provident Fund System

To some extent, the government's intention in initiating the HPF system was to provide the necessary foundation to stimulate a move towards a market-oriented housing mechanism, promoting the commercialisation of housing (Lee, 2000; Yeung and Howes, 2006). The HPF provided a platform that connecting the efforts of government, employers and employees; it was also designed to enhance the housing allowance and create opportunities for households to enter the owner-occupied market. As discussed previously, the HPF was primarily designed as a financial tool to advance the ECH scheme (Lee, 2000). After the introduction of the housing reform, the HPF sought to reduce housing affordability difficulties for low and middle-income households by granting them access to low-rate debt, thereby stimulating the development of a market-oriented housing market (Burell, 2006). A low-level mortgage rate reduces housing costs and the overall size of mortgage debt, thereby stimulating housing demand for the majority of middle and low-income households. Moreover, the HPF contributed to a transition in mentality, from the reliance on an allocated housing system to the adoption of a new aim, i.e. achieving the homeownership by obtaining housing debt. Data concerning the uptake of HPF verifies this shift; showing that by the end of 2007, the accumulated HPF deposits had exceeded 16230 hundred million Yuan, whereas the net deposits in 2007 was 3543 hundred million yuan. Moreover, overall, 50 million employees had drawn from their HPFs in 2007, in an amount equivalent to 6625 hundred million Yuan, whilst 80 per cent of drawings had been used for housing purchases (MOHURD, 2008). Table 2-3 below illustrates the progress of HPF deposits and debts between 2000 and 2008, and 2014 (data are not available for the years between 2009 and 2013, since MOHURD did not

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[11] For more information, please see http://www.zzz.gov.cn/index.jsp.

publish any briefings at this time). Table 2-3 shows that HPF deposits rose from 1797 hundred million Yuan to 37047 hundred million Yuan from 2000 to 2014.

Table 2-3: Data on Deposits and Debt of HPF (2000-2008, 2014) (Unit: 100 million Yuan)*

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2014
Net Deposits	638	907	851	1358	1838	2359	2928	3543	4470	12957
Net Debt	231	395	620	751	1621	1195	1765	2202	2036	6593
Aggregated Deposits Balance	1797	2405	2952	3814	4894	6260	7871	9605	12116	37047
Aggregated Debt Balance	517	830	1143	1583	2230	2834	3805	5074	6094	42245

Note: *Data between 2009 and 2013 are not available since MOHURD did not publish any briefings for that period. (Source: MOHURD, 2008-2010, 2014)

In relation to the usages of the HPF, it functions as a long-run housing assistance tool for housing purchases. The majority of employees, especially those in middle and low-income groups are heavily reliant on the HPF system. Since 2007, the function of HPF has been extended to deliver financial support for social-renting, contributing further to affordable housing projects and the public rental sector. It is now the broadest administered coverage help-to-live system across the nation. The data show that 324 cities (including Xinjiang Production and Construction Corps) had set up the HPF Centralised Management Centre, and that there were also 208 centres in rural areas by 2014. The number of work units providing HPF was 2.065 million, encompassing 11.88 million of employees (MOHURD, 2014).

When evaluating the HPF system in terms of its broader contribution, it becomes apparent that it has provided a good fertile in which to develop the housing finance market. From the supply side, the HPF functioned as an effective financial tool under the ECH scheme prior to 1998, resolving the housing shortage caused by financial problems. Moreover, the HPF was endorsed as a dedicated housing policy for the demand side after 1998, with the aim of mitigating housing difficulties by granting low-rate debt to HPF holders. As a consequence, the HPF encouraged a number of households to enter the owner-occupied market by obtaining low-cost housing debt. As documented in a number of studies, it is evidenced that the HPF is now effective at improving housing affordability for homebuyers, reducing housing

difficulties by providing low-rate housing debt, thereby leading to an increase in the homeownership rate (Ying et al., 2013; Xu, 2016; Chen and Yang, 2017).

2.3.3   Limitations of the Housing Provident Fund System

Undeniably, the HPF system has functioned effectively as a housing assistance policy, providing financial support for home purchases and contributing to developments in the housing and housing finance market; however, the system has some limitations.

Firstly, accessibility to the HPF for those most in need is limited. In relation to the qualification of the HPF, those who have signed an employment contract for over a one-year length to become actively involved. This means groups such as laid-off workers, rural migrant workers, temporary-employed, and self-employed individuals are excluded from participating in the scheme (Yeung and Howes, 2006; Burell, 2006). More specifically, data has revealed that rural migrant workers[12] and temporary workers numbering around 277 million, in 2015, are excluded from the HPF system (NBS, 2015). This group need the support of HPF when it comes to housing purchases, because they lack sufficient household income and have low prospects of increasing family wealth.

In addition, the HPF system has extended tangible social inequalities, because it exaggerates income inequality. Typically, those with higher income obtain more benefits than low-income groups (Yeung and Howes, 2006). As house prices are increasing at a faster rate than incomes, the HPF only alleviates the housing difficulties of the high-income group, who can thereby access the market more quickly, due to their larger HPF deposits, which enable them to obtain low-rate HPF debt. Research conducted in Beijing found that over 80 per cent of HPF debt is applied for by high-income families (Wang, 2000). More specifically, those who have low professional status, basic educational attainment, and low-paid jobs obtain relatively few benefits from the HPF, and as has been empirically evidenced in a number of recent studies (Ying et al., 2013; Xu, 2016).

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[12] Also termed as 'Nong Min Gong' (农民工) in Chinese.

As discussed previously, the HPF scheme is an income-based housing assistance project that absorbs a set proportion of employees' monthly income, providing a given amount of low-rate HPF debt to mitigate housing difficulties nationally. By 2014, the proportion of employees using HPF debt for housing purchases had reached 68.69 per cent across the nation (MOHURD, 2014). However, low-income employees are generally unable to save enough to become eligible to obtain HPF debts (Burell, 2006). This is because HPF is an income-based housing assistance system that absorbs a fixed proportion of the employees' income. Therefore, exaggeration of income inequity is a significant feature at the root the HPF system. In addition, regional inefficiencies and discrepancies mean that developed regions have greater opportunities to benefit from the HPF system. Therefore, in subsequent sections, data at the national level are graphed to show the regional differences in housing and economic sectors. Moreover, in the subsequent chapters of this thesis, data at the household level are employed to examine the regional differences in the HPF system, highlighting the implications of disparities.

As referenced in the preceding section, the coverage of the HPF has expanded to most cities in China. However, the benefits of HPF vary across the country, according to the levels of economic development in each region. Developed cities, such as Shanghai and Beijing, have absorbed more HPF funds, and their economic statuses have provided residents with greater access to HPF debt. Data show that by the end of 2015, the aggregated HPF deposits in Beijing were 7902.51 hundred million Yuan, whereas those in Shanghai were 6096.56 hundred million Yuan. Meanwhile, Guangzhou absorbed fewer HPF funds than the other two cites, but remained at 3869.21 hundred million Yuan.[13] However, in contrast, developing cities like Lanzhou, absorbed aggregated HPF deposits of 550.39 hundred million Yuan in 2015, representing just 6.9 per cent of Beijing's figure (MOHURD, 2015). Moreover, the maximum debt that employees can obtain from their HPF accounts varies between cities. Data show that employers located in Beijing could obtain the eligible maximum HPF debt of 1.2 million Yuan per employer in 2015, and employers in Shanghai could obtain 1 million Yuan per employer, while those in Guangzhou could obtain up to 0.6 million per employer, half the

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[13] Guangzhou is the provincial capital city of Guangdong province, whereas Guangdong province absorbed 9162.53 hundred million Yuan HPF funds in 2015.

sum in Shanghai. Thus, the economic differences between the regions influence the HPF due to variations in regional unemployment, income levels and the implications and impact of monetary policies.

The HPF is a housing assistance policy that aims to overcome housing difficulties and helping low- and middle-income households to achieve homeownership. As it is a demand-side assistance policy, it would not dramatically increase house prices, for the reasons that follow:

Firstly, the intended outcomes driving the implementation of the HPF were to overcome liquidity constraints and achieve homeownership using for average-to-low and low- income households by granting access to HPF housing debt (Burell, 2006; Wang and Murie, 2011). However, the HPF system operates very strict criteria to decide whether to grant HPF housing debt, setting an upper limit for the HPF debt that a borrower can apply for. This to some extent restricts potential borrowers (especially new HPF participators) from accessing HPF housing debt, and when entering the homeownership market. The intention of the housing assistance policy is to allow purchase of affordable housing for those proven to be in a position to access it (Li and Yi, 2007; Wang and Murie, 2011). Thus, the HPF housing debt can be used for the purchase of affordable housing; however, the central government announced the restrictive policies on sales of affordable housing within the HPF framework, requiring that owners of affordable houses cannot resell their properties within 5 years. If they need to sell they must to seek approval from the relevant government agency and if sale is permitted, they had to sell at the original purchase price (Mak et al., 2007). This policy to some extent reduces interest from speculators, effectively controlling the house price appreciation for affordable housing.

Second, as was discussed in section 2.3.3, the accessibility to HPF is restricted; some households such as self-employed, seasonal workers, migrants, and low-skilled workers are excluded from participating (Wang and Murie, 1999, 2000; Li and Yi, 2007). As a result, it would prevent some potential homebuyers from entering the homeownership market, subsequently reducing the demand for housing from those groups.

Aside from assisting housing purchases, the outcome of HPF now has now been extended to support rental payments since 2007. A Notice was jointly issued by the PBOC, the MOF, and the MOHURD in 2015,[14] requesting the release of the requirement to use HPF savings to support rental payments, in order to stimulate the implications of the HPF on house renting. This notice allows HPF participators, who have paid for HPF for 3 consecutive months in full, and who have not owned an owner-occupied home or rented a public rental property, to use their HPF savings for a rental payment. This action buffers the down payment pressures for liquidity constrained households, allowing disadvantaged households with insufficient capacity to save longer for the housing purchase while maintaining the rental tenure. In addition, this action serves as a policy to disperse demand for housing throughout the country; therefore, the HPF would not be expected to trigger a house price rise.

In light of above-mentioned factors, the HPF would not be expected to have a direct impact on house price appreciation at this stage; since its initial aim is to reduce housing difficulties, enabling households to achieve homeownership, as per the government's aims.

2.4   Development of the Chinese Housing Finance Market

It is essential to explain the development of the finance market and the housing finance system before analysing the market performance of the Chinese housing market, as the finance market determines the availability of mortgages and has a significant role in the development of the housing market. For this reason, it also corresponds closely to the transmission of the monetary policy. This section focuses on the housing finance market in China, detailing the circumstances within the mortgage market, and explaining how housing finance assists housing purchases, and how the government regulates the overall stability of the finance market.

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[14] '*Notice on Releasing the Requirement of Using the Housing Provident Funds to Pay Rent*' (No. 17 [2015] of PBOC, MOF, MOHURD, January 01, 2015). In Chinese, 《关于放宽提取住房公积金支付房租条件的通知》

During the early stages of the housing allocation, the cost of the housing supply was fully financed by the government and SOEs, as they provided the main capital flows for housing allocation. At this time, there is no housing mortgage was available. Alongside the housing reform, experiments involving the sale of public houses to sitting tenants were conducted in pilot cities. From the outset, public houses were sold at one-third of construction costs upon receipt of a single payment, but eventually, payment methods were improved to include instalment plans (Wang and Murie, 1996; Lee, 2000; Deng et al., 2005). This represented the origin of mortgage debt in China, as a means to raise funds for housing purchases.

A number of actions were then launched subsequently, serving to develop the financial market. In 1994, mortgage debt was first introduced (Deng et al., 2009); however, this action was accompanied by very strict lending criteria. Mortgages were only issued to borrowers with savings equivalent to 30 per cent of total house prices. The first payment was capped at 30 per cent of the total cost of housing, and the maximum duration for a mortgage was 5 years (Deng et al., 2009). Under these stringent restrictions, the majority of urban borrowers were unable to meet the lending criteria, due to lack of household savings. Consequently, the level of mortgage lending remained very low in the late 1990s.

In response to the success of the housing reform, the People's Bank of China (PBOC) modified mortgage-lending regulations in 1998. This proved to be a milestone in the development of the finance market. The mortgage lending criteria were modified, requiring a maximum loan-to-value ratio of 70 per cent, and the maximum duration for a mortgage was extended to 20 years, and it was extended to 30 years in the subsequent years (Deng et al., 2005; Deng et al., 2009). The benchmark mortgage interest rates were centralised controlled by the PBOC (the Central Bank), and mortgage rates for all long-term mortgages (in excess of 5 years) were required to follow bank lending rates as set by the Central Bank. Meanwhile, mortgage lenders could set up their own mortgage rates by offering a floating point for first-time buyers. The floating point actually was a preferential mortgage interest rate, the PBOC set up the level of mortgage rate allows 10 basis points below benchmark lending rate with the same terms until August 2006 (Deng et al., 2009). Subsequently, the floating points changed from 10 points to 15 points for the period from August 2006 to October 2008, then increased to 30

between October 2008 and March 2010 before rising once again to 15 points (Fang et al., 2016, p.46). The maximum spread between long term (over five years) and short term (five years or less) mortgage rates was capped at 36 basis points in 2006. Subsequently, in the latter half of 2007, the minimum spread was capped at 9 basis points. Currently, all residential mortgages in China are adjustable rate mortgages (ARMs), and when the Central Bank announces changes in policy rates, the new rate is then applied to all existing mortgage loans in the market without caps, from the beginning of the following year.

As active participants in mortgage lending and resulting from the sensitivity of ARMs loans to changes in the interest rate regime, lending institutions, directly or indirectly, became highly exposed to market risks and credit risks at each stage of housing market operations, responding to changes in housing values and resultant changes in working capital risks (Deng et al, 2005). The resultant risks were compensated for by growing profits from the housing/mortgage markets, interacting with capital markets and are affected by quantitative easing policy changes. This is because the expansion of monetary supply facilitates rises in property prices via the availability of credit, extending the gap between house prices and incomes. Conversely, support for quantitative easing and the interest rate regime from the perspective of the housing industry also contributed to the rapid growth in household's mortgage loans and the promotion of homeownership and investment growth in housing (Li et al., 2010).

Combined with HPF across the country, the dual debt product was introduced to the market, and borrowers were permitted to jointly apply for a mortgage and HPF housing debt to support their housing purchases. However, responding to the sluggish implementation and the strict lending criteria of the HPF system, mortgage lending accounts for the largest proportion of household borrowing. Four state-owned banks hold 90 per cent of market shares in the primary mortgage market,[15] which is: The China Construction Bank (CCB); the Agriculture Bank of China (ABC); the Bank of China (BOC); and the Industrial and Commercial Bank of China (ICBC) (Deng et al., 2009). There are some joint-equity commercial banks that

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[15] The secondary mortgage market is not available nationwide yet.

also provide mortgage lending, although, they are responsible for a relatively small proportion of mortgages when compared to the state-owned banks.

The development of the finance market, especially the growth in mortgage lending, fuels the demand for housing in the Chinese housing market, because the availability of mortgages and the amount of mortgage flows is continuously rising. Housing demand accelerated due to the termination of the housing allocation coupled with modified lending regulations. The development of the finance market has also witnessed rapid growth, becoming the largest residential mortgage market in Asia by 2005, with an outstanding balance exceeding around 198 billion dollars[16] (Deng and Liu, 2009). Zhang et al. (2012) stated that the housing market has become an important real capital market, one essentially connected to monetary growth and house price appreciation in China, responding to the success of national housing market reform in 1998.

Monetary policies influence the finance market by adjusting the level of interest rate, money supply, and regulating mortgage flows into the finance market. Since 1991, the PBOC, the State Council, and China's Banking Regulatory Commission (CBRC) have announced a number of notices to regulate the development of the lending market, as shown in Table 2-4:

Table 2-4: Key Policies to Manage Regulations of the Lending Market alongside Housing Reform to date

1991	The China Construction Bank (CCB) and the Industrial and Commercial Bank of China (ICBC) started to grant debts for housing purchase.
August 1995	The PBOC promulgated a 'Notice on *The Interim Measures for the Administration of Commercial Loans for the Purchase of Owner-occupied Housing'*,[17] formally launching loans for housing purchases, including setting the requirement to provide collateral items. Borrowers should have a deposit equivalent to 30 per cent of total housing costs, and the duration of savings should not be less than 6 months. For the first time, the maximum length of a mortgage was increased to 5 years.

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[16] The exchange rate from USD to RMB in 2005 is 8.1823 (data source: St. Louis FRED).

[17] In Chinese, 《商业银行自营住房贷款管理暂行办法》

1997	The PBOC issued an amended *'Interim Measures for the Administration of Personal Loans'*,[18] including cancellation of the requirement for collateral, and implementing floating points for the base interest rate, to set up preferential mortgage rates. The maximum length for a mortgage was extended to 10 years.
April 1998	The PBOC enacted a *'Notice on The Management of Mortgage to Individuals for the Purchase of Owner-Occupied Housing'*,[19] stating the following four key principles: First, individual mortgages can be used for all types of housing. Second, mortgage lending is to be implemented nationwide, including in towns and small-sized cities. Next, all commercial banks across the nation were eligible to grant mortgages. Finally, the mortgage interest rates were to be set at below the base lending rate.
1999	The PBOC issued the *'Several opinions on Promoting Consumption Loans'*,[20] adjusting the Loan-to-Value (LTV) ratio to 80 per cent, while also reducing the floating points for HPF rates. The maximum length of a mortgage was extended to 30 years.
June 2003	The PBOC enacted a *'Notice on further Strengthening the Management of Real Estate Debts'*[21], indicating that the LTV ratio remained at 80 per cent for 1st time homebuyers, while increasing the down-payment requirement for homebuyers purchasing high-grade apartments and obtaining 2nd properties. In addition, it was required that there are no floating points for mortgage rates for those homebuyers.
August 2004	CBRC published *'Notice on Issuing the Guidelines for Risk Management Real Estate Loans of Commercial Banks'* (No. 57 [2004] of CBRC, August 30, 2004),[22] requiring that the monthly payment to monthly income ratio should be below 50 per cent.
March 2005	The PBOC issued a *'Notice on Adjusting the Housing Debt Policy and Excess Reserve Interest Rate for Commercial Banks'*[23], indicating that the requirement for the down payment ratio be increased to 30 per cent, namely, the LTV ratio was reduced to 70 per cent. The floating points for setting up a mortgage rate should then be 10 basis points below benchmark lending rate.
May 2006	The PBOC enacted *'Notice on Adjusting the Housing Debt Policies'*,[24] requiring that the LTV ratio for the purchase of an owner-occupied house remain 70 per cent, but that the ratio can be increased to 80 per cent for those buying houses under 90 square metres in size.

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[18] In Chinese, 《个人担保住房贷款管理办法》

[19] In Chinese, 《个人住房贷款管理办法》

[20] In Chinese, 《关于鼓励消费贷款的若干意见》

[21] In Chinese, 《关于进一步加强房地产信贷业务管理的通知》

[22] In Chinese, 《商业银行房地产贷款风险管理指引 （银发〔2004〕57 号）》

[23] In Chinese, 《关于调整商业银行住房信贷政策和超额准备金存款利率的通知》

[24] In Chinese, 《关于调整住房信贷政策有关事宜的通知》

August 2006	The floating point for setting up the mortgage rate was adjusted to 0.85 multiples of the base lending rate.
2007	The PBOC sought to head off rising inflation, cooling the housing market with a contractionary monetary policy in 2007, in accordance with six base interest rate rises (start from March to December of 2007), raising the base rate from 6.12% to 7.47%. The CBRC issued a '*Notice on Strengthening the Management of Real Estate Debts*' (No. 359 [2007] of CBRC, September 27, 2007),[25] adjusting the LTV ratio for 2nd time homebuyers to 60 per cent; and the floating points was 10 points over the base lending rate (1.1 multiples of the base lending rate). For first-time buyers purchasing houses under 90 square metres, the LTV ratio remained 80 per cent, while first-time buyers obtaining house above 90 square metres, the LTV ratio was adjusted to 70 per cent.
2008	The PBOC adjusted the minimum LTV ratio to 80 per cent for 1st time homebuyers, and reduced the floating point to 0.7 multiples of the base lending rate. The PBOC adjusted the base rate with five reductions in 2008 (since September of 2008), lowering the base rate from 7.47% to 5.31%.
April 2010	The State Council issued a '*Notice of the State Council on Resolutely Curbing the Soaring of Housing Prices in Some Cities*' (No. 10 [2010] of State Council, April 17, 2010),[26] requiring banks to reduce the LTV ratio to 70 per cent for 1st time homebuyers, and 50 per cent for 2nd time homebuyers. Requiring the floating point for a mortgage rate to be no less than 10 points over the base lending rate (no less than 1.1 multiples of the base lending rate). It is necessary to limit speculative housing purchase. Commercial banks may suspend granting the mortgage for third-time buyers in accordance with the lending conditions in areas where house prices are regarded as excessive. In addition, it is necessary to suspend the granting of mortgages for non-local residents who have failed to provide proof of local tax payments or social insurance payments for more than one year.
2015	The PBOC adjusted the base rate with five base rate decreases in 2015, making the base rate from 5.60% to 4.35%, to stimulate the investment and mortgage borrowing in the housing market. The PBOC, MOHURD, and CBRC jointly issued a '*Notice on further Regulating the Business of Personal Housing Mortgage Loans*',[27] requiring that, to further exert the role of HPF in supporting housing consumption, for first-time buyers that have joined the HPF, the minimum down payment proportion is 20 per cent. While for those who have paid off the

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[25] In Chinese, 《关于加强商业性房地产信贷管理的通知 （银发〔2007〕359 号）》

[26] In Chinese, 《国务院关于坚决遏制部分城市房价过快上涨的通知（国发〔2010〕10 号）》

[27] In Chinese, 《中国人民银行 住房城乡建设部 中国银行业监督管理委员会关于个人住房贷款政策有关问题的通知》

	housing debt for the first property and now intend to buy a second property, the minimum down payment ratio for the HPF mortgage is 30 per cent.
2015-2016	The CBRC required that in regions that do not apply property-purchasing limitations, the LTV ratio for first time homebuyers should be set at 75 per cent, while that of 2nd time homebuyers to be 70 per cent; and the floating point for the mortgage rate should be 5 points below the base lending rate.

(Source: Author's summary based on official documents)

Table 2-4 summarises some of the key policies put in place to regulate the development of the lending market, including the adjustment of LTV ratios, setting up floating points for the mortgage rate, and extending the maximum duration of mortgages. The notice announced in 1995 outlined the first framework for the mortgage loans in China, specifying regulatory requirements would need to be met. Interestingly, in 2004, the CBRC issued a notice requiring the ratio of monthly payment to monthly income should remain below 50 per cent. This is a relatively loose requirement for mortgage affordability, compared with the theoretical requirement that the mortgage payment to income ratio should not exceed 30 per cent. As shown in Table 2-4, a number of articles were announced over the years, to regulate the lending environment for housing mortgages, also tightening the borrowing requirements for the second time housing purchases, in order to curb speculative housing purchases and control the surge in house price in some cities.

2.5   An Overview of the Economic Circumstances

This section details the circumstances of the Chinese economy, illustrating the macroeconomic performance and the developments in the housing market by involving key economic indicators. National level data, obtained from CEIC database and the World Bank database, are graphed here to illustrate the economic circumstances. The period for quarterly data spanning between 2000 and 2015, and that for annual data between 1998 and 2016 are illustrated.

2.5.1 Macroeconomic Performance

Existing studies revealed that the performance of the housing market relates to outcomes in the macroeconomic market. In particular, house price fluctuations are linked to GDP, unemployment rate, population growth, urbanisation rate, inflation rate, housing investments, etc. (Kim, 1993, 2004; Muellbauer and Murphy, 1997; Andrew and Meen, 2003; Adams and Füss, 2010). When examining the factors influencing housing affordability, it is essential to elaborate on the performance of the macroeconomic environment and the housing market, providing theoretical support when identifying the factors that drive housing affordability changes at the aggregate level.

China underwent a set of structural transformations as the economic system is transitioning from a centrally planned economy to a market economy; a change followed by the bullish progress of privatisation, industrialisation, and commoditisation. Consequently, the Chinese economy has been growing at an average rate of almost 10 per cent, since it embraced economic reforms and free-market principles (author's self-calculation based on Figure 2-5). Figure 2-4, 2-5 and 2-6 show China's GDP and GDP growth rate. Figure 2-4 reveals that China underwent rapid and continuous economic growth during the sampled period, although the corresponding GDP growth rate experienced cyclical volatility over that period (see Figure 2-5). Figure 2-5 displays the annual GDP growth rate over the sampled period between 1998 and 2016, encompassing two financial crises that took place during the period. During the Asian financial crisis (as shown in Figure 2-5), the GDP growth experienced a slight decline, reaching 7.67 per cent in 1999. After this time, China experienced a bullish growth in GDP between 2000 and 2007, peaking at 14.4 per cent in 2007. However, as a consequence of the global financial crisis (GFC) in 2008 (as shown in Figure 2-5), the annual GDP growth rate declined sharply from 14.23 to 9.65 per cent in 2008, reducing further to 9.4 per cent in 2009. However, the country's economic growth was impressive at this time, when compared with its slowdown during the Asian financial crisis in 1998. After the GFC, China regained its bullish growth in GDP; attaining an average growth rate of almost 8 per cent since 2009. However, the growth in the Chinese economy has been witnessing a continuous decline since 2010, representing a new era of a shift from high-speed growth to high-quality development.

China GDP: 1998-2016
(Unit: 100 million Yuan)
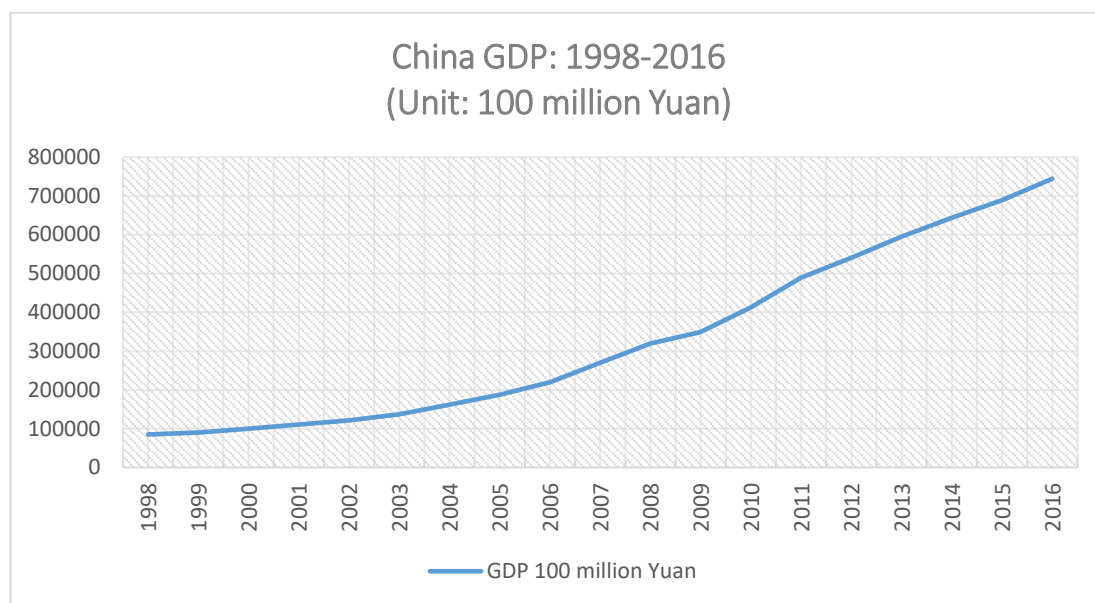
(Source: CEIC database)

GDP Annual Growth Rate (%)
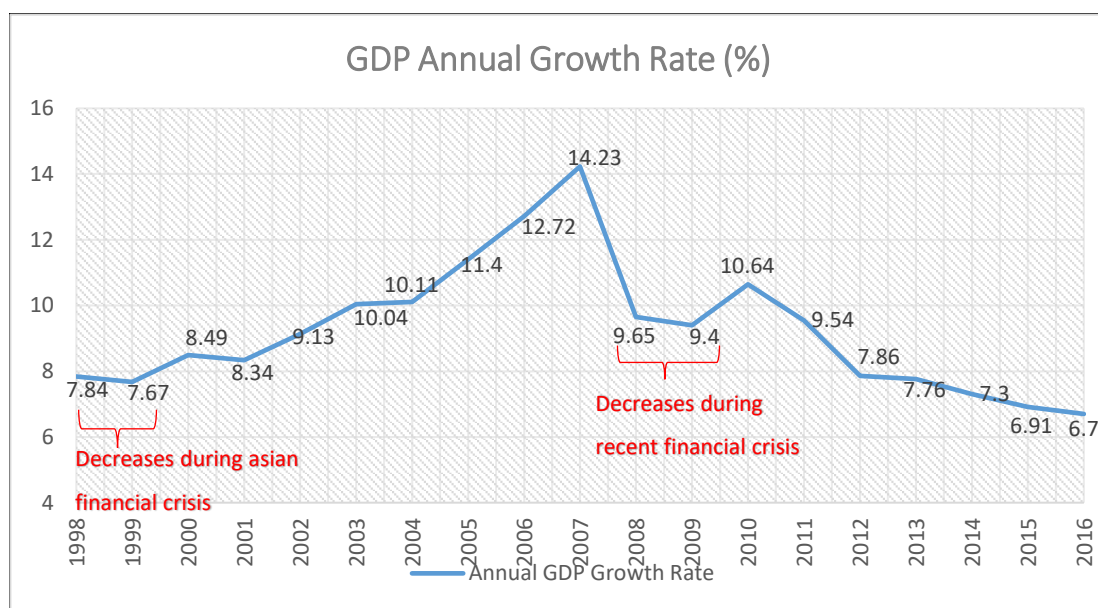
(Source: CEIC database)

Comparing with the annual GDP growth rate displayed in Figure 2-5, Figure 2-6 presented below displays the quarterly GDP growth rate, spanning between 2000 Q1 and 2016 Q3, showing the growth rate fluctuated with great volatility between 2000 Q1 and 2007 Q3, peaking at 14.4 per cent by 2007 Q3. Subsequently, the GDP growth experienced a sharp

decline from 2007 Q4 to 2009 Q1, reaching a low of 6.4 per cent in 2009 Q1, due to the GFC. The declines in GDP growth during the GFC led to an increase in price levels and a decrease in income growth (see Figures 2-8 and 2-9). Similarly, household debt experienced a sharp decline during 2007 Q1 and 2008 Q4 (as shown in Figure 2-19) in response to the influence of GFC and the fall in the M2 supply (see Figure 2-17).

After the GFC, China regained bullish growth in GDP between 2009 Q2 and 2010 Q1, peaking at 12.2 per cent by 2010 Q1. However, the pace of economic growth later slowed, reaching 6.7 per cent by the end of the fourth quarter of 2016, which was the slowest growth since 1990. The reasons for this are as follows: First, the soring growth in China's economy has long been built on the manufacturing sector and export of manufactured products, benefiting from the country's supply of labour. However, a decline in population growth, affected by the birth control policy,[28] leading to a reduction in the size of the working-age population, resulting in a slowdown in output growth. An additional factor was that China was trying to shift its industrial structure from a manufacturing and export-based economy to a domestically driven economy. This change has led to reduced rate of economic growth.

Figure 2-6: Quarterly GDP Growth Rate
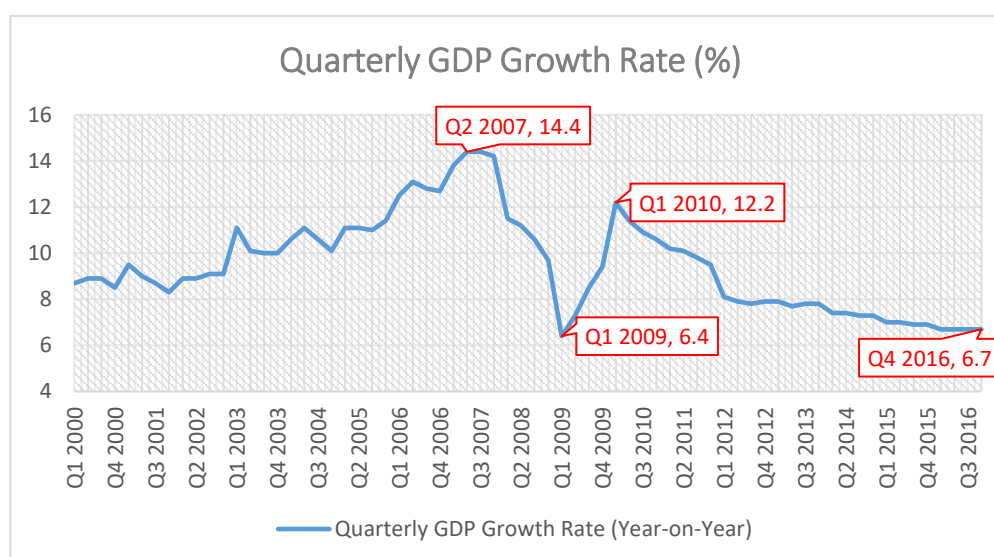
(Source: CEIC database)

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[28] Also called the 'one child policy', requiring that each urban household in China is permitted to have only one child, in order to control the excessive population growth.

Figure 2-7 presented below displays the inflation rate in China, which is measured by a year-on-year basis. The inflation rate fluctuates over time, reaching a peak of 8.03 per cent in 2008 Q1, because of the influence of the GFC. Due to the GFC, the growth in income proved to be far behind that of inflation. Figure 2-8 compares the growth rate in household income and inflation rate changes, revealing that the level of inflation goes beyond income growth in a number of periods, spanning between 2007 Q2 and 2008 Q3 (see Figure 2-8). Over the same period, a contractionary monetary policy was implemented, raising the interest rate level, and reducing the supply of money (see Figures 2-14 and 2-17). Alongside the transmission of the contractionary monetary policies, increases in the level of base interest rates were adopted as a tool for controlling economic development, and regulating inflation. As a result, the level of inflation experienced a sharp decline over a short period (from 2008 Q2 to 2009 Q2).

Figure 2-7: Quarterly Inflation Rate Changes (Year-on-Year Basis)
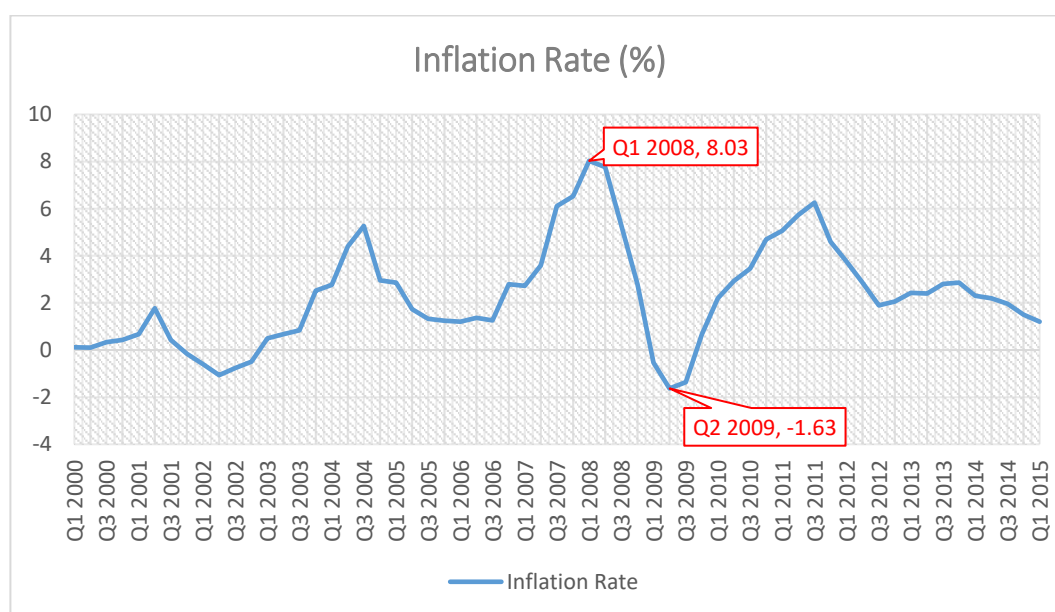
(Source: CEIC database)

Figure 2-8: A Comparison between Income growth rate and Inflation Rate
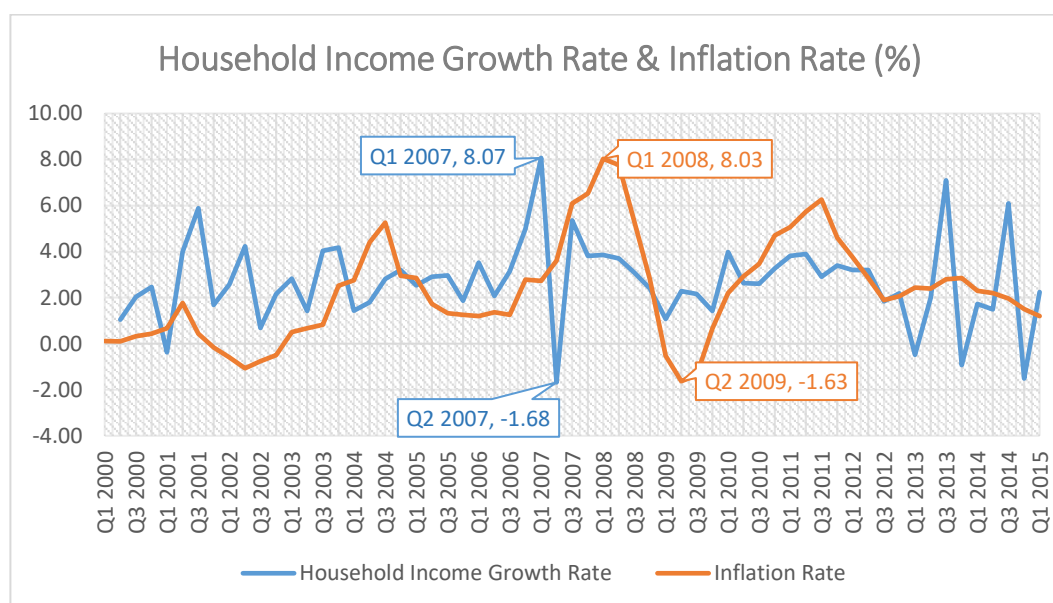
(Source: CEIC database)

Theoretically, the unemployment rate, inflation and interest rates are inter-related (Tobin, 1995). When the unemployment rate remains at a lower level, this results in an increase in income, creating more labour opportunities. This consequently raises the demand for housing, as households become more willing to enter the housing and mortgage market. However, a continuous increase in housing demand can fuel house price rises. Employment provides interaction between the national economy, the housing market, and the mortgage market. As shown in Figure 2-9, unemployment rates remain a low level in China. When considering the impact of economic development on the level of employment, it reveals that declines in GDP growth influence employment levels. In relation to Figure 2-6 and Figure 2-9, the increases in unemployment rate appear to coincide with the economic slowdown over the period of GFC. As mentioned previously, the effects of a slowdown in the economy worsen the employment environment, reducing job opportunities, weakening the demand for housing, as income growth becomes decline (Mian et al., 2015). In addition, the worsening employment level aggravates housing affordability problems. Existing borrowers might then be at risk of falling into arrears or encounter difficulties paying their mortgages due to incomes fall, and potential borrowers might suffer liquidity constraints (Feins and Lane, 1982; Quercia and Stegman, 1992; Horsewood and Doling, 2004; Gan and Hill, 2009).

Figure 2-9: Quarterly Unemployment Rate

Unemployment Rate (%)
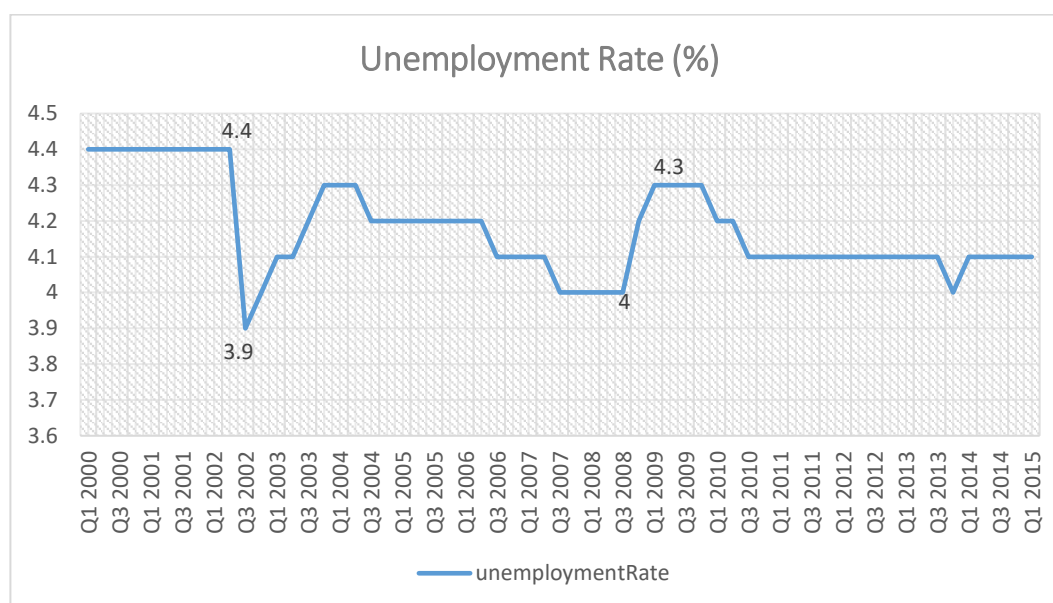
(Source: CEIC database)

In addition to the above, the progress of migration and urbanisation improved employment levels, providing additional work opportunities in tandem with economic development. Simultaneously, urbanisation drives housing demand alongside the increase in labour, household formations, and the level of household income (Goodman, 1982; Reichert, 1990; Feinstein and McFadden, 1989; Painter et al., 2001; Chen et al., 2011). In relation to China, urbanisation progressed continuously alongside industrialisation and the development of the economy, bringing migrants and labour sources from rural to urban areas, leading to an increase in the demand for housing (Chan, 2010). Figure 2-10 below displays the level of urbanisation in China between 2000 and 2016. It illustrates that the population growth rate in urban areas remained stable at an average of 1.5 per cent per annum during this period. According to Figure 2-10, the proportion of urban residents exceeded that of rural residents for the first time in 2011, peaking at 57.35 per cent in 2016, implying that the population residing in urban areas are now far exceeds that in rural areas.
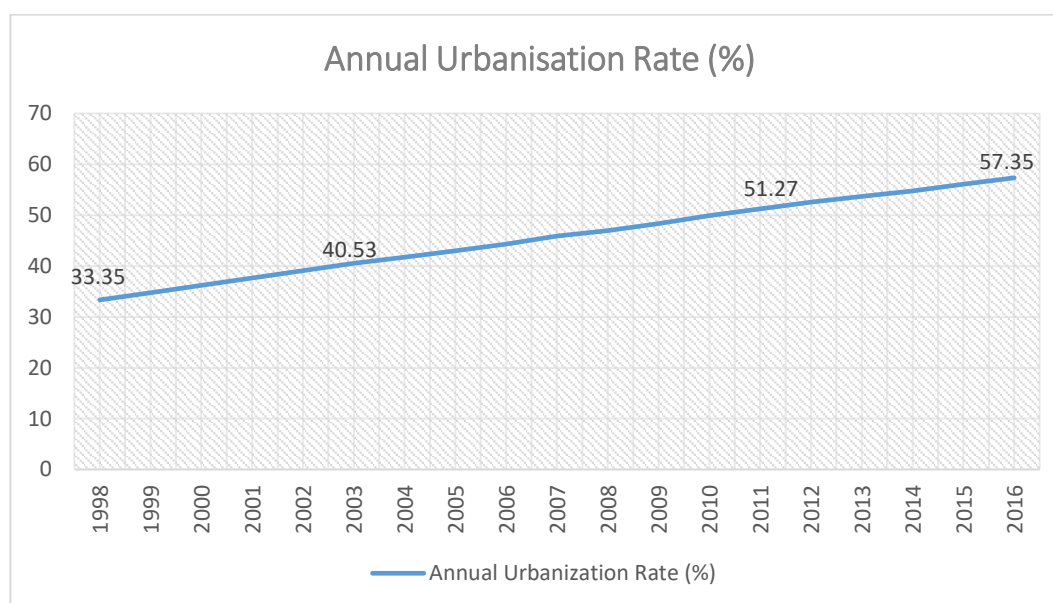
(Source: CEIC database)

Population size is linked to the level of economic development, and as such has a significant impact on housing demand (Muellbauer and Murphy, 1997). Figure 2-11 below displays the population growth rate since 1975. It reveals that between 1975 and 1987, the figure was volatile, and declined sharply since the late 1980s (see Figure 2-11). The triggers leading to the drop in population growth are complex; the most significant aspect being the implementation of a birth-control policy from the 1980s onwards, combined with the population's growing social mobility. Economic development and potential housing demand were also affected by the population growth rate, as declines in population growth typically result in labour shortages, sluggish investment, and reduced consumption.

Figure 2-11: Population Natural Growth Rate
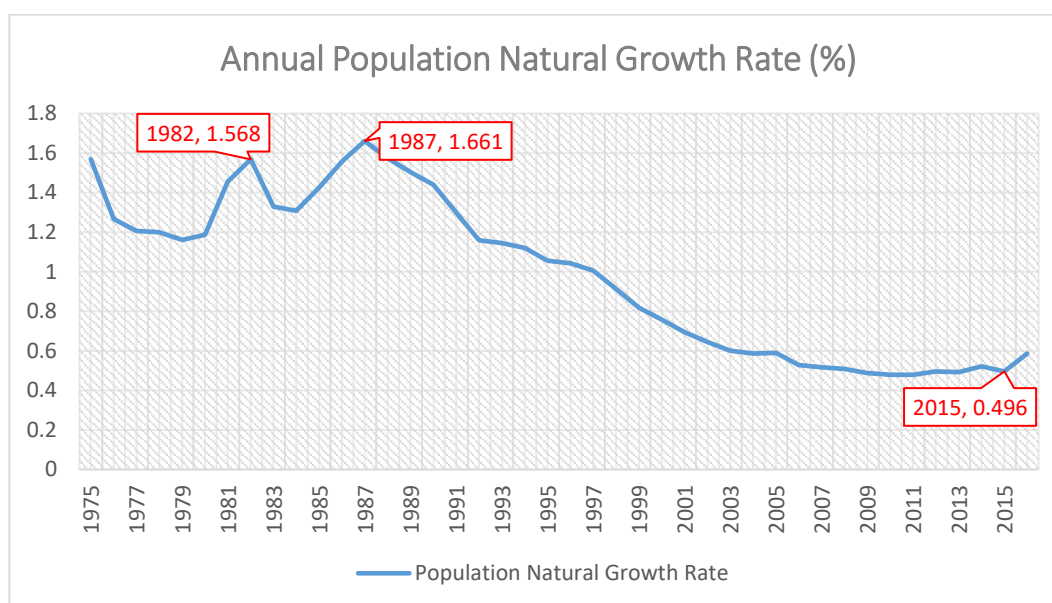
(Source: CEIC database and author's calculation)

A correlation between the performance of national economy and the housing market has long been established (Taltavull and White, 2012; Mian et al., 2015; Zhang et al., 2016). In conjunction with growth in the economy, income rises enable households to increase their housing consumption (Capozza et al., 2002), thereby fuelling the growth in housing demand. Figure 2-12 below presents a comparison between total house prices and total household income over time. The left axis on the figure represents total house prices, and the right-hand axis represents total household income. According to Figure 2-12, it is illustrated that both household income and house prices rise significantly over time, but that the tendency for house prices to grow was stronger than that for household income, from the fourth quarter of 2003 onwards. At the beginning of the time frame, the gap between nominal total house prices and nominal total household income was moderate, and the growth in total house prices fell slightly towards the end of 2003. The gap has since expanded, with the result that house prices are unaffordable relative to the comparatively sluggish income growth. The result is that homebuyers are experiencing more severe housing affordability difficulties, and the level of borrowing constraints and payment difficulties are increased subsequently. The level of the housing affordability difficulties in China is presented more exhaustively in Figure 2-13.

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Figure 2-12: Total House Price and Household Income
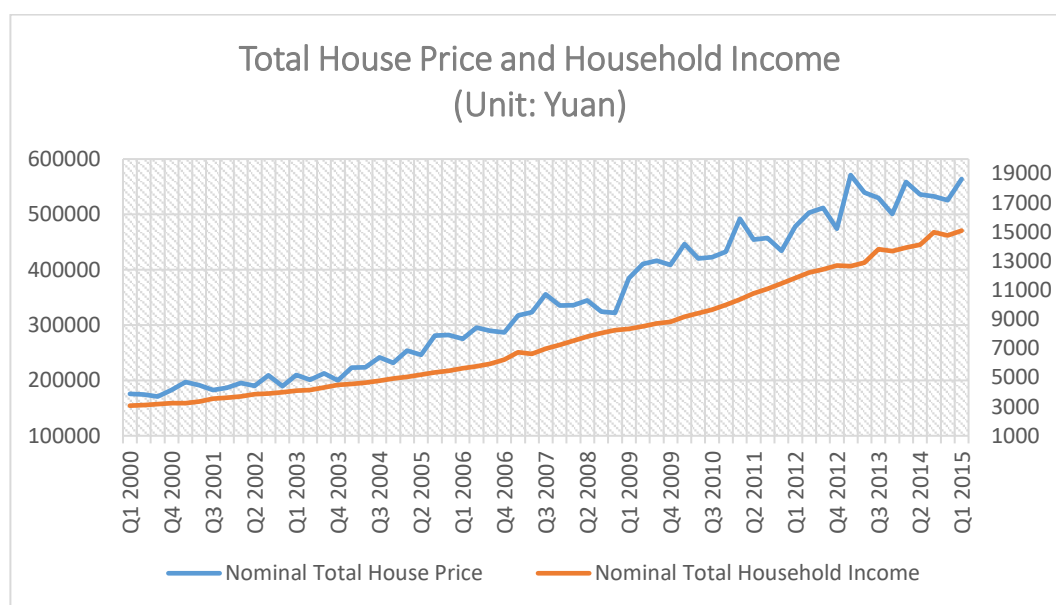
Note: Total household income is based on calculating incomes for two working persons in a family.

Total house price refers to the price of a 90 m^2 sized house.

(Source: CEIC database)

By the inclusion of the house price to income multiple approach, Figure 2-13 below presents the house price to household income multiple in China, spanning 2000 Q1 and 2015 Q1. Theoretically, the threshold for the multiple approach requires that a median house price to median income multiple should remain 3.0 and under, otherwise it would be deemed as resulting in affordability difficulties (Demographia, 2016). However, it can be observed that this figure has risen far beyond the given threshold, peaking at 15.27 in 2001 Q1, indicating that China now has a deteriorated housing affordability environment. Although the house price to income multiple has declines slightly over time, reaching 9.34 as of 2015 Q1, this is still far beyond the threshold.

China's high level of house price to income multiple has been documented in many resources. As Rosen and Rose (2010) reported, the house price to income multiple in China are often 10 to 20, while that in the US is 5 (Kuang and Li, 2012). Similarly, the house price to income multiple was reported in the Demographia 2016 survey, reporting that the overall housing affordability multiple in China was 8.9 by the end of the third quarter of 2014. More unexpectedly, the overall figure for this ratio was severely unaffordable in China by the end

of the third quarter of 2016, which is 10.2 (Demographia, 2016). Therefore, those figures concerning house price to income multiples evidence the existence of housing affordability difficulties in China, stagnating households' ability to enter the housing market.

Figure 2-13: House Price to Household Income Multiple
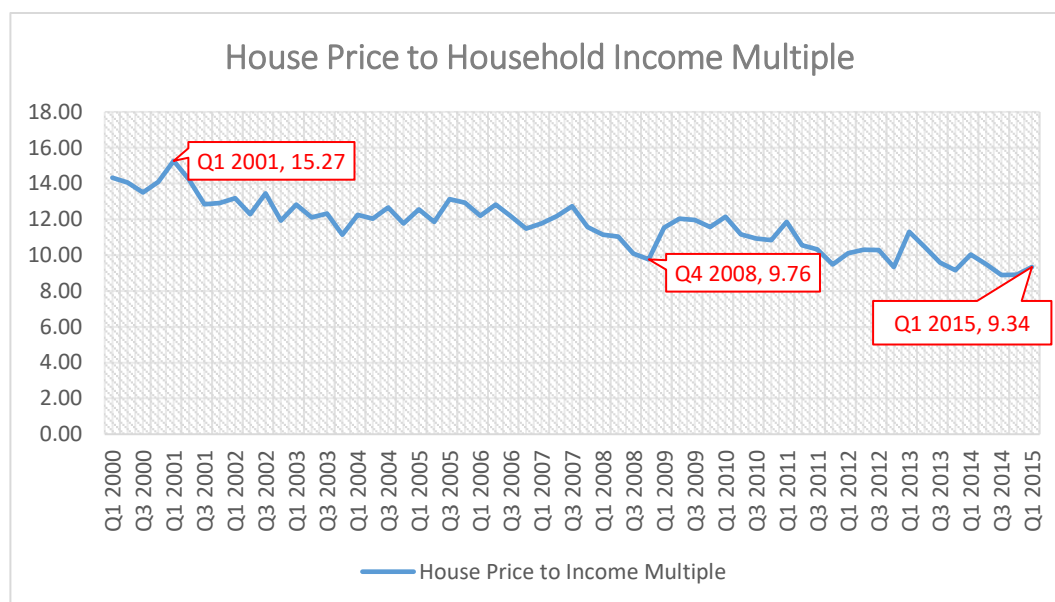
Note: House price to income multiple = Total house price / Total household income
(Source: CEIC database and author's calculation)

2.5.2   Performance of the Housing Finance Market

Following discussions concerning the development of the housing finance market in China; this section outlines the performance of the housing finance market over the period, directing particular attention to interest rates in China. Figure 2-14 displays the base borrowing rate relative to both the mortgage rate and HPF debt rate, as calculated based on adjustments to the base lending rate (see Appendix 1). The mortgage rate and HPF interest rates displayed cyclical movements throughout all periods, showing a moderate movement over the 7-year period from 2000 Q1 to 2006 Q1. Subsequently, the PBOC increased the base rate, and the long-term (5 years and over) mortgage rate peaked at 7.83 per cent by 2007 Q4, whereas the long-term HPF lending rate peaked at 5.22 per cent, and the peaks remained unchanged up to 2008 Q3. Additionally, the maximum spread between the long term (over five years) and short term (five years or less) mortgage rates was capped at 36 basis points in 2006, whereas

the minimum was capped at 9 basis points in the latter half of 2007 (see Appendix 1). After the GFC, the PBOC took a number of measures to mitigate the effects of the economic slowdown, and to boost domestic demand, including repeatedly reducing the base interest rate 5 times in 2008 (see Figure 2-14 and Appendix 1).

Figure 2-14: Average Annual Base Mortgage Lending Rate and HPF Debt Rate
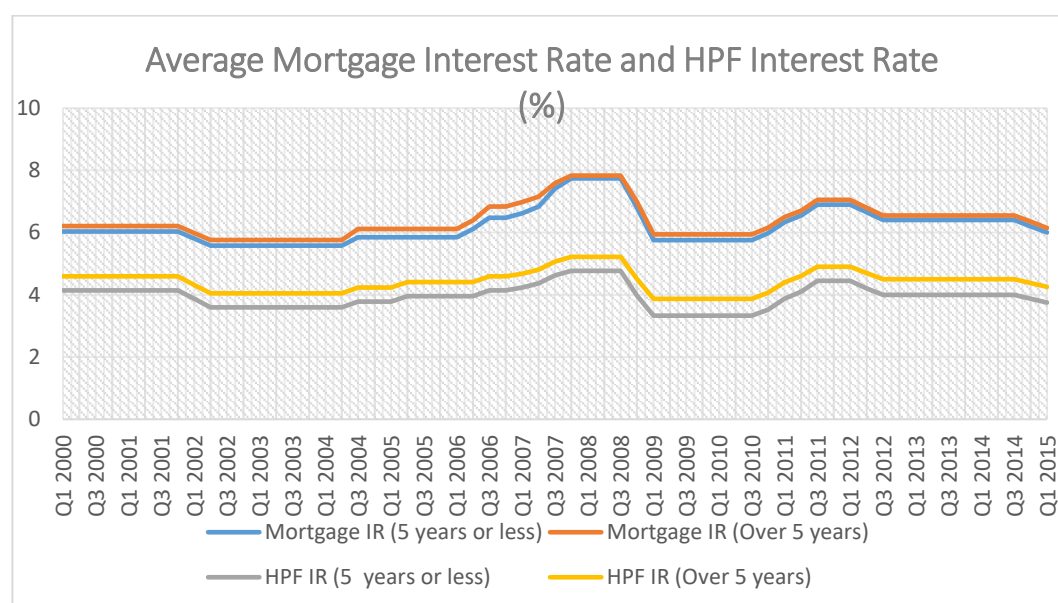
(Source: People's Bank of China and author's calculations)

The evidence suggests interest rates are a critical influencing factor in the housing market, determining both housing demand and level of affordability. A lower interest rate would therefore be expected to both facilitate demand for housing, and push up house prices, by encouraging more households to enter the mortgage market (Reichert, 1990; Ellis, 2006), thereby raising demand for owner-occupied housing (Kenny, 1999; Painter and Redfearn, 2002). Meanwhile, a reduction in borrowing rate opens up the mortgage market to households on lower levels of income (Ellis, 2006); reducing housing affordability difficulties, by generating lower financial costs (Quercia et al., 2003; Gan and Hill, 2009).

Conversely, upward mobility in interest rates impedes the development of the housing market because of increases in borrowing costs. Higher interest rates cause a rise in borrowing costs, which obstructs investment in the market, and reduces demand for housing. Arguably then, increases in the interest rate ultimately influence housing supply (Painter and

Redfearn, 2002). In addition, for households at the lower income level, or those suffering housing affordability problems might be prevented from entering the housing and mortgage market in response to interest rate rises. The financial burden they would then encounter would be exacerbated, because mortgage costs rise with interest rates (Leece, 2004; Gan and Hill, 2009); hence, the demand for housing and mortgages would then be expected to decrease substantially.

As discussed in section 2.3, the housing finance market was first established alongside the housing reform; delivering finance flows for housing mortgages and HPF debts for home-buyers. Corresponding to the development of the housing finance market, changes in Loan-to-Value ratios were announced by the PBOC and CBRC, in order to regulate borrowing conditions in China. We captured the figure on the LTV ratio by collecting official announcements concerning adjustments (see Table 2-4), since the NBS did not publish data on the LTV ratio (see Figure 2-15).

Figure 2-15: Official Adjustments in Loan-To-Value Ratio for 1st and 2nd Home buyers
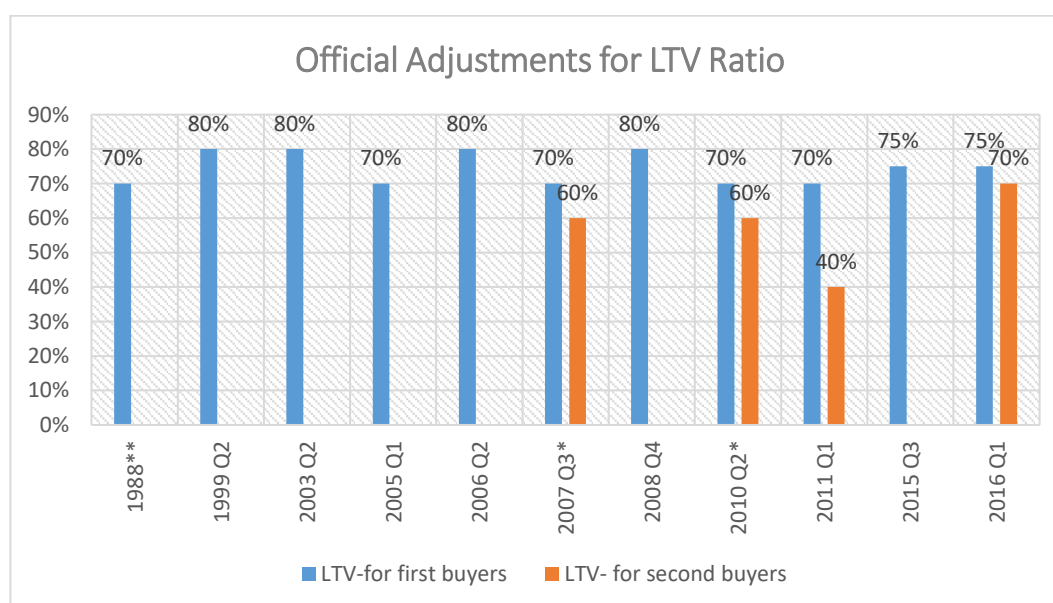
Note: *Denotes that the figures on first time buyers are applicable for house size above 90 m^2

(Source: PBOC's official announcements (see Table 2-4) and author's own diagrammatic representation)

When considering the lending requirement in China, it can be seen that it remains comparatively strict when compared with countries that set looser lending criteria, such as

the US, the UK and the Netherlands. As depicted in Figure 2-15, the LTV ratio was set at 70 per cent when it was first introduced into the market, requiring first-time buyers to pay at least 30 per cent of the total housing cost as a deposit. Over time, the LTV ratio for first time buyers fluctuated between 70 and 80 per cent. As the effects of the GFC were felt, a higher down payment requirement for second time homebuyers was issued in 2007 Q3, and this figure was subsequently adjusted, peaking at 40 per cent in 2011 Q1 (as shown in Figure 2-15). The intention was to curb speculative housing purchases, and to control soaring house prices nationally. Adjustments in LTV, associated with changes in interest rate and money supply, led to a pronounced decline in house prices during 2007 Q3 and 2008 Q4 (see Figure 2-12).

A higher LTV ratio alleviates liquidity constraints, allowing households to borrow more, and thereby stimulating housing demand (Cerutti et al., 2017). However, in this situation the mortgage to income ratio increases subsequently, due to increased access to mortgage debt and payments arising from the higher LTV ratio. In addition, a high level of LTV heightens the risk in mortgage affordability difficulties, if the growth in income remains sluggish, or the mortgagors suffer from unemployment (Deng et al., 2005; Mayer et al., 2009; Igan and Kang, 2011; Campbell and Cocco, 2015).

The availability of mortgage flows relates closely to monetary policy concerns, and is a crucial factor influencing the timing of housing purchases (Chiuri and Jappelli, 2001; Whitehead and Williams, 2011; Scanlon et al., 2011). Figures 2-16 and 2-17 below show the persistence of strong growth in money supply in China, and the corresponding year-on-year M2 growth over the sampled periods, illustrating that money supply (M2) in China increased to 1275332.78 (100 million yuan) in 2015 Q1 from 120399.58 (100 million yuan) in 2000 Q1. The year-on-year growth in the M2 supply in China averaged 16.59 per cent from 2000 Q1 until 2015 Q1, peaking at 29.31 per cent in 2009 Q3 and reaching a record low 11.62 per cent in 2015 Q1. After the GFC, China's central government and the PBOC took a number of measures to address the influence of the GFC, and to stimulate domestic demand, including expanding the scope of financial supports through increasing the supply of M2.

Figure 2-16: Quarterly M2 Supply (Balance at the quarter end)
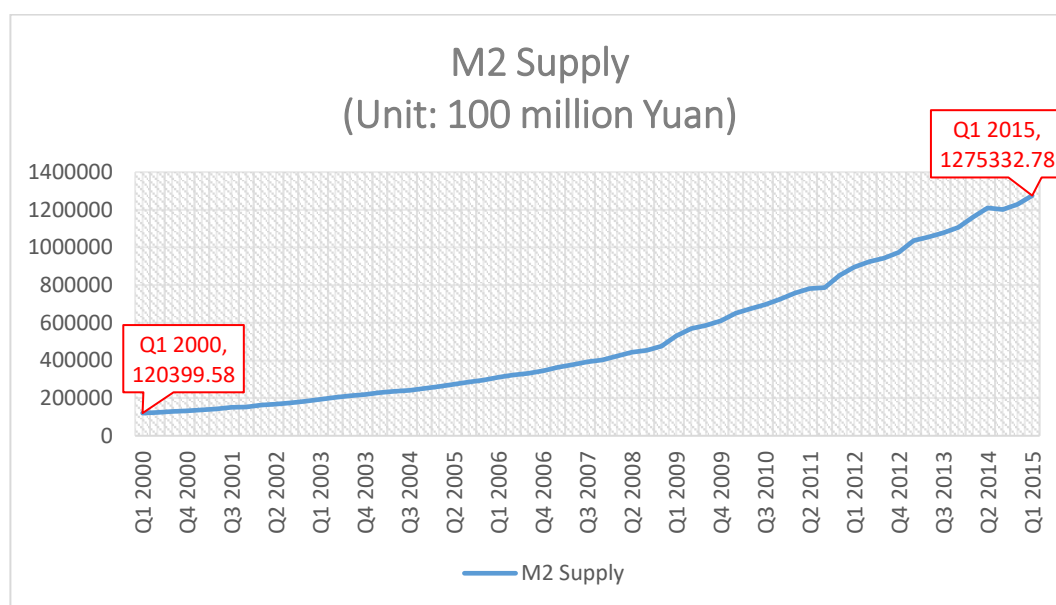
(Source: CEIC database)

Figure 2-17: M2 Supply Growth Rate (Year-on-Year Basis)
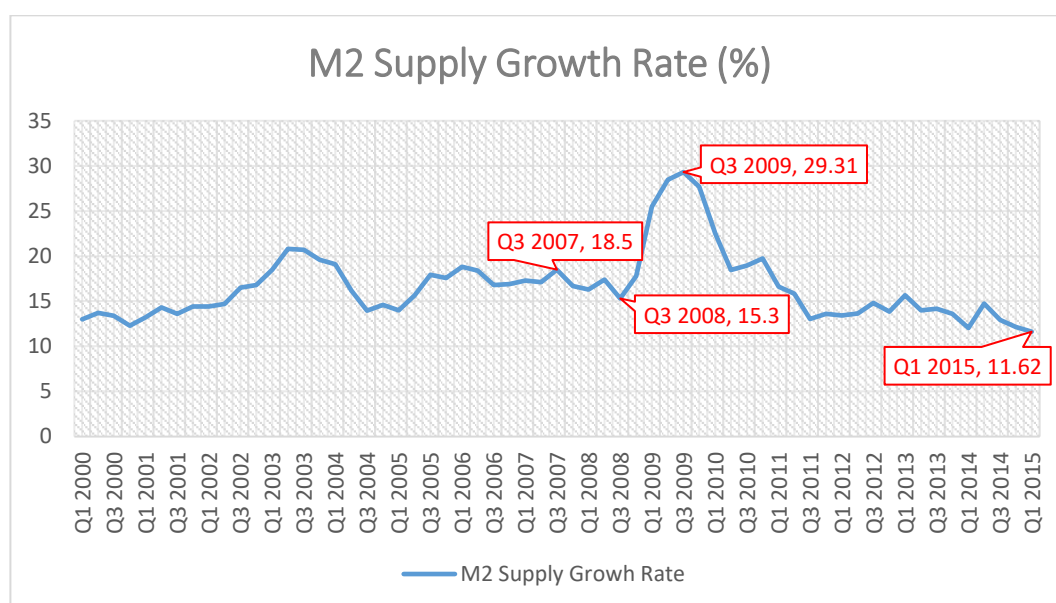
(Source: CEIC database)

A number of discussions have been put forward, stating that increases in money supply brings credit availability to the market, expanding mortgage accessibility and liquidity in the market, and increasing housing demand and house prices (Lastrapes, 2002; Taltavull and White, 2016). In relation to the level of mortgage lending in China, gross household debt is employed as a

proxy for mortgage lending. The level of household debt and its corresponding year-on-year growth are displayed in Figures 2-18 and 2-19; however, due to data transparency limitations, the time frame for household debt and its growth rate spans between 2007 Q1 and 2015 Q1[29].

Figure 2-18: Gross Household Debt (Balance at the quarter end)
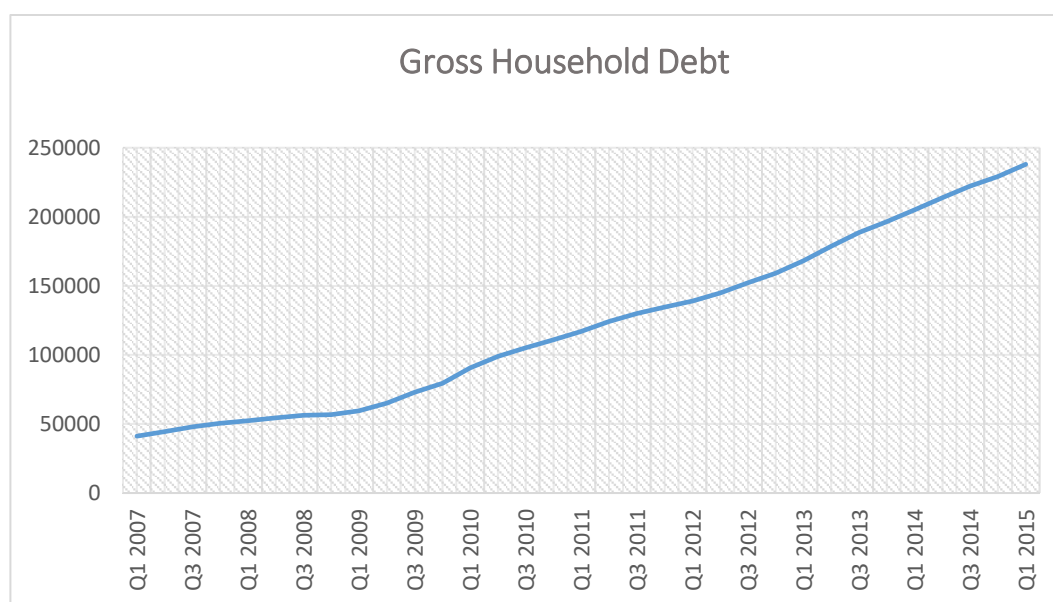
(Source: CEIC database)

When comparing the level of M2 growth and household debt growth between 2007 Q2 and 2015 Q1 (see Figures 2-17 and 2-19), the data reveals a similar cyclical movement over the sampled periods. More precisely, the growth in M2 supply and household debt declines sharply from 2007 Q2 to 2008 Q3 (and to 2008 Q4 for growth rate of household debt) due to the influence of GFC, the implementation of a contractionary monetary policy, and increases in the mortgage rate (see Figure 2-14). In 2009 Q1, the central government and the PBOC issued measures to boost domestic demand, including increasing the money supply and reducing the interest rate. This caused a sharp increase in the growth rate of M2 supply and household debt until 2009 Q3 (see Figures 2-17 and 2-19). In addition, after a short and slight decline, the growth rate of household debt then peaking at 13.87 per cent in 2010 Q1. As shown in Figure 2-17, the growth of M2 supply has witnessed a sharp decline since 2009 Q3.

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[29] Due to the data transparency limitations, data on mortgage lending are not available. Herein the household debt covers housing mortgages and other kinds of debts from both the short and long terms.

Subsequently, in 2010 Q1, this expansion in household debt started to decline (see Figure 2-19). The growth rate of the M2 supply and household debt then returned to a level similar to the pre-GFC level.

Figure 2-19: Household Debt Growth Rate (Year-on-Year Basis)
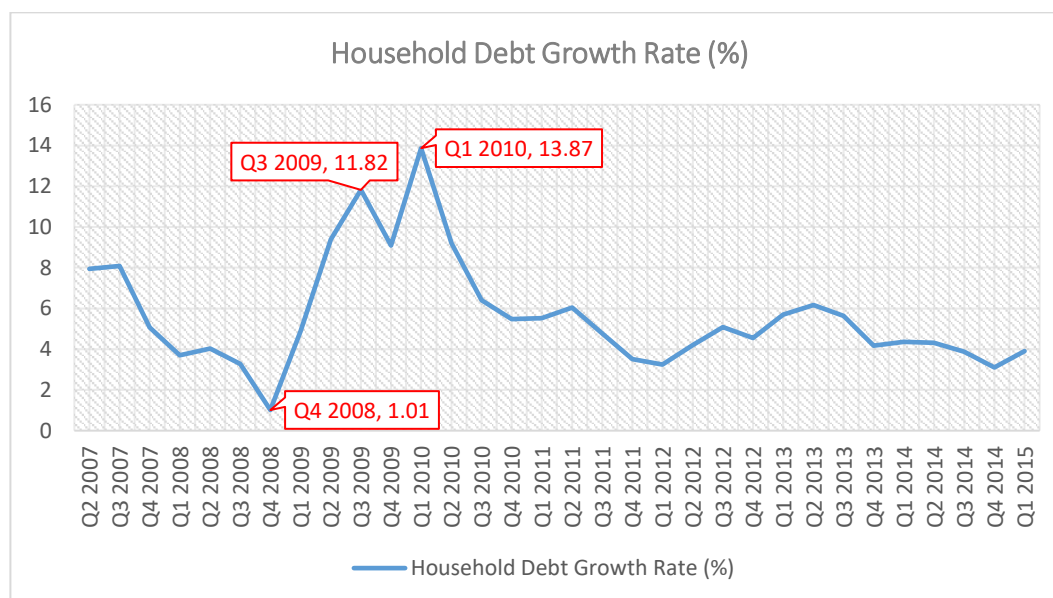
(Source: CEIC database and author's calculation)

2.5.3 Performance of the Housing Market

This section offers an overview of the housing market, illustrating the relevant data from both the supply and demand side by using national level data obtained from the CEIC database. The data period covered spans from 2000 onwards, corresponding to all the implementation steps for the housing reform, as well as the availability of the data.

Figure 2-20 presented below displays the real total house prices in the period 2000 Q1 to 2015 Q1, as deflated by employing the CPI index in 2015 Q1. The house prices experienced volatile increases over the 16-year period, with a 5-quarter decline from 2007 Q4 to 2008 Q4, linked to the GFC and monetary policy changes. As has been proved theoretically, the volatility of the housing market is closely linked to the performance of the economy, and fluctuations in GDP significantly influence house prices (Kim, 1993, 2004). Notably, the decline in house

prices corresponds to the economic situation over the same period, while GDP growth displayed a sharp drop, due to the influence of the GFC (see Figure 2-6). Similarly, when compared with Figure 2-9, the unemployment rate is seen to have experienced a continuous decline since 2003 Q4, coinciding with the supposition that employment levels closely relate to fluctuations in house prices. Interestingly, a pronounced appreciation in real house prices occurred after 2008 Q4, and that increase was sustained until 2011 Q1 (see Figure 2-20). Subsequently, the market experienced short-term volatility between 2011 Q1 and 2012 Q4, peaking sharply in 2013 Q1.

Figure 2-20: Real House Price of a Standard-sized House
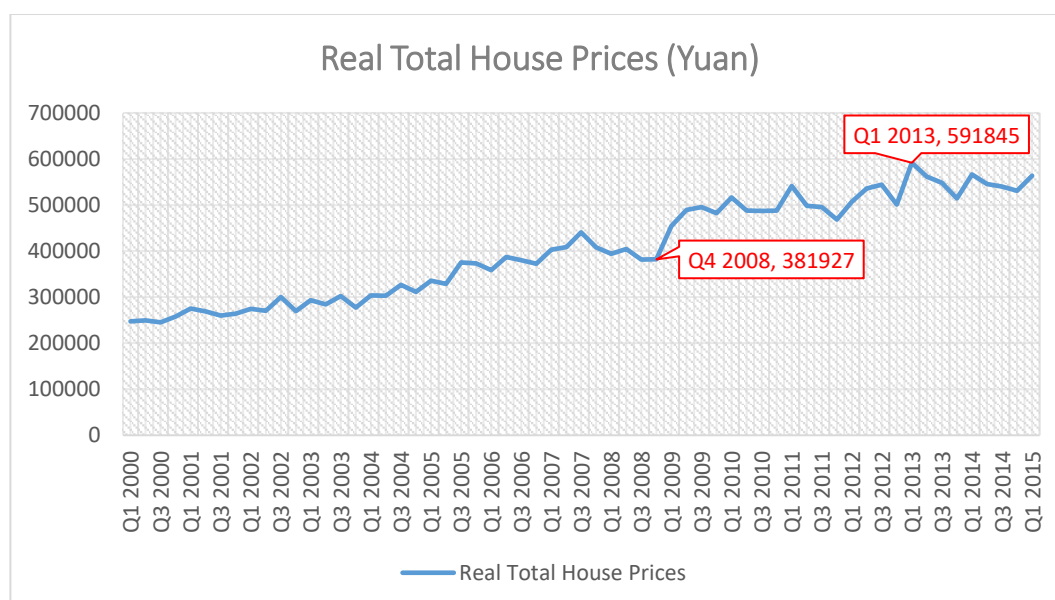
Note: A standard-sized house in this thesis is measured as 90 m^2

(Source: CEIC database and author's calculation)

To establish the performance of the housing market, it is essential to address the activities necessary to support housing investment. Figure 2-21 presents total capital flow devoted to residential dwellings, comprising the total costs of land acquisition, housing construction, management fees, etc. The evidence suggests housing investments are closely related to national economic growth, stimulating an increase in urban employment and the national economy (Hongyu et al., 2002; Kim, 2004). The figure also shows that housing investment volumes rose continuously, increasing over a period of 15 years; however, housing demand far exceeded housing supply in China. In reference to Figure 2-22, it is apparent that there is a

huge imbalance between the volumes of newly-built and new homes sold.[30] The ratio of new homes sold to newly-built units can therefore be computed, spanning 2005 and 2015, as a result of the limited data availability. This ratio is presented in Figure 2-22, which is expressed as the number of new homes sold per 100 newly-built houses. The figure illustrates that the proportion of new houses sold to newly-built houses was 115.01 in 2005, revealing an imbalance in the housing market between demand and supply.

Figure 2-21: Value of Housing Investments Devoted to Residential Dwellings

(Source: CEIC database)

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[30] In the Chinese housing market, the volume of new homes sold does not fully measured by the number of completed houses, as homebuyers can buy unfinished projects in the form of a presale; and these purchases are regarded as sales.

Discussing the demand for housing in more detail, Figure 2-23 below shows the figure concerning housing floors sold in each quarter, carrying a significant seasonal trend. The figures remain at a lower level in each first quarter, as the first quarter is a comparatively quiet business season, including the New Year breaks and Chinese New Year breaks. However, it maintained a continuous increase over the previous period generally, although there was a decline between the first quarter of 2008 and the first quarter of 2009. This fall in sales, as recorded between 2008 Q1 and 2009 Q1 reflects the impact of the financial crisis, which affected the housing market on the demand side. Correspondingly, Figure 2-19 presents a sharp decline in the growth rate for household debt over the same period, also explaining the reason for the receding sales during 2008 Q1 and 2009 Q1.

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[31] The volumes of new homes sold comprise presale and completed houses. The housing market at the transaction stage consists of two components; the existing market, which is regarded as the stock market, and the pre-sales market, which is deemed to be the flow market (Deng and Liu, 2009).

Figure 2-23: Housing Floor Spaces Sold in Each Quarter
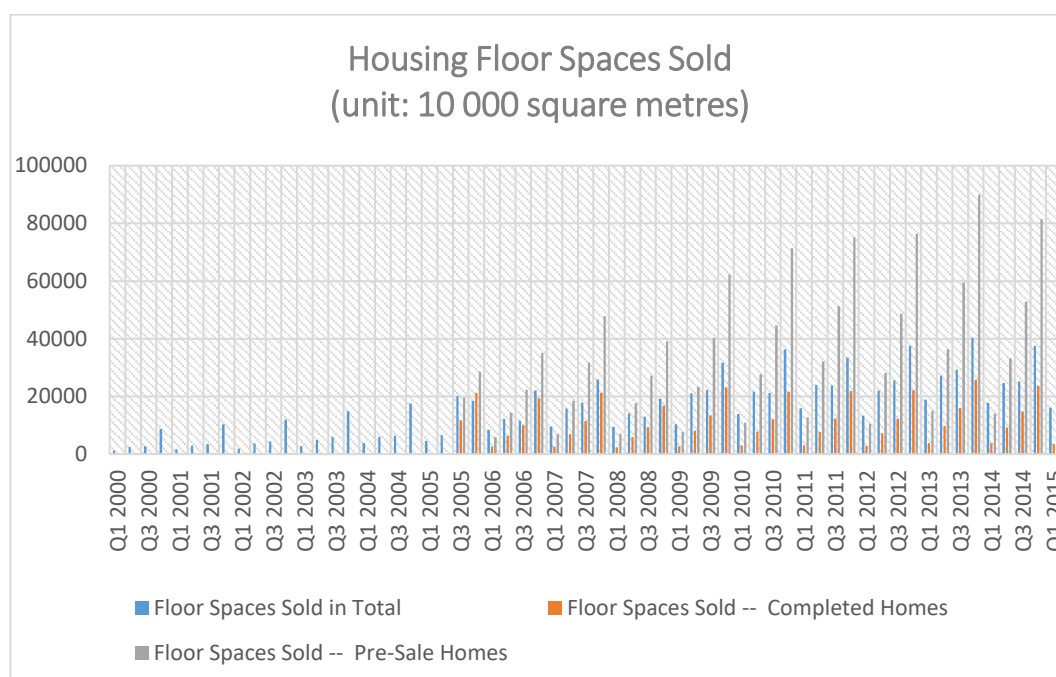
(Source: CEIC database)

The planning system plays a significant role in interconnecting the land supply and the housing market, as is apparent in many countries. As Cullingworth (1997) pointed out, land-use planning in the US is mostly a local consideration, and in the UK, according to Barker (2003), issues influencing housing are subject to the land use planning system. In relation to China, Lichtenberg and Ding (2009) stated that the state ultimately owns all the land, but the rights of selling land are increasing, allowing private investors[32] to embark on the residential development. Thus, land plays a multiple-linkages between the government, the developer and the housing market. As a proxy for fiscal revenue, land and use rights are continuously granted to real estate developers by local governments; while real estate developers are required to pay high acquisition fees and relevant taxes for obtaining lands (Gao and Liu, 2010). Therefore, as Bramley (2007) pointed out, the inadequate and inelastic housing supply

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[32] The government sells the right to use the land, the ownership of all land in China still rests with the state government. Real estate developers obtain land by paying high acquisition fees and taxes, and in return receive the right to use the land for a certain number of years. Land for residential development purposes is usually granted a use right of 70 years; 50 years are granted when the land is intended for the combined use of commercial and residential; and 40 years for commercial use (Wu et al., 2012).

is caused by the land supply system. This happens to China, and pertains to land transaction activities. The land supply influences the housing market significantly by restricting the elasticity of housing supply, however, the amount of land required for residential development is based upon population forecasts, which can be used as a proxy for demand-side factor (White and Allmendinger, 2003). Therefore, as White and Allmendinger (2003) argued, anticipated population 'is then compared against supply of existing stock and land already with planning permission' (p.956).

In addition to the above discussion in reference to land supply, it has also been stated that the costs of land have a significant impact on house prices (Gao and Liu, 2010). This is because land prices are the initial costs laid out when embarking on a housing investment; thus, increases in land prices would fuel an increase in house price appreciation. Figure 2-24 below displays the figures for total land supply over the period considered; the data represents the total amount of land developed for housing. The figure reveals volatility during the 16-year period. Overall, an enormous growth in land supply occurred between 2000 Q1 and 2003 Q1, immediately after the housing reform, and the demand for housing accelerated at this time. The figure also reveals that land supply experienced a short-term, but relatively sharp decline in the four-quarter periods between 2008 Q1 and 2009 Q1, associated with a resultant shock in the national economy. Since 2013 Q3, the level of land supply has been in a continuous decline, due to the implementation of land acquisition restrictions.

Figure 2-24: Total Land Supply for Residential Development
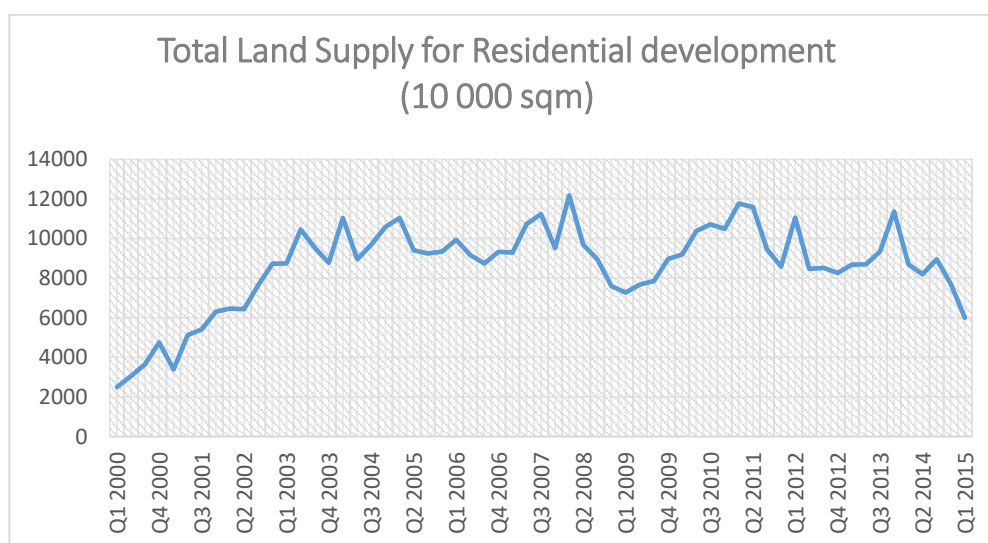
(Source: CEIC database)

This section gives contextual interpretations to understand how the macroeconomic environment, the finance market, and the housing market interrelate. As discussed in Section 2.3, the Chinese mortgage market was the largest in Asia by 2005, being characterised by the high availability of mortgage flows (Deng et al., 2009). In some countries, the continuous house price appreciation, combined with sluggish income growth, resulted in households increasing their borrowing levels (Whitehead and Williams, 2011). In the context of China, as shown in Figure 2-13, the high house price to income multiple enlarges the difficulties of accessing the owner-occupied market, which has become a key issue of aggravating housing affordability difficulty (Rosen and Rose, 2010; Kuang and Li, 2012). As a result, households need to borrow more to support housing expenditure; thereby the gross household debt remains a continuous increase over time. Discussions concerning the performance of the macroeconomic, housing market and the housing finance market, establishing the theoretical understandings for empirical investigation.

2.6   Selected Regional Markets

In relation to the research questions, regional imbalances can arise due to diversification in the economy, geographical factors and policy implications, which result in regional differences in housing affordability and homeownership rates (Reichert, 1990; Levin et al., 2009). In addition, the implications of monetary and fiscal power for the regions have been viewed as a political imperative (Bell, 1993), driving greater regional deviation. Consequently, regional differences in monetary policies transmission have affected the development of the regional mortgage market and the level of mortgage availability (Campbell and Cocco, 2007).

In reference to studies concerning regional patterns in the housing market, the majority of existing studies emphasised differentials in the fundamentals of the housing market. The results illustrate that regional differences, concerning house prices, inflation, monetary policies and income, have a significant impact on regional housing markets (Reichert, 1990; Bell, 1993; Fratantoni and Schuh, 2003; Hwang and Quigley, 2006). However, studies concerning housing affordability in relation to regional differences are very limited, especially as regards research into housing affordability in China. In relation to the research questions,

this thesis identifies regional variations in housing affordability and tenure choices amongst the regions by the inclusion of three regional dummies in the household level model, which are Beijing, Shanghai and Guangdong. Prior to conducting the empirical investigation, a contextual illustration of the market performance in the three regions was prepared, collecting relevant economic data spanning from 2000 to 2016. As the most extensive economically developed areas in China, the geographical locations of Beijing, Shanghai and Guangdong were graphed in Figure 2-25.

Figure 2-25: The Geographical Location of Three Key Regions

(Source: http://www.chinamaps.org/china/china-blank-map-large-2.html)

Shanghai and Guangdong have attracted significant investment, witnessing greater rates of mobility over time, because the regions along their costal side attract greater advantages in terms of economic prosperity, generating rapid house price appreciation (Yu, 2006). Beijing is the Capital of China, and this has provided political advantages to the local housing market, in the form of historical and political benefits to develop its economy. Huang (2004) stated that Beijing's existing housing market is substantially affected by the planned economy. In addition, the number of allocated houses in Beijing was greater than that in any other city in China (Duda et al., 2005). Alongside the housing reform, Beijing achieved a distinct advantage

when establishing a market-based housing market, because around 60 per cent of the allocated housing units were transited to owner-occupied houses during the reform (Huang, 2004).

Beijing, Shanghai, and Guangdong are among the most economically developed regions in China, attracting greater investment and higher migrant mobility than other cities, thereby creating higher potential housing demand within the housing market. Figures 2-26 and 2-27 below present the level of GDP and the household income in these three regions. According to Figure 2-26, it emerges that Guangdong is ahead of Beijing and Shanghai as most developed region, attaining a regional GDP of 80854 hundred million yuan in 2016. Conversely, the disposable per capita income in Guangdong is significantly lower than that in the other two regions, although it still exceeds the national level (compare with Figure 2-12). This is because the population base in Guangdong is larger than that in Beijing and Shanghai. Figure 2-27 reveals that the deviation in disposable income between Shanghai and Beijing increased between 2006 and 2013, but halted after 2013, due to a sharp income growth trend in Shanghai at that time. However, the overall level of income in Beijing and Shanghai extends far beyond that of Guangdong. As Figure 2-27 shows, the level of disposable income in Guangdong experienced a decline between 2012 and 2013, reaching the lowest income level since 2010. This can be ascribed to a slight reduction in the economic growth rate between 2010 and 2012, accompanied by worsening unemployment in this region (NBS, 2010-2016).

Figure 2-26: Regional Annual GDP
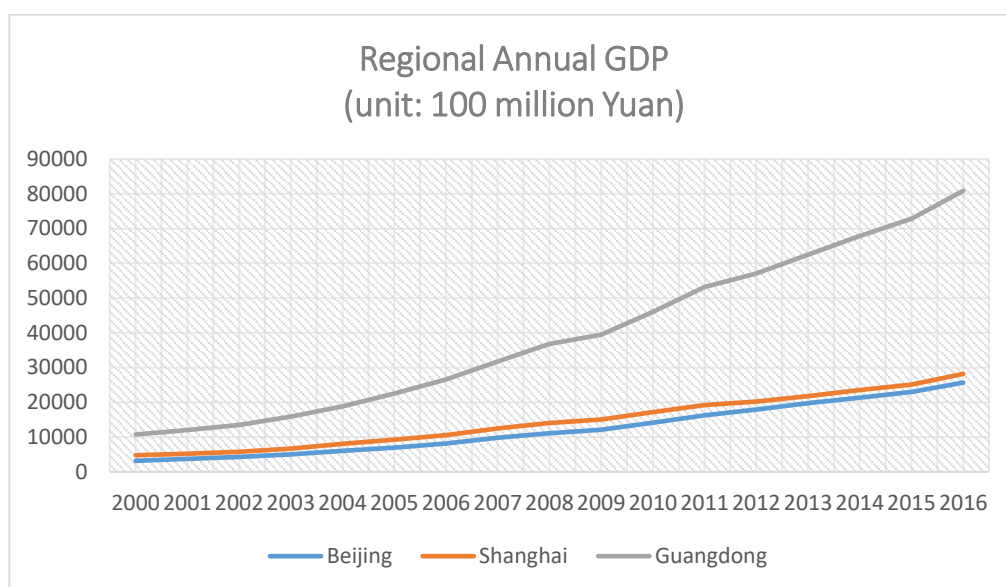
Figure 2-27: Regional Annual Disposable Income
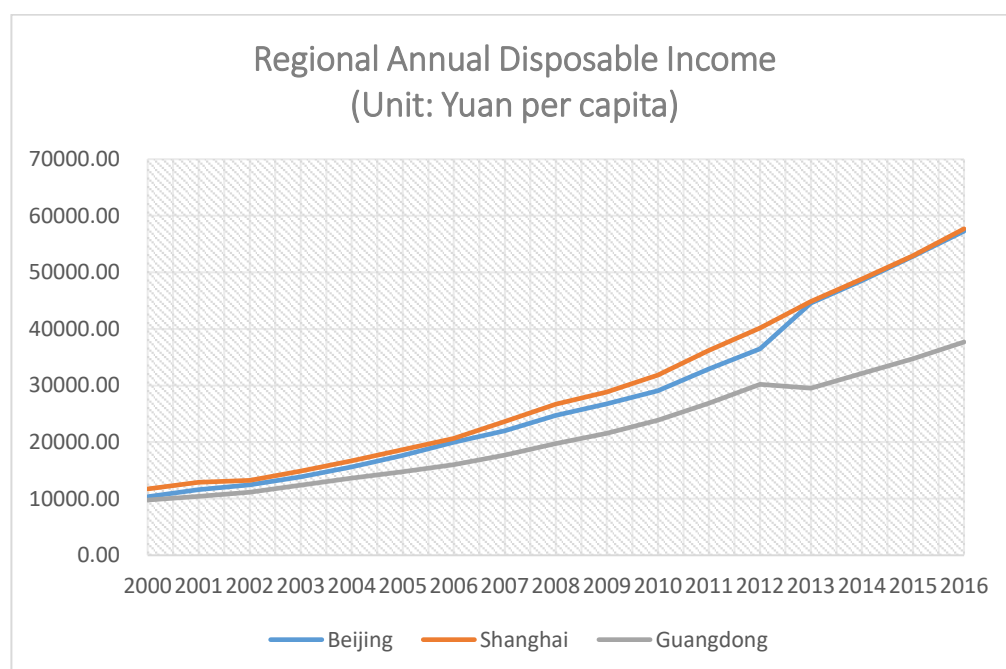
(Source: CEIC database)

Figure 2-28 below demonstrates the level of house prices in the three regions, revealing that house prices in Beijing and Shanghai display greater fluctuations than those in Guangdong;

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largely due to the implications of monetary policy and property-purchasing limitations.[33] Beijing is the most expensive city across the three regions, followed by Shanghai and Guangdong. In can be seen that house price growth in Beijing has slowed since 2010, as the government issued a number of steps to tighten the credit flows into the housing market, in order to cool down the excessive house price appreciation and speculative housing purchases. Figure 2-28 shows the deviation between the three regions' house price were significant, and expanded throughout the period. Most importantly, this deviation was exaggerated after the GFC, due to house prices in Beijing and Shanghai experiencing a sharp rise between 2008 and 2010, while that of Guangdong remained comparatively stable. In addition, as seen in this figure, house price appreciation in Beijing and Shanghai altered after 2014, experiencing a two-year sharp rise in 2015 and 2016. This was due to the adjustments in lending conditions, in which the PBOC reduced the mortgage rate, raising the level of the LTV ratio.

Figure 2-28: Regional House Prices: Beijing, Shanghai and Guangdong
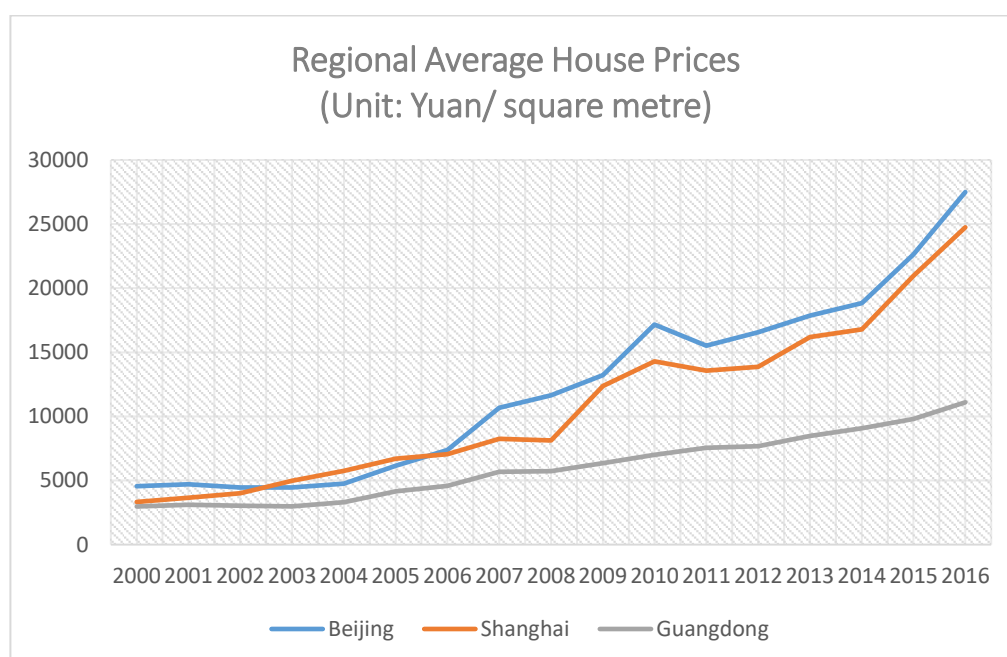
(Source: CEIC database)

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[33] The property-purchasing limitation is an article issued by central government to control the overheated housing market and speculative housing purchases by restricting lending criteria. Migrants are not allowed to buy a house in Beijing or any housing-costly regions for 5 years.

Notably, demographic trends also influence the character of the housing market across China's various regions. The scale of a region's population has a significant impact on its housing market. House prices are expected to rise most rapidly in regions with a large population base, especially in urban areas. Furthermore, house prices are expected to rise faster in regions experiencing greater mobility (Henley, 1998). In terms of China, regions like Beijing, Shanghai and Guangdong are attracting large migrant populations, including millions of labourers and young graduates annually, due to the work opportunities available. In addition, research conducted by Garriga et al. (2017) evidenced that an increase in migrations to Beijing and Shanghai led to the house price rise.

Finally, lending and borrowing channels were found to vary between regions, due to differences in the financial markets, and the transmission of the monetary policies (Dow and Montagnoli, 2007). In reference to the UK, Dow and Montagnoli (2007) stressed that London provides lower lending costs than other regions because it has established a developed financial market, reflecting its status as a financial centre. Similarly, Shanghai, as the financial centre of China has developed a larger sized mortgage market, which would be expected to deliver higher availability in terms of mortgage lending flows and a lower floating point than other regions; thereby supporting borrowing for housing purchase. Meanwhile, in relation to the housing reform, Beijing, Shanghai and Guangdong were among the first cities to launch the HPF (Wang and Murie, 1996). Thus, a well-developed HPF system now exists in these regions, benefitting from both the housing reform and the monetary policies applied to the housing market.

2.7 Conclusion

This chapter detailed the development and progress of the housing market in China, and delivered a market overview incorporating relevant economic data. Significantly, it also described the transition that has taken place in the Chinese housing market, detailing the process by which the allocated housing system was gradually transformed into a market-oriented housing system. In addition, this chapter discussed the establishment of the HPF, emphasising its functions in terms of assisting housing purchases and mitigating housing

affordability challenges. The performance of the housing finance market was then introduced, followed by a comprehensive illustration of the macroeconomic circumstances in China, outlining relevant economic data. Figures were presented to illustrate fluctuations in the Chinese housing market in recent years. It was noted that the growth in average household income did not keep pace with house price appreciation, resulting in housing affordability difficulties and inflated house price to income multiples. In addition, interest rates experienced fluctuations over this period, corresponding to developments in the national economic environment and the level of inflation. Similarly, the LTV ratio experienced cyclical movement during the period, with upward changes in the LTV ratio introduced via a relaxed mortgage lending criteria, triggering rapid growth in borrowing for housing consumption. Moreover, the relationship between LTV and housing affordability was observed as potentially heightening the risk mortgage default (Clauretie, 1990; Quigley and Van Order, 1991; Deng et al., 2005).

In addition, this chapter discussed market performance, by presenting relevant economic data concerning both the supply and demand side. Housing investments and urbanisation display a continuous increase, laying the foundations for house price appreciation. The increasing sale of floor spaces indicate that demand for housing is rising due to the progress of urbanisation. Finally, it has been evidenced that regional diversification is influenced by economic developments, policy implications, geographical locations, and population distribution. The following chapter will define the measures for establishing housing affordability and discuss the factors that theoretically influence housing affordability.

Chapter 3   Literature Review

3.1   Introduction

As discussed in Chapter 2, the housing market in China has undergone a period of considerable transitional development, establishing a relationship between the housing market and the emerging housing finance market. The succeeded housing reform has continued to increase house prices by encouraging the housing demand for market-oriented dwellings. Consequently, the house price to income multiple has risen considerably, far beyond the theoretically affordable level of 3.0 and under (Demographia, 2016). This resulting in an increasing number of households experiencing housing affordability difficulties when seeking to achieve homeownership, impeding them from entering the owner-occupied housing market. Alongside the process of the nationwide housing reform, a housing assistance policy, the HPF, was introduced to the market, aiming to assist homebuyers wishing to enter the housing market by granting a low-rate housing debt. However, due to the limited accessibility and potential inequality of the HPF, a number of potential homebuyers have remained unable to benefit from this housing assistant, and thus so continue to experience their housing difficulties. In addition, house prices are rising significantly, and the level of house price to income multiple is becoming excessive, leading to an increasing number of younger households postponing entering the homeownership market due to liquidity constraints. As a result, particular attention needs to be focused on factors influencing housing affordability and the choice of achieving homeownership market, in combination with the explorations of relationship between macroeconomic performance and the housing market.

This current chapter reviews existing literature relating to housing affordability and households' tenure choice, in order to establish a theoretical context for a discussion of housing affordability. This information will comprise a basis upon which to establish theoretical variables for econometric modelling, to generate econometric specifications for the purpose of empirical estimation. In addition, to answer the research question, this

chapter focuses factors influencing households' decision to enter the homeownership market, in association with lifecycle theories. This research focuses on the Chinese housing market, and therefore this review has a particular focus on Chinese data, comprising the discussions concerning effectiveness of the housing policies. This chapter is structured as follows: A conceptual measurement of housing affordability is established in next section, and this includes contextual illustrations concerning housing affordability issues, and interpretations of different approaches to the measurement and norms of housing affordability from different approaches. As discussed in Chapter 2, the macroeconomic environment has a crucial impact on the housing market, influencing housing affordability, and therefore Section 3.3 presents a detailed discussion concerning the relationship between house prices and housing affordability from a macroeconomic perspective. Section 3.4 discusses theoretical factors with a potential impact on housing affordability in relation to the existing empirical literature, including studies combining data at the aggregate level and the household level. This section establishes a theoretical understanding, identifying important factors in relation to the empirical investigation. Section 3.5 focuses on existing studies related to housing affordability in relation to Chinese data, focusing on specific regions in China to illustrate regional differences in terms of housing affordability and monetary transmission. Linking this to life cycle theory, section 3.6 illustrates that there are a number of factors influencing the likelihood of achieving homeownership, in combination with a discussion of the relationship between homeownership and housing affordability. Section 3.7 forms a conclusion of this chapter.

3.2   Housing Affordability: Conceptualisation and Measurement

This section discusses theoretical understandings relating to housing affordability, including: (1) theoretical conceptualisation; (2) the measurement of housing affordability; and (3) the interpretation of a normative threshold of housing affordability.

3.2.1   Conceptualising Housing Affordability

Discussions relating to housing affordability have received an increasing amount of attention in many countries over the years, and have long been associated with different phases of the housing market cycle. The boom in the UK housing market during the late 1980s and early 1990s resulted in a number of households experiencing housing difficulties. Many would-be buyers experienced affordability pressures, and were priced out of the market due to the unprecedented changes in housing costs, while recent buyers defaulted on their mortgages and thus lost their homes. Deregulation in the rental market led to tenants being forced by landlords to pay higher levels of rents (Bramley, 1994). Similarly, the rapid increase in house prices in many countries between the late 1990s and the late 2000s has led to a widespread concern over housing 'affordability' (Bramley, 2012). According to lifecycle theories, entering the homeownership market is considered the most important tenure choice that most households would like to pursue over the life cycle path, due to this acting, over the long term, to maximise family wealth (Boehm, 1993). However, issues related to house price appreciation have stagnated access to homeownership for many households, and in particular for younger households who are encountering housing affordability difficulties (Hendershott, 1988; Grigsby, 1990; Linneman and Megbolugbe, 1992).

Housing affordability is a commonly used term when summarising the housing difficulties. More specifically, Thorns (1988, p.29) documented housing affordability as the ''ability to gain access to housing'', and ''the capacity of household to afford housing'', implying that housing affordability refers to the ability of households to access and afford housing. The key words ''ability to gain access'' indicates that households are required to have sufficient financial capacities, or savings, to get access of housing or a mortgage.

Other academics have defined housing affordability as the relationship between housing expenditure and household income, conceptualising the housing expenditure to household income ratio in many literatures (Linneman and Megbolugbe, 1992; Bramley, 1994, 2012). Maclennan and Williams (1990) have further documented housing affordability in the following terms:

Affordability is concerned with securing some given standard of housing (or different standards) at a price or rent which does not impose, in the eyes of some third party (usually government), an unreasonable burden on households' income. (Maclennan and Williams, 1990, p.9)

Maclennan and Williams (1990) described housing affordability as the relationship between housing expenditure and household income, focussing on whether the given standard of housing expenditure imposes pressure on households' incomes. This then suggests the notion of a housing expenditure to income ratio, illustrating that whether a household is affordable refers to a given standard of housing expenditure, and does not exceed the given level of household income. In relation to viewpoints proposed by Maclennan and Williams (1990), Linneman and Megbolugbe (1992) stated the issue of housing affordability as follows:

Middle class households, especially young urban professionals, either began experiencing difficulty in realising the 'American dream' of homeownership or found themselves spending a disproportionately large share of their incomes on housing (Linneman and Megbolugbe, 1992, p.369)

This is apparent that housing affordability is no longer seen an issue effecting only low-income households, it turns to be an issue that influences young urban households, middle-income households and moderately low-income households; moreover, it encompasses both the affordability of homeownership and rented housing (Linneman and Megbolugbe, 1992, p.370). This may arise from imbalances between housing expenditure and household income, and borrowing constraints (Linneman and Megbolugbe, 1992; Bramley, 1994; Bourassa, 1996). Accordingly, inflation rises can cause a shrink in real income, such that potential homebuyers are prevented from entering the homeownership market due to an inability of meeting the down payment requirements and a lack of sufficient family capacity. This results in housing affordability being linked to an income issue, arising from high levels of inflation, insufficient family wealth, and sluggish growth in real income. For those who are semi-skilled, housing affordability issues arising from stagnant incomes, or a change in the employment

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status (transformation from employed to unemployed, leading to the risk of being unable to meet down payment requirement, or to maintain their current housing expenditure (Gabriel et al., 2005).

Hancock (1993) identified the causes of housing affordability, suggesting that due to the rapid increase in housing costs, the abolition of double tax relief for single households, increases in interest rates and the economic downturn, which have raised concerns in relation to homeownership of owner-occupiers (p.127). In both the US and Australia, high housing costs, and stagnant incomes led to aggravation in housing affordability, accompanied by a reduction in home-ownership rates (Bourassa, 1996). High levels of housing costs have raised the demand for a higher level of mortgages to support housing purchase, resulting in an increase in housing pressures. Consequently, households becoming sensitive to any potential variation in future interest rates. (Gabriel et al., 2005). Therefore, discussions concerning housing affordability advocated links between house prices, mortgage debts and the macroeconomic environment in the late 1980s, have been re-concerned recently since the financial crisis (Murphy, 2011; 2014), in relation to macroeconomic issues, and the policy concerns.

Housing affordability is regarded as having difficulties in achieving homeownership, and the pressures related to private renting market and the social renting sector. When housing costs become too high, potential homebuyers, especially low-income and liquidity constrained households tend to choose renting rather than entering the owner-occupied market, thus leading to a decline in the demand for housing. House price tend to decrease along with a decline in housing demand, subsequently result in house prices decreases to the level of rental costs (Bramley, 1994; Himmelberg et al., 2005). However, due to deregulation in the private rental market, it has generated an increase in the level of rents (Bramley, 1994), leading to a growing number of low-income tenants are struggling to meet both rental and non-housing expenditure. In addition, Bramley (1994) stated that an affordability issue occurs in the social rental sector due to a rapid increase in the demand for social housing, while that for supply was inadequate. Consequently, issues of homelessness due to housing affordability may arise from low income, reductions in housing benefit, shrinkage of the cheaper private rental sector, and increases in house prices and rentals (Bramley, 1994, p.116).

In a number of countries, the private rental sectors are excluded from receiving subsidies comparable to those provided by the tax system to investors in owner-occupied housing (Bourassa, 1996, p.1867). As a consequence, poor households and low-income households become unable to afford private rental properties, increasing the demand for social housing. However, there remain a number of difficulties in terms of ability to access social housing. Firstly, it can take a considerable length of time to access social housing, because it is necessary to meet the relevant eligibility criteria (Priemus and Dieleman, 2002). Secondly, there has been a decline in social housing relative to the increase in the number of low-income households (Nelson, 1994; Yates and Wulff, 2000; Priemus and Dieleman, 2002). More specifically, the share of affordable housing in China in 2010 represented only 3% of all new housing supply (Barth et al., 2012). This ultimately resulted in a shortage in social housing, creating high level of private rental burdens, leading to higher levels of overcrowding and homelessness (Nelson, 1994, p.401).

3.2.2 Measuring Housing Affordability

Measurements of housing affordability are widely discussed in the literature. However, there remains a lack of generally accepted method for measuring housing affordability in relation to differing circumstances relating to the housing market and household types. This has led a number of different approaches to be proposed as the measurement of housing affordability, emphasising different areas of concern. This section discusses the measurement of housing affordability from a variety of perspectives, establishing a theoretical understanding of measurements including the ratio approach, the residual approach, and the poverty approach. This establishes a theoretical support for empirical investigations in this current thesis.

In relation to discussions undertaken by Linneman and Megbolugbe (1992), housing affordability examines the relationship between the level of housing costs incurred and household income. The notion of housing affordability is therefore measured by a ratio approach, which is designed to examine whether housing expenditure exceeds a given proportion of household income (Chaplin et al., 1994; Bourassa, 1996; Chaplin and Freeman, 1999). In addition, cases where there are concerns about the level of non-housing

expenditure and housing costs relative to the given household income, housing affordability is measured by the residual income approach. This examines whether the residual household income after deducting the housing expenditure could meet the non-housing expenditure with the given level of income (Bramley, 1990, 1992, 1994; Hancock, 1993; Stone, 1993, 2006). These two approaches are classified as a normative perspective, in which a given standard is used to measure housing affordability in terms of the relationship between housing expenditure and household income. Households are thus regarded as experiencing difficulties in affording housing if housing expenditure exceeds a given standard (or ratio).

In addition, it is widely suggested that measurements of housing affordability should be linked with poverty measures, raising discussions about 'housing-induced poverty', 'shelter poverty', and 'a social basket of the living standard' (Stone, 1993; 2006; Bramley, 1994; Kutty, 2005). This then in practice measures what households actually spend on housing overall, examining whether housing expenditure induces poverty, or whether households fall beneath the official poverty line after paying for housing cost. The notion 'social basket' refers to 'a basket' of basic living necessities, comprising food, clothing, medical care, etc (Stone, 2006), and is assumed to be two-thirds of the official poverty line.

Thus, discussions in this section relating to housing affordability are extended to include measurement, emphasising the strengths and imperfections present within each method. The following discusses the measurements of housing affordability, principally comprising of three approaches: (1) the ratio approach, (2) the residual income approach, and (3) the poverty approach.

3.2.2.1 Ratio Approach

The ratio approach focuses on the relationship between housing expenditure and household income, establishing a given proportion of household income than can be reasonably allocated to housing expenditure (Bramley, 1992; Linneman and Megbolugbe, 1992; Hulchanski, 1995). The ratio approach considers each type of housing tenure, establishing the ratio of house prices to income, and rent to income, to determine housing affordability for

both homeowners and renters, respectively. Regarding different types of housing tenure, housing expenditure (along with the components of such expenditure) for homeowners primarily comprises of a down payment and mortgage payments (Gan and Hill, 2009). While for renting households, housing expenditure generally refers to the level of the rent and relevant utility bills. Theoretically, a ratio approach can be expressed by the following formula:

$$r_h = \frac{HE}{INC} \times 100\% \qquad\qquad 3\text{-}1$$

Where the given r', is required to be less than 30% of household income (Bourassa, 1996; Bogdon and Can, 1997)

if $\quad r_h > r'$, then households are experiencing housing affordability difficulties

Where,

r' = Threshold Housing Expenditure to Income Ratio requires under 30%

r_h = Housing Expenditure to Income Ratio is based upon the research data

HE = Housing Expenditure (i.e. rentals, mortgage payments, related utilities payments, and property taxes)

INC = Household Income

Accordingly, a threshold ratio ('rule of thumb') has been established (which is expressed as *r'* in Equation 3-1), advocating that households spending over a specified maximum percentage of their household income on housing expenditure should be regarded as experiencing housing problems. The standard level of 'ratio' set in the literature, is agreed as no more than 30%, stating that housing expenditure in relation to either renting or owner-occupying, should not exceed 30 per cent of monthly household income. If the percentage is higher than this, then households would be regarded as suffering from affordability difficulties (Maclennan, et al., 1990; Linneman and Megbolugbe, 1992; Chaplin et al., 1994; Hulchanski, 1995; Thalmann, 2003).

In relation to discussions concerning the threshold of the acceptable housing affordability ratio, it has a long history: Grigsby and Rosenburg (1975) suggested a range of acceptable housing expenditure to income ratios, ranging from 0% to over 50%, with the relationship between housing expenditure and household income being considered as one week's income representing one month's rent (Gilderbloom, 1985; Hulchanski, 1995). The threshold ratio was therefore suggested as being the equivalents of 25% of monthly household income being

spent on monthly rent. Similarly, the National Housing Federation (NHF) in the UK defined acceptable housing affordability as the number of employed householders whose rent-to-income ratio was less than 25% (Randolph, 1992). The ratio approach was adopted for official use by the U.S. Department of Housing and Urban Development (HUD), which specified that the 'threshold' of housing affordability ratio should not be more than 20% of household income at the beginning. Subsequently, this threshold was adjusted to 30%, indicating that monthly housing expenditure should not exceed 30% of monthly household income. A similar scale of the threshold scale has been documented in a large number of the literature, identifying 30% was the acceptable level housing affordability (Bourassa, 1996; Bogdon and Can, 1997). In relation to the level of threshold for the mortgage affordability ratio in China, it is defined as no more than 50% of household income (Mostafa et al., 2005; Chen et al., 2010), requiring that the level of a household's monthly mortgage payment should not exceed 50 percent of monthly household income (see Table 2-4).

The concepts of ratio approach and the expressions in Equation 3-1 reveal the primary cause of housing affordability to be the mismatch between house prices and household income. Similarly, Maclennan (2008) stated the existence of a link between housing affordability and fluctuations in house prices, leading to housing affordability being viewed as a symptom of the volatility of the housing market. In this regard, the cyclical movements of over-heated housing markets, in particular as they relate to appreciations in house price, have been regarded as the primary cause of a deterioration in housing affordability (MacLennan and Williams, 1990; Bramley, 1994). The continuous increase in house prices was previously regarded as a key aspect of the discussion relating to the volatility of the housing market, however, this has now been applied to discussions concerning issues related to housing affordability (Bramley, 1990, 1992; Whitehead, 1991; Chaplin and Freeman, 1999; Stone, 2006). It can therefore be argued that the issue of housing affordability has been influenced by the growing mismatch between house prices and household incomes. Undoubtedly, restricted access to homeownership has arisen because of low-income households being unable to afford to buy, primarily due to inadequate levels of income, and a rapid increase in house prices in relation to any increase in household income (Linneman and Megbolugbe, 1992).

In addition, housing affordability is inextricably linked to a number of further discussions, in relation to housing finance, macroeconomic circummundane, and other relevant factors influencing house prices (Hulchanski, 1995; Bourassa, 1996; Gan and Hill, 2009). Furthermore, affordability relates closely to households' tenure choice, especially the ability to enter the homeownership market (Zorn, 1989; Linneman and Wachter, 1989; Hulchanski, 1995; Bogdon and Can, 1997). Many studies discuss households borrowing constraint as key factors influencing the accessibility of homeownership (Linneman and Wachter, 1989; Bourassa, 1995; Bourassa et al., 2015), and this is informed by inabilities accruing sufficient savings and income to pay for a down payment. Housing affordability difficulties relating to mortgage payments arise from increases in interest rates and house price appreciation, leading to an increase in mortgage costs, thereby inducing more severe housing affordability difficulties for households with limited income and lack of family wealth. Accordingly, mortgage repayments no longer stressed low-income households, but it towards to middle-income households. Linneman and Megbolugbe (1992) pointed out that:

"Down payment constraints are binding for many younger lower- and middle-income households who find themselves postponing homeownership" (Linneman and Megbolugbe, 1992, p. 388).

More exhaustively, Gan and Hill (2009) proposed three aspects of housing affordability in relation to discussions concerning liquidity constraints, mortgage costs, and household income. The author clarified the concepts of purchase affordability, repayment affordability and income affordability, pointing out that purchase affordability refers to whether households could borrow funds for housing consumption; whereas, repayment affordability relates to the mortgage-induced burden on households, while income affordability measures the house price to income ratio. This thesis employs the concepts and measurement of repayment affordability, as proposed by Gan and Hill (2009), and the measurement of mortgage repayment affordability as follows:

$$r_m = \frac{Monthly\ Mortgage\ Payment}{Monthly\ Household\ Income} \times 100\%$$ 3-2

Referring a given r*, which is required no more than 30% of household income

If $r_m > r^*$, then households experience mortgage affordability difficulties

Where,

     r_m = Mortgage Affordability Ratio based upon the research data

     r* = Threshold Mortgage Payment to Income Ratio

Bourassa (1996) stated that mortgage affordability measures how much households are able to afford rather than how much they should afford. Mortgage affordability issues are indicated by an excessive proportion of mortgage payments (expressed as *r** in Equation 3-2), as these are caused by an upward movement in mortgage rates, and an increase in LTV, in conjunction with sluggish income growth. This could result in problems such as mortgage arrears, preventing buyers, especially first-time buyers from achieving homeownership. This is because the majority of homebuyers, in particular those on low incomes are heavily reliant on mortgage borrowing to support home purchases.

The house price to income multiple approach (or a similar approach, known as the Median Multiple) forms an alternative measure of housing affordability. Equation 3-3 presents the formula for the house price to income ratio:

$$m = \frac{House\ Price}{Household\ Income}$$ 3-3

Referring a given m', which is required to be no more than 3 times of household income (Demographia, 2016)

If, $m > m'$, then the household is experiencing housing affordability difficulties

Where,

     m = House Price to Income Multiple (Median Multiple) based upon the research data

     m'= Threshold House Price to Income Multiple (Threshold Median Multiple)

This measure has been detailed as a specific proportion of the median new home sale price to family income, suggesting the median multiple should remain between 2.8 to 2.9 (which is expressed as *m'* in equation 3-3) (Cox and Pacletich, 2009). Recently, this figure has remained at a similar level; whereby, a house is regarded as affordable if the median house price to

income multiple remains 3.0 and under (Demographia, 2016). This indicates that a house costing less than three years of total household income is regarded as affordable, while anything higher than this would result in households experiencing issues with housing affordability. The measures of price-to-income multiples (i.e. housing affordability multiples) and median multiples are used to examine international affordability problems by the International Monetary Fund and the World Bank. In addition, this measure is also the most frequently used by many counties to examine housing affordability, e.g. the UK, the US, Australia, Canada, South Korea, and China (Kim, 1993; Yates and Wulff, 2005; Hulchanski, 2005; Mostafa et al., 2006; Chen et al., 2010). The Annual Demographia International Housing Affordability Survey employed the median house price to income multiple measure to examine housing affordability difficulties (Demographia, 2016). The survey established that a standard median house price multiple of 3.0 and under is regarded as affordable, whereas a median multiple over 5.1 is highly unaffordable (Demographia, 2016).

A number of studies concerning housing affordability in China have established the house price to income multiple utilising this approach. However, due to limitations on data availability, the majority of researchers have employed an average, rather than median value. In addition, there is lack of any general standard to quantify housing quality, such as housing unit size, in particular, the housing unit being measured in China in square meters. Therefore, the measures for calculating the house price to income multiple in China vary according to differences in floor space. For the first time, Lau and Li (2006) were the first to propose the usage of a shared public floor area and usable private floor area to establish the gross house prices and the house price to income multiple. They measured the gross house size by aggregating the private usable floor area and shared public floor areas as the total house size. The usable floor areas consist of internal floors within the housing, including private floor spaces (i.e. living room, dining room, and kitchen), while shared public floor areas include external areas (i.e. lobby, corridor, elevator, and fire-fighting access). However, this measurement is not readily applicable to the overall housing market, because data regarding shared public areas is not included in the national level database. Thus, the widely assumption is that the standard dwelling size is a house sized at 60-square-meters.

Likewise, Mengjie et al. (2008) assumed an average gross floor space of 60 square meters, in order to obtain the housing affordability index. Similarly, Ahuja et al. (2010) employed a measure of 70 square meters to establish a house price to income multiple in their research. A number of researchers suggest an average floor space of 90 square meters as the standard house size, for obtaining the total house price, and the house price to income ratio (Chen et al., 2010; Wu et al., 2010; Huang, 2012). In view of this, this current thesis employs a 90 square-meters measurement as the standard dwelling size, when establishing the house price to income multiple at the national level. This is because a house size of 90 square meters is the most applicable measure to the Chinese housing market. Measurements and discussions concerning the house price to income multiple at the aggregate level are discussed in Chapters 5 and 6.

3.2.2.2 Residual Income Approach

As discussed above, the ratio approach focuses on proportional housing expenditure in relation to household income. However, a number of academics have proposed an alternative method, residual income approach, to discussing housing affordability. The residual income approach establishes the amount of income remaining for non-housing expenditure after the housing expenditure has been deducted. This focuses on whether households have sufficient income to pay for other expenditure such as basic living essentials and other services, after housing costs are paid (Maclennan and Williams, 1990; Bramley, 1990, 1994; Whitehead, 1991; Hancock, 1993; Chaplin et al., 1994; Stone, 2006). residual income is clearly defined by Brownill et al. (1990) as "It is the amount of money left after housing costs have been met that is crucial in determining whether the costs of housing are really affordable" (Brownill et al., 1990, p. 49)

Brownill et al. (1990) gave a clear definition concerning housing affordability in relation to residual income approach, clarifying the criteria for what is affordable as being, whether the amount of residual income after housing expenditure is paid meets daily expenditure on living essentials. The discussion undertaken by Whitehead (1991) coincided with that of Brownill et

al. (1990), more exhaustively, Whitehead defined the level of being affordability, just as follows:

The standard may be defined in terms of the absolute amount of residual income remaining once the housing has been purchased, i.e. it is set at a level which allows the household to pay for the housing and still purchase a socially acceptable bundle of other goods.

(Whitehead, 1991, p.875)

Both quotations discussed housing affordability as related to the residual income approach, emphasising the importance of the relationship between housing costs and remaining income. Equation 3-4 (below) formulates this definition, indicating that households should be regarded as subject to having housing affordability issues if the income remaining after deducting housing consumption is inadequate to cover non-housing consumption.

$$INC_R = INC_T - HE \qquad\qquad 3\text{-}4$$

Referring a given S,

If, $\quad INC_R <$ S, then households having affordability difficulties

Where,

$\qquad$ S = Social Minimum Non-Housing Living Standard

$\qquad INC_R =$ Residual Income based upon research data

$\qquad INC_T =$ Total Household Income

$\qquad HE_T =$ Total Housing Expenditure

The most important focuses in Equation 3-4 is expressed as INC_R, referring to the amount of remaining income after paying for housing, whereas S in the equation represents the level of social minimum standard of living necessities, which varies with countries, due to differences in the level of income, price level and welfare. There have been a number of discussions concerning the social minimum standard and quantity of non-housing consumption items in terms of housing affordability (Hancock, 1993; Chaplin et al., 1994; Bramley, 1994). Hancock (1993), noted that non-housing expenditure should involve food, clothing, education, health care and transportation, with the overall costs of these items being regarded as at a socially acceptable minimum level (Hancock, 1993). Oh (1995) also included the following costs as elements of non-housing consumption: entertainment; alcohol; vehicle; reading; cash

contributions; insurance; and pensions. Stone (2006, p.459) stated that ''how to specify the monetary level of a minimum standard of adequacy for non-shelter items was a practical challenge'', due to the variation between different countries' socially acceptable level and quantity of non-housing consumptions.

In relation to the residual income measurement, many scholars have stated that non-housing consumption is related to poverty standard, indicating that households should have sufficient residual income without living below the poverty standard. (Bramley, 1990, p. 16). Further, Maclennan and Williams (1990), believed that housing costs (i.e. house prices or rent) are a burden on household income, and that this is a governmental concern. These views highlight the importance of developing standards linking housing consumption to residual income, establishing a clear threshold for the level of non-housing expenditure; however, they did not encompass any indication of housing quality. Hancock (1993) proposed a point of view in relation to opportunity costs, as a supplement for discussions raised by Maclennan and Williams (1990) and Bramley (1990), identifying housing affordability as:

What has to be foregone in order to obtain housing and whether that foregone is reasonable or excessive in some sense. The value of the foregone goods and services is measured in terms of their total cost, and not in terms of the fraction of consumers' income absorbed. (Hancock, 1993, pp.129-133)

Hancock (1993) stated that, for a given income level, as it relates to the concept of residual income approach, only if housing expenditure and non-housing essentials' costs break the socially acceptable minimum, can a household be regarded as having a housing affordability problem. More crucially, Hancock (1993) pointed out that housing should be considered as a merit good when employing a residual income approach, because homelessness could be seen as meeting minimum daily consumption levels, which theoretically satisfy the threshold of the residual income approach, thus, such individuals do not have housing affordability problem under the criteria of residual income. However, in practice, the homeless are unable to acquire, and maintain, adequate housing. Thus, the opportunity cost of non-housing consumption forms an important discussion in relation to housing affordability, emphasising

that with a given level of household income, the relationship between housing and non-housing refers to an opportunity cost: there is a need to forgo some non-housing expenditure in order to maintain adequate housing expenditure.

3.2.2.3   Poverty Approach

The poverty approach forms a further measurement of housing affordability in relation to the measurement of residual income, when concentrating on issues related to poverty and household income (Bramley, 1990; Stone, 1993; 2006; Kutty, 2005). When housing absorbs a high proportion of a households' disposable income, this places a strain on the ability to cover a household's daily expenditure. This led Stone (1993, 2006) to view non-housing expenditure as being limited by the amount of residual income following housing costs, arguing that many of the lowest income groups can devote no more than 25% to 30% of their limited income to housing. The author therefore challenged the established ratio approach to housing affordability by providing a definition of shelter poverty as follows:

A household is shelter-poor if it cannot meet its non-housing need at some minimum level of adequacy after paying for housing. That is, shelter poverty is a form of poverty that results from the squeeze between incomes and housing costs rather than just limited incomes. (Stone, 1993, p.44; Stone, 2006, p.459)

Thus, key discussions concerning shelter poverty focus on the level of income available to devote to minimum levels of non-housing expenditure, making the squeeze between income and housing expenditure. A minimum level of remaining income determines considered to be the minimum standard required to support non-housing consumption, i.e. minimum poverty for households (Chaplin et al., 1994). A comparison between the poverty approach and the residual income method has established that the poverty approach places a greater emphasis on income than housing (Bogdon and Can, 1997), i.e. measuring whether households can be deemed as having housing poverty or shelter poverty due to their expenditure on housing. This measure has consequently attracted considerable attention from academics researching issues relating to poverty (Henman and Jones, 2012). It appears to be a more logical approach

to measure housing affordability than the poverty approach, as it also assesses households' non-housing expenses, including household income, household sizes and household type. Therefore, an important aspect of the poverty approach is that it forms a ''sliding scale on which the maximum proportion of income available for housing varies with income and household size and type'' (Bogdon and Can, 1997, p.49). Theoretically, the poverty approach is expressed by the following formula:

$$INC_R = INC_D - HE_T$$ 3-5

Referring to a given EXP_N*, which is the official poverty standard

If, $EXP_N* > INC_R$, then households experience shelter poverty or 'after housing poverty' problems due to housing consumption.

Where,

INC_R = Households' Actual Income Remaining after Housing Expenditure based upon research data

EXP_N* = Official Poverty Threshold for Non-Housing Expenditure

INC_D = Disposable Household Income (after tax)

HE_T = Total Housing Expenditure

Housing costs represent initial expenditure of a household's disposable income, leading to the level of non-housing expenditure being restricted by the level of income remaining (Stone, 2006). Accordingly, the poverty approach explicitly requires a determination of an affordability threshold; however, this is typically employed in relation to non-housing expenditure. As expressed by Equation 3-5, the official poverty threshold for non-housing expenditure (EXP_N*) consists of an affordability threshold, indicating that households would experience housing affordability difficulties if their residual income after paying for housing (INC_R) is unable to cover the official poverty level for non-housing necessities. Stone (1990, 1993) proposed a general standard of poverty threshold, requiring not less than two-thirds of household income. Considering that households are heterogeneous, particularly when it comes to inequality of income and differences in household formation, Stone (1990, 1993) suggested households should be ascribed different affordability thresholds in accordance with their income levels. The resultant finding was that, to prevent households from being regarded as shelter poor, both low-income households and larger sized households should allocate no more than 25% of their household income to housing, while retaining sufficient

income for non-shelter expenditure. Similarly, Stone (1993) advised high-income households and small sized middle-income households to pay 25%-30% of their income towards housing to avoid becoming shelter poor.

Bramley (1994) acknowledged the concept of poverty in relation to housing affordability, stating that housing affordability is linked to the poverty line in terms of requiring a normative standard for housing affordability:

"Housing affordability is closely bound up with the definition of a poverty line, and that the key ratios are likely to be expressed in terms of residual income (after housing costs) relative to that line" (Bramley, 1994, p.104)

Furthermore, Bramley (1994) stated that the most comprehensible concept of affordability is one relating to normative standards of housing expenditure, combined with judgements regarding a minimum level of non-housing consumption to be covered by residual income. Consideration of the discussions set out by Stone (1993, 2006) and Bramley (1994) established a standard for a scale for minimum income and a standardised level of non-housing necessities, to examine the housing affordability. However, there is lack of any universal identification of the poverty line or shelter-standard since non-housing expenditure items vary between countries (Bramley, 1994; Chaplin et al., 1994). In addition, Whitehead (1991) and Bramley (1994) pointed out that the definition of residual income indicates that housing affordability is not a perfect alternative when establishing housing policy in relation to normative housing needs. Therefore, Kutty (2005) pointed out that a situation known as 'housing induced poverty' may arise in relation to the concept of poverty and housing affordability, establishing that households have difficulties in affording the poverty basket of non-housing necessities after paying their housing expenses. Kutty (2005) was the first to clarify that non-housing goods create a poverty basket in terms of non-housing goods, when they are assumed to be two-thirds of the official poverty line. More importantly, housing-induced poverty is generally perceived to represent a minimum subsistence level of housing and non-housing costs. Households on the poverty line can experience 'housing-induced poverty' if they spend over one-third of their income on housing. Households above the

poverty line are also seen to be at risk of housing induced poverty if their residual income is below two-thirds of the official threshold due to an excessive expenditure on housing.

3.2.3   Debates on Housing Affordability Measurements

Housing affordability is a well-developed theory; however, no specific measure has yet been identified to conclusively establish housing affordability. The measurements discussed in the preceding section highlighted their own specific aspects, which have been widely adopted to examine housing affordability issues across the world, but which also contain a number of limitations. Both the ratio approach and the residual income approach employ a given standard, requiring implementation of a normative benchmark to set a threshold for examining housing affordability. The ratio approach simplifies the definition of housing affordability (Stone, 2006), by establishing a ratio to identify the relationship between housing expenditure and household income. The residual income approach more comprehensively examines the relationship between housing expenditure and income, by considering whether there is sufficient income after housing costs to cover the non-housing expenses. Both approaches hold some limitations due to fail to consider the housing quality. Bramley (2012) noted that the discussions regarding the measurements of residual income, and the ratio of house price to income, have been ''a long-running, but not wholly resolved, debate'' in the context of housing affordability (p.135).

3.2.3.1   Debates on the Ratio Approach

As previously discussed, the ratio method has been frequently employed to examine housing affordability (Chaplin et al., 1994; Stone, 2006). However, a number of researchers have argued that, questions remain over employing this measure to examine housing affordability. Brownill et al. (1990) emphasised the drawbacks of the ratio approach, stating that ''no single ratio could apply over time to people on varied incomes, in different types of household and tenure'' (p.47). Bramley (1992) further stated that the ratio approach is an imperfect measurement, as it examines households' affordability from a general perspective, failing to consider differences in household incomes. A number of academics have criticised the

threshold of the ratio approach, viewing the 25 to 50% ratio as arbitrary (Bogdon and Can, 1997; Stone, 2006; Henman and Jones, 2012). This is due to this benchmark was principally proposed in relation to a social judgement or market requirement, rather than on how much a household can afford i.e. ''one week's income for one month's rent'' (Hulchanski, 1995). Jewkes and Delgadillo (2010) suggested that policy makers should obtain qualified ratios to ensure an appropriate evaluation of housing affordability.

Maclennan et al. (1990) argued that, due to its failure to account for the actual level of housing costs, this is an oversimplified measure. Because housing costs vary by tenure, income, household types, along with the social characteristics of households. Similarly, Hulchanski (1995) pointed out that the ratio approach fails to comprehensively clarify a standard for housing need, neither fails to consider the household consumption preferences. Thus, a specific ratio of housing expenditure to is criticised as being too generalised. This leads to questions concerning the ratio approach, as well as its threshold, as they fail to take into account that household income and housing consumption vary between different types of households and household choices. As regards to this, Bogdon and Can (1997) pointed out that the ratio measure fails to acknowledge the financial constraints faced by individual and low-income households, with some unable to sustain even a 30% threshold for housing expenditure, while maintaining their normal living standards at the same time. Similarly, it does not control for differences in housing quality; i.e. some households may plan to allocate a sizable proportion of their income, in order to live in a house of greater size or quality, but the ratio approach would identify them as having issues in relation to housing affordability. This argument was acknowledged by Abelson (2009) and Gan and Hill (2009), who stressed that housing affordability, and the choice of housing tenure is related to household size and household composition, while household income forms a significant consideration when making housing choices. As a result, the ratio approach may underestimate affordability difficulties for low-income groups.

Hancock (1993) stated that the rent-to-income ratios approach fails to illustrate the standard of housing, while also failing to account for different levels of housing and non-housing levels. Chaplin and Freeman (1999) criticised the weakness of the ratio approach, pointing out its

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weakness in failing to consider specified levels of housing and non-housing expenditure. Due to the fact that some households may choose to live in a lower standard of accommodation, or even experience overcrowding, in order to maintain a proportion of housing expenditure under the required threshold. Burke et al. (2004) and Rowley and Ong (2012) acknowledged the weakness of the ratio approach, indicating that it fails to clarify the standard and quality of housing, i.e. that some households reduce their housing conditions by squeezing housing quality, or choosing to live in a distant location in order to avoid falling into housing affordability difficulties. In accordance with the threshold of the ratio approach, households are deemed as 'affordable' when housing expenditure remains below a given percentage of household income, but it is restricted to specific housing areas and conditions.

In addition, Stone (1993) suggested there is a need to examine housing affordability in combination with income inequality. Bourassa (1996) and Chaplin and Freeman (1999) viewed the ratio test as unsatisfactory, due to its failure to consider the issue of income inequality. Bourassa (1996) believed that some poor households with lower levels of income would retain affordability difficulties, no matter how little they allocated to housing expenditure, while those at the upper income level would retain sufficient income even when their housing expenditure exceeded the given percentage of income. Chaplin and Freeman (1999, p.1950) noted that a single rent ratio should not be employed to examine housing affordability for all households, as this fails to distinguish between households with different levels of income, thus leading to an underestimation of the housing affordability issues for the poorest households.

In addition, affordability is related to households' tenure choice, pertaining to their ability of to pay for homeownership or renting. Imperfections in this measurement have been highlighted in relation to homeownership affordability, in particular the ability to take up, and pay mortgages (Linneman and Wachter, 1989; Hulchanski, 1995; Bogdon and Can, 1997). In relation to discussions about the threshold of mortgage payment to income ratio, Bogdon and Can (1997) argued that a threshold is problematic, due to the true measure of housing costs for homeowners needing to be measured by housing user costs rather than house prices. More significantly, a number of factors such as interest rates, are excluded from the

measurement of the ratio approach. This could prove misleading, as it fails to take into account the costs of housing finance and the impact of interest rates on house prices (Bogdon and Can, 1997; Abelson, 2009). Similarly, Gan and Hill (2009) discussed the fact that, as households' accessibility to mortgage is dependent on their ability to raise a sufficient deposit, the mortgage lending environment and borrowing constraints, vary between different individuals and markets, leading to difficulties in defining a universal normative standard for housing affordability in relation to mortgage repayments.

In addition to the previous discussion, a number of technical methodological questions arise when employing the ratio approach, i.e. the type of income to use, which has been widely discussed over the past years. This has been stated by Bogdon and Can (1997), indicating that the type of income used should be a permanent income, as this is most appropriate when examining long-term issues relating to housing affordability. More exhaustively, Nelson et al. (2002) argued that, the investigation on housing affordability goes beyond a simplified measurement, it should address the type of income (whether transitory or permanent), liquidity constraints, household formation, mortgage costs and LTV. Similarly, Thalmann (2003) pointed out the imperfection of ratio measurements in relation to what types of household incomes that should be employed. Thalmann (2003) stated that the measurement of income used to examine housing affordability is ambiguous. The types of income involved in the ratio measurement result from the outcomes of housing affordability. Quigley and Raphael (2004) pointed out the limitations on measuring housing affordability are based upon annual income, and so they contended that it is therefore preferable to employ permanent income when examining housing affordability, as housing affordability improves alongside increases in households' income over a lifetime.

3.2.3.2   Debates on the Residual Income Approach and Poverty Approach

In relation to the preceding discussions concerning the measurement of residual income and poverty approaches, it is evidenced that both approaches focus on housing affordability in relation to income adequacy after housing costs, in order to meet the socially acceptable living costs and avoid falling into housing-induced poverty. The key argument regarding the

residual income approach concerns the degree of income remaining for a socially acceptable minimum of non-housing expenses (Bogdon and Can, 1997; Stone, 1993, 2006), while that of the poverty approach focuses on whether households experience housing poverty or shelter poverty as a consequence of paying their housing costs (Bramley, 1994; Kutty, 2005). These approaches view affordability problems as the inability of paying for non-housing items, or as falling below the poverty line due to expenditure on housing. Thus, these two approaches are employed when implementing a housing policy in relation to income assistance or housing subsidies.

However, there have been a number of discussions concerning the minimum standard for non-housing expenditure, and the kind of shelter-standards employed (Bramley, 1994; Chaplin et al., 1994). Meanwhile, Hancock (1993) established an effective reference for non-housing expenditure, encompassing food, clothing, education, health care and transportation, but failed to exclude government provision in cases where there is a welfare state offering free education and medical treatment. Education and medical costs can represent a large proportion of non-housing expenditure, and thus being provided free of cost would help to reduce non-housing expenses requirements. In addition, the residual income approach should consider the impact of social welfare on housing affordability. Such social welfare remains inaccessible in the majority of developing countries, leading to education and medical costs still representing the largest component of non-housing expenditure.

There has been a discussion of normative non-housing expenditure undertaken by Hancock (1993) and many researchers in Australia (Gabriel et al., 2005; Stone et al., 2011). However, Bourassa (1996) criticised the imperfections in establishing what constitutes the poverty line, indicating that the factors proposed have little direct relevance to the experiences of households, as a result of the variance between households' preferences and composition. Therefore, the equivalence scales used to define poverty lines for all households are arbitrary, as they fail to account for the differences in household types.

In relation to the definition of residual income, it fails to specify a qualified standard for non-housing expenditure. Just as Stone (2006, p.459) noted that, ''how to specify the monetary

level of a minimum standard of adequacy for non-shelter items was a practical challenge''. Thus, the standard items for non-housing consumption remain debatable, due to variations between households and countries. From a similar perspective, Henman and Jones (2012) argued that the key imperfection in employing the residential income approach is its complexity. Since residual income encompasses a benchmark in terms of income for a non-housing budget, it requires access to households' actual budgets. However, it is difficult to establish a specific standard for all households, because housing and non-housing consumption varying in relation to household type and size. They further pointed out that residual income measures fail to account for differences in living costs determined by geographical locations.

This entire section has discussed both the given proportion of housing expenditure to income (ratio approach), and the normative standard of income residual for non-housing expenditure (the residual income approach and the poverty approach), alongside the corresponding thresholds for housing affordability. The ratio approach is simple to use, while the residual income approach is more sophisticated. The weaknesses of both measures are that they fail to address housing quality and adequacy, household locations, and issues concerning inequality in household income. More specifically, the ratio approach fails to account for housing quality and living standard, mortgage accessibility, liquidity constants, and the LTV requirement (Nelson et al., 2002; Gan and Hill, 2009). These approaches are therefore considered as fairly ambiguous (Bogdon and Can, 1997; Thalmann, 2003; Stone, 2006). Some imperfections in the ratio approach have been modified by strengthening the residual income approach, such as reflecting market realities in housing and income (Henman and Jones, 2012). However, the residual income approach ignores the fact that households may choose to temporarily squeeze their non-housing consumptions in order to build up equity in a house (Bourassa, 1996, p1869). In addition, a key imperfection of the residual income approach concerns its confusion with the poverty approach. As stated above, the key discussions concerning the residual income approach consider ''the income remaining for non-housing affordability after housing expenditure'', with some scholars claiming the requirements for the residual income measure are linked to the definition of poverty. This approach has thus

attracted the attentions of scholars engaged in researching poverty issues (Bramley, 1994; Stone, 2006; Henman and Jones, 2012).

3.3   House Prices from the Macroeconomic Perspective

As discussed in the previous sections, housing affordability can be measured by the ratio approach, the residual income and the poverty approach, all of which focus on housing expenditure, household income, and house prices. The majority of the literature establishes a relationship between macroeconomic circumstances and the housing market (Andrew and Meen, 2003; Leung, 2004; Meen, 2008; Dreger and Zhang, 2013). As discussed in Chapter 2, as a result of the housing reform, the housing allocation system in China has been transformed into a market-based housing system, accompanying the development of the housing finance market. Housing demand is therefore associated with a wish to achieve homeownership, and is supported by the housing assistance policy and the emerging mortgage market. Those key components involved in the performance of a macroeconomic environment and monetary policies, pertaining to national economic fluctuations, the availability of mortgages, and interest rate volatility, have had a crucial influence on the housing market, also influencing housing affordability (Miles, 1994; Ortalo-Magne and Rady, 2006; Iacoviello and Minetti, 2008; Goodhart and Hofmann, 2008).

This section moves beyond a theoretical framework justifying the relationship of the macroeconomic environment and the housing market, specifying the theoretical factors that influence house price changes, to establish an understanding of the macroeconomic performance in relation to housing affordability, providing theoretical specifications for the empirical investigation.

A number of existing studies have highlighted the interactions between the national economy and the housing market, establishing that fluctuations in aggregate GDP exert a significant influence on the volatility of the housing market, pertaining to housing booms, house price fluctuations, and credit availability. It has long been established that positive changes in GDP growth rates correspond to growth in income and housing demand, thereby contributing to

increases in house prices (Mostafa et al., 2006; Meen, 2011). Goodhart and Hofmann (2008) stated that ''the housing wealth and housing collateral effects of consumption are the most important channels of the transmission of house price fluctuations to the real economy'' (p. 182). An increase in house prices accelerates growth in asset wealth (Taltavull and White, 2012); therefore, when considering the effects of housing wealth, it is important to note that house price appreciation contributes to an increase in investment activity and speculative housing purchase, which, in turn, increases GDP (Goodhart and Hofmann, 2008). Changes in GDP growth stimulates house price rises, thereby suggesting an increase in demand for mortgage finance, as the majority of housing purchases are financed by mortgage debt (Goodhart and Hofmann, 2008). Growing house prices can create a boom in investment, fuelling development of the economy. As a result, a growth in house price is recognised to have a significant influence on future GDP.

Conversely, macroeconomic shocks influence the performance of the housing market with deteriorations in economic performance, triggering a drop in income growth, and a decline in consumer confidence, consequently resulting in a fall in house prices and stagnated consumer expenditure (Baffoe-Bonnie, 1998; Whitehead and Williams, 2011; Ferrero, 2015). In addition, slumped consumer expenditure accelerates fluctuations in house prices, constraining macroeconomic prospects. This then results in the influence of wealth being reversed, as a result of the rapid decline in income and the capital value of houses, which (combined with uncertainty in relation to anticipated future house prices) influences housing consumption, leading to deteriorating macroeconomic prospects (Taltavull and White, 2012).

Previous research has established that monetary policy interacts with both the housing market and the macro economy. Goodhart and Hofmann (2008) stated the existence in a number of countries of a multi-faceted relationship between monetary policy, the housing market and the macroeconomic environment, specifying that rises in both finance and credit lead to a rapid appreciation in house prices (pp. 180-181). A number of studies have documented that it is not only the credit channel that influences changes in house prices (Mishkin, 2007; Ferrero, 2015; Chen et al., 2017). Greiber and Setzer (2007) pointed out that the collateral channel has a significant positive effect on money and housing. Taltavull and

White (2016) stated that, an increase in money supply improves credit availability in the market, leading to an increase in the demand for housing if the interest rate remains low. Moreover, greater demand for housing results in a rise in liquidity, creating an improved housing supply. This indicates that the money supply impacts on the volatility of house prices, through its influence on decisions made relative to spending and investment (Nelson, 2003; Shi et al., 2014).

Furthermore, existing studies have identified that monetary policy has a significant impact on house prices, through the influence of money supply, mortgage finance, interest rate, and liquidity (Lastrapes, 2002; Aoki et al., 2004; Liu et al., 2014). Increases in money supply generate increases in house prices, while fluctuations in house prices adjust the gross value of housing, resulting in changes in demand for money. Mishkin (1995) considered the impact of monetary policy on consumer spending, pointing out that a contractionary monetary policy reduces bank lending, resulting in a decline in house purchases for those who lack an alternative source of financing. Lastrapes (2002) stated that monetary shocks have a significant effect on the housing market, and in particular, on house prices fluctuations. This ensures that mortgage flows and availability are influenced by the impact of monetary contractions, thereby exerting an influence on house prices.

A link has been established between credit and house prices by means of their collateral effects on credit demand and credit supply (Goodhart and Hofmann, 2008). Housing purchases are generally financed by mortgage borrowings, and house price appreciation increases the added value of housing, thus generating an effect from collateral effects of house prices, i.e. houses are widely used as collateral for loans. On this basis, increases in house prices result in homeowners needing to increase both their spending and borrowing when making a housing purchase, leading to a number of potential housing affordability risks for specific income groups. Meanwhile, rises in house prices enhance the borrowing capacity of some households, due to the increased house wealth and collateral effects. That is to say, house price appreciation has a double-effect: on the one hand, increases in house prices generate a positive wealth effect and collateral effect on existing homeowners via the increased value of the property and family wealth. While, at the same time, it produces a

negative influence and creates potential housing difficulties for potential first-time buyers, as a result of needing to save an increased amount for any future house purchases.

In addition to the relationship between monetary policy and the housing market, Taltavull and White (2012) (in combination with data on selected European countries) have established that mortgage lending is relative to GDP, stating that, prior to the recent financial crisis, mortgage lending had a close relationship with GDP. Increases in mortgage lending raise liquidity in the housing market, while liquidity has an impact on the accumulation of credit through the simulation of demand for housing and money (Lastrapes, 2002; Mishkin, 2007). Therefore, an increase in mortgage finance leads to a rise in house prices (Goodhart and Hofmann, 2008). Similarly, countries experiencing significant house price appreciation also experience increases in the mortgage debt-to-GDP ratio. Thus, housing forms a platform implementing the effects of monetary policy, and strengthening the relationship between house prices and the mortgage market.

The level of unemployment, and the performance of the labour market, has also been discussed in terms of their influence on house prices. Employment plays an inextricable role in influencing the choice of housing and housing demand for both national economies and individual households, as it can be used as a proxy for household income. Volatilities in the job market therefore impact on house prices, by influencing the level of income and the demand for housing. An increase in the employment rate is positively associated with house prices, often leading to a rise in housing demand. Meen and Andrew (1998) stated that volatilities in the labour market have a considerable impact on housing demand via income elasticity, with labour market reform, in particular, being expected to result in changes to the housing market. They evidenced the empirical findings that, during the 20th century, the falling demand for housing and house prices was associated with changes in the labour markets, establishing that changes in employment influence the housing affordability in terms of changes in household incomes. This was proven by Horsewood and Doling (2004), who indicated that a change in the employment status of those households who had already applied for housing loans, would result in issues relating to housing affordability issues, including repayment difficulties. They advocated that unemployment in itself does not create

repayment risks, but rather leads to a transformation from employed to unemployed. The repayment difficulties vary with income differentials, but are primarily influenced by the employment status.

As discussed above, the labour market has an important impact on house prices, as income changes relative to employment volatility. Flexibility in the labour market has an influence on the distribution of income, influencing housing demand, due to its varying in relation to incomes (Meen, 2008). In much of the literature, income has been evidenced as the most important factor that dominates the housing demand, furthermore influencing changes in house prices (Muellbauer and Murphy, 1997; Malpezzi, 1999; Taltavull and White, 2012). Meen and Andrew (1998) evidenced that changes in house prices during the 1990s were closely related to changes in income during this period. Malpezzi (1999) revealed that rapid increases in income are related to higher house price appreciation, indicating a short-term inelastic housing supply.

Interest rates form a crucial factor in the housing market, influencing the demand for housing and house price via borrowing costs. Changes in interest rates in accordance with the implementation of monetary policies, play a role in either encouraging, or reducing, investment in housing, as well as mortgage borrowing and housing consumption. A lower interest rate due to an expansionary monetary policy, expands the accessibility of mortgage borrowing and provides chapter mortgage costs. This generates a rise in house prices due to increased accessibility to mortgages and growing demand. Linking mortgage payment to the ratio concept, a low-interest rate reduces payment costs when compared with high-interest rates, thereby improving borrowers' ability to meet mortgage payments if all other factors remain equal. This was discussed by Gan and Hill (2008), who suggested that holding house prices unchanged, a decrease in the mortgage interest rates helps to improve mortgage payment affordability, through decreasing the mortgage costs.

There have been a considerable number of discussions concerning the relationship between interest rates, house prices and housing affordability in combination with mortgage borrowing. Berry and Dalton (2004) stated that low-interest rates result in cheaper mortgage

costs for given housing costs, also increasing the upper limits of borrowing capability, thus enabling borrowing at a given repayment-to-income ratio. It can be seen that lower interest rates increase the demand for housing, and consequently stimulate house price increases. Kim (2004) suggested that the effects of interest rate decreases impacts on the mortgage market, decreasing borrowing costs, reducing housing affordability difficulties, and furthermore stimulating housing demand from potential homebuyers. Similarly, Ellis (2006) stated that a nominal interest rate determines the size of the mortgage repayment and the maximum size of any loan granted. Therefore, lower mortgage interest rates increase borrowers' ability to pay, and simultaneously broadens the mortgage accessibility to a wider array of borrowers. This was acknowledged by Kim and Cho (2010), indicating that a decrease in interest rates is closely related to changes in payment costs, and therefore, that low-interest rates generates a rise in house prices.

A number of scholars have pointed out that interest rates influence house price appreciation in relation to changes in housing supply and demand. A decrease in interest rates, in both real and nominal terms, results in changes in housing supply and demand (Kelly and Menton, 2007; Caldera and Johansson, 2013; Ferrero, 2015). Conversely, increases in interest rates (alongside the economic cycle) increases borrowing costs, reducing cash flow in the market, thus leading to a decrease in housing demand and house prices (Berry and Dalton, 2004; Taylor, 2007). Kenny (1999) identified that housing demand is a function of the interest rate, to which it has a negative correlation, as an increase in interest rates raises the borrowing costs and housing consumption costs, thereby squeezing demand for housing. Thus, fluctuations in interest rates have a significant impact on housing stock. Tu (2000) employed data on Australia, between 1989 and 1998, and established that nominal mortgage interest rates influence real house price appreciation over both the short and longer-term. Girouard et al. (2006) suggested that increases in interest rates could generate a significant decline in real house prices. Renaud and Kim (2007) noted that the cause of the global boom in housing prices between 2000 and 2005 resulted from strong housing demand associated with low nominal and real interest rates, alongside a rapid increase in annual global economic growth. Painter and Redfern (2002) indicated that, in terms of the effects of interest rates, changes in interest rates influence the timing of transiting the tenure status from renting to owner-

occupancy. Increases in interest rate may lead to sitting tenants postponing their purchase plans, as a result of needing to save an increased amount for any future house purchases. In addition, the author further demonstrated that the aggregate housing supply is sensitive to changes in interest rates, indicating that high interest rates have a negative impact on the housing supply.

A considerable proportion of the literature emphasised inflation as a crucial factor impacting house prices (Catte et al., 2004; Demary, 2010; Taltavull and White, 2012). Inflation affects house prices primarily by influencing wealth effects and household consumption. High levels of inflation lead to those on high levels of income purchasing houses to hedge against inflation. In contrast, those at the lowest income levels have trouble in entering the housing market, or struggle with mortgage repayments, as a result of shrinking real incomes. Conversely, during periods of high inflation, a contractionary monetary policy is introduced through the restriction of money supply and raising interest rates, which can mitigate high levels of inflation. Consequently, this leads to a reduction in housing demand due to increased borrowing costs, ultimately leading to declines in house prices.

Demary (2010) suggested that inflation is negatively related to house price, being more significant when house prices are measured in real terms. Housing is regarded as a consumption good and investment vehicle employed by households to hedge against inflation which potentially squeezing their wealth. Tastsaronis and Zhu (2004) explained that, in relation to the impact of inflation on mortgage costs, a higher level of inflation rate leads to a decrease in house price. Inflation can, through its links with mortgage borrowing, be used as a proxy for the prevailing financing conditions, thereby influencing demand for housing. In terms of the effects of high inflation and high nominal interest rates, these impose additional payments at the later stages of the mortgage repayments of the principal, rather than at the earlier stages, raising the real value of repayment in the early period of the mortgage repayment (Debelle, 2004; Tsatsaronis and Zhu, 2004). Consequently, this reduces demand for housing. Conversely, a reduce in inflation increases borrowers' ability to pay by reducing real interest rates, while the nominal interest rates remain unchanged. This has been

regarded as an important factor driving up house prices by influencing the costs of mortgage borrowing (Eillis, 2006).

In relation to the demand-side factor, a considerable number of scholars have considered that a change in population forms an important impact on house prices (White and Allmendinger, 2003; Terrones and Otrok, 2004; Paris, 2007). Population growth can be employed as a significant proxy for housing demand, as it increases the number of households, thereby increasing demand for housing. White and Allmendinger (2003) stated in their research that population forecasts arise from a demand-side factor employed to estimate the amount of land required to invest in housing. Berry and Dalton (2004) pointed out that continuing population growth forms the main proxy for housing demand, alongside the increase in the number of households. Glaeser et al. (2005) developed a model involving demographic variables to integrate the heterogeneity of housing supply into urban developments. They captured the relationship between the population growth rate and housing units, evidencing the existence of a strong correlation between urban development and housing stock. In relation to the theory of housing supply and demand, they pointed out that, an increase in a city's population results in a moderate upward shift in housing demand, thereby generating a corresponding increase in house prices. Similarly, Girouard et al. (2006) indicated that an upward trend in fluctuations in real house prices is expected to increase housing demand associated with population growth.

In relation to population growth, mobility and urbanisation are factors influencing house prices by affecting housing demand. Many academics have focused on the interaction between urbanisation, urban development, and the housing market. Kahl (2006, p. 34) pointed out that, rural-to-urban migration has made the most important contribution to urban development in developing countries, especially those countries experiencing rapid economic development. This viewpoint was subsequently acknowledged by Peng et al. (2011) in relation to economic development and urban development in China.

In the context of China, the *'hukou'* system is interconnected with industrialisation, acting as a strategy driving the process of industrialisation (Chan, 2010). In the meantime,

industrialisation creates job opportunities by supporting economic transition, encouraging a growth of urbanisation. Urbanisation has been involved in a policy concern associated with economic development, because it is closely related to the creation of job opportunities (Peng et al., 2011). Ding and Zhao (2011) stated that household income in China is expected to increase along with the industrialisation and urbanisation. Considering the relationship between urbanisation and the housing market, Chen et al. (2011) and Wu et al. (2012) identified that the population shift towards urbanisation resulted in an increased demand for housing under the *'hukou'* system, and especially in China's major cities. This is in accordance with the discussions undertaken by Peng et al. (2011) and Ding and Zhao (2011), suggesting that urbanisation creates job opportunities along with industrialisation and economic development (Gu et al., 2012; Buhaug and Urdal, 2013), therefore driving a growing trend towards housing demand, and the increases in house prices (Feinstein and McFadden, 1989; Chen et al., 2011). In relation to this consideration, Wu et al. (2012) evidenced that, in 2009, one-third of newly-built residential housing was purchased by migrants.

When discussing the dynamics of the housing market and house prices in relation to the macroeconomic perspective, housing supply is as important as housing demand, having an important influence on house price volatility, the dynamics of housing market, and the performance of the development of the aggregate economy (Ball et al., 2010; Caldera and Johansson, 2013). Mayer and Somerville (2000) stated that changes in the price of existing house may arise due to changes in new housing supply, influencing the wealth capacity of homeowners and their housing affordability. Linking this to elasticity theory, it is claimed that whether the demand shocks drive house price appreciation is determined by the elasticity of supply. Some academics evidenced that in regions with high supply responsiveness, the markets experience a slight increase in house prices alongside shocks to housing demand. By contrast, in a supply-constrained market, the market responds to a large change in house prices, rather than to an expansion of housing supply (Glaeser et al., 2008; Gyourko, 2009). An unresponsive housing supply leads to volatilities in aggregated economies, by accelerating changes in house prices. Wu et al. (2012) stated that the considerable increase in newly-supplied housing fuels the development of China's newly-built housing market.

3.4 Factors Influencing housing Affordability

Theoretical discussions concerning the definition and measurement of housing affordability have long been held, proposing a theoretical 'rule of thumb' to define the level of 'affordable' (Maclennan and Williams, 1990; Bogdon et al., 1994; Laird, 2007; Demographia, 2016). However, over previous decades, there have been a number of discussions concerning the imperfections in housing affordability measures, leading to both measurement approaches being consistently criticised by researchers (Hulchanski, 1995; Thalmann, 2003; Jewkes and Delgadillo, 2010; Bramley, 2012). Consequently, there is a need to develop studies concerning housing affordability in relation to econometric analysis, as this links theoretical backgrounds and discussions concerning macroeconomic circumstances, demographic characteristics, and liquidity constrains. This section discusses those factors impacting housing affordability by illustrating existing econometric analyses of housing affordability. However, it has been found that studies of econometric analysis concerning housing affordability remains to be developed.

Housing affordability is a complex theory, the analysis of housing affordability issue has a close relationship with multiple aspects, including macroeconomics, mortgage payments, the housing economy, life cycle theory and political considerations. More exhaustively, Quigley and Raphael (2004) documented the factors affecting affordability as follow:

Affordability... together in a single term a number of disparate issues: the distribution of housing prices, the distribution of income, the ability of households to borrow, the choices that people make about how much housing to consume relative to other goods, the distribution of housing quality, public policies affecting housing markets, and conditions affecting the supply of new or refurbished housing. (Quigley and Raphael, 2004, pp.191-192)

This discussion focuses on each aspect relating to housing affordability, elaborating on all relevant theoretical factors that could potentially affect housing affordability. Bramley and Karley (2005) discussed the housing affordability crisis in the British mortgage system in the early 1990s, identifying that such issues are caused by a combination of circumstances,

pertaining to household income, demographic changes, factors impacting mortgage supply and changes in policy. The following discussions concern factors influencing housing affordability as it accords with the conclusions of Quigley and Raphael (2004), and includes the following aspects: house prices, household income, borrowing constraints, housing conditions, housing supply and housing policies.

House prices have been viewed as having a positive impact on housing affordability difficulties, holding everything constant, and thus increases in house prices aggravate housing affordability problems, as a result of a corresponding increase in down payments and mortgage repayment (Quigley and Raphael, 2004; Tsai, 2013). In view of this consideration, Campbell and Cocco (2007) focused on the impact of house price fluctuations on household consumption, as evidenced by the existence of a positive relationship between the house price and mortgage affordability ratio, showing that the impact of predictable changes on house prices tend to influence both renters and homeowners by increasing mortgage costs.

Income has also been established as the most important factor impacting housing affordability (Kim, 1993; Oh, 1995; Gabriel et al., 2005; Bramley and Karley, 2005). Rapid growth in income improves payment affordability relative to mortgaged homeowners, thereby mitigating housing affordability difficulties (Kim, 1993). Oh (1995) stated that household incomes contribute to reducing the housing affordability ratio, thus mitigating housing affordability problems. Bramley and Karley (2005) concluded that income influences housing affordability at different income levels, and inadequate income results in extremely low-income or poverty households being unable to afford private rentals, or have a heavy burden of repayment, while slow growth in income results in affordability difficulties for middle-income mortgagors.

Changes in the housing supply impact housing affordability, due to a direct impact on house prices. Glaeser and Gyourko (2003) stated that that factors from the supply side would impact housing affordability, suggesting the construction costs of housing should be regarded as an appreciable benchmark when assessing housing affordability. Moreover, because changes in house prices are fundamentally linked to changes in construction costs, they also impact on

housing affordability. Similarly, Quigley and Raphael (2004) and Tsai (2013) established that factors concerning the housing supply also influence housing affordability, comprising land-use regulations or quantity of supply.

Based on existing studies (Quigley and Raphael, 2004; Campbell and Cocco, 2007; Tsai, 2013), a figure has been developed, to summarise the relevant factors influencing housing affordability, supporting the theoretical framework of factors influencing housing affordability, as presented below:

Figure 3-1: A summary of relevant factors influencing housing affordability
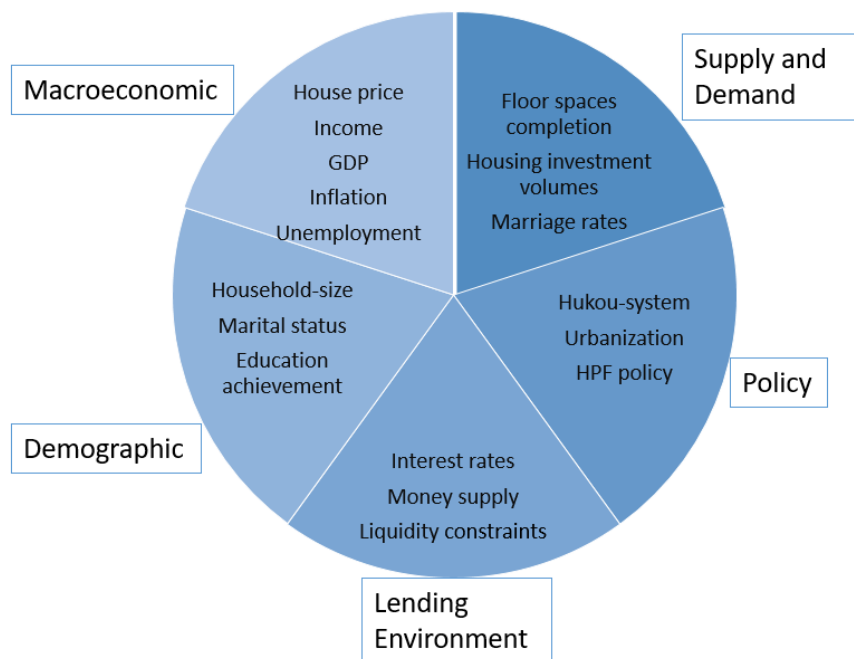
(Source: Author's self-study)

As shown in Figure 3-1, the factors influencing housing affordability can be categorised according to five major perspectives, including macroeconomic side, supply and demand side, demographic factors, lending environment, and policy factors. These factors have been identified in a number of existing studies as having a significant impact on housing affordability (Leece, 2004; Mostafa et al., 2005; Eillis, 2006; Bramley, 2012). In relation to the research questions, the following sub-sections discuss the factors influencing housing

affordability, providing theoretical understandings as a basis for further empirical investigation. In accordance with the type of data employed in this current thesis, the discussions are grouped into different levels of data utilisation, as presented in sections 3.4.1 and 3.4.2 separately.

3.4.1   Empirical Literature Based on Data at the Aggregate Level

Mostafa et al. (2005) employed aggregate level data to investigate those factors impacting on housing affordability in the context of Hong Kong. A number of macroeconomic factors were found to have significant influences on housing affordability, including GDP, inflation rate, and inverse household income. The findings established a clear picture of the relationship between housing affordability and key economic indicators, providing a theoretical foundation for this current research. According to Mostafa et al. (2005), GDP has no direct influence on housing affordability, but influences economic growth by raising income levels, thus improving purchase affordability and payment affordability. In addition, the results indicated the presence of a significant relationship between inflation and housing affordability. Increases in inflation aggravate issues of housing affordability for households, in particular those households with limited income and family wealth. This finding is acknowledged by the authors' subsequent research, clarifying the impact of GDP and inflation rates, in combination with differences in incomes and tenure Mostafa et al. (2006).

Mostafa et al. (2006) examined factors influencing housing affordability in Shanghai, observing macroeconomics factors such as GDP, inflation, income division, and a housing policy factor HPF. The finding established that rapid GDP growth and low inflation rates contribute to raising the living standards of households residing in Shanghai, but also generate a number of impacts on housing affordability. Firstly, as a result of income inequality, GDP growth fails to benefit all members of society. An increase in income arising from GDP growth has a significant impact on affordability for high-income groups. However, difficulties remain for those who with low levels of income and weak professional skills, due to their comparatively relatively lower level of income growth. Secondly, they illustrated that GDP

growth helps households improve their housing affordability, but, over the long term, also widening the income gap between different income groups.

Inflation rate is one of the most important macroeconomic factors established as having a significant impact on housing affordability (Debelle, 2004; Mostafa et al., 2005; Eillis, 2006). Linking to the mortgage perspective, a low inflation rate generates a lower mortgage payment to income ratio (Mostafa et al., 2006), leading to an increase in real household income, enabling mortgaged homeowners to better afford the mortgage payment. Conversely, a high rate of inflation has an adverse impact on middle and low-income groups, because high inflation rate shrinks real wages. This generates difficulties with housing expenditure for these groups at a limited income level. Mostafa et al. (2006) evidenced that the impact of inflation rate on mortgage affordability varies by income groups, with Mostafa et al. (2006) graphed the deviation in the impact of inflation on housing affordability between four income groups, revealing that an increase in the inflation rate decrease the affordability ratio, whereas it has the strongest impact on low-income households.

Tsai (2013) generated a model in order to examine the impact of specific factors on housing affordability. The debt to income ratio is used as a proxy for housing affordability, in cooperation with aggregate level data spanning from 2003 Q1 to 2009 Q2. The results indicated that house price return is positively auto correlated in the short term, but negatively auto correlated over the long run. The author employed fourth order lags of house price returns in the model in order to examine the impact of house price returns on housing affordability. The results revealed that both normal, and first order lag house price returns have no impact on housing affordability, while the second, third and fourth order lag house price returns have a significantly positive impact on the debt to income ratio. The sign of the parameter evidenced that an increase in house price returns results in a deterioration in housing affordability.

Li et al. (2015) examines housing affordability in relation to regional variations by use of a fixed effect model, employing panel data spanning 2002 to 2015. Factors pertaining to rents, real interest rates, and household income are involved in the model, showing that the results

of real interest rates are found to have a negative impact on house prices. In relation to mortgage affordability, Li et al. (2015) stated that mortgage costs change with interest rates, as a higher interest rate leads to a more expensive mortgage rate, thereby restraining the mortgage demand for potential homebuyers. Meanwhile, for existing mortgagors, an increase in interest rate raises their mortgage payments, enlarging the proportion of the mortgage to income ratio, when income remains unchanged or is experiencing a slow growing pace. In addition, in relation to supply side factors, an increase in interest rates has a negative impact on investment, reducing the housing supply due to rises in borrowing costs.

3.4.2 Empirical Literature Based on Data at the Household Level

Life cycle theory is widely employed in existing studies pertaining to housing affordability, illustrating differences in households' housing consumption and family financial capacity across the life cycle path (Leece, 2004). Linked to life cycle theory, research concerning housing affordability has established an extensive study by the use of household level data, capturing household heterogeneity in terms of household formation, household income, and housing choice. This section continues by presenting existing studies concerning housing affordability at the household level.

Oh (1995) examined differences in demographic characteristics in relation to rent burden households and non-rent burden households. Linked with lifecycle theory, the rent burden arising from income shortages, changes in family size, marital status, and population size of the city. Evidence revealed that, firstly, income growth reduces the risk of having a rent burden, positively improving the affordability of paying rents. Secondly, a city's population size has a negative impact on rent burdens, indicating that an increase in population size raises the probability of having a rent burden. This is because an increase in population raising the demand for housing, leading to house price appreciations, and resulting in housing affordability burdens. Lifecycle theory states that age bears a close relationship to housing affordability. Oh (1995) evidenced that households aged below 34 and over 65 have less probability of a having affordability burden, while those aged between 35 and 64 have a higher likelihood of experiencing affordability problems. However, age did not prove

significant when income and other variables were controlled. In addition, empirical findings revealed that being single generates a higher risk of having a rent burden, this is due to individual households possessing less aggregate income in comparison to married couples.

Bramley (2012) employed BHPS data for the period 1997 to 2003, to examine issues concerning housing affordability. Respondents were asked if they had experienced difficulties paying for their accommodation over the previous 12 months. The issue of housing affordability was subsequently validated if the respondents confirmed encountering difficulties paying for housing. This is known as 'self-reported affordability problems', by the employment of the payment to income ratio measure. Logistic regression was employed to identify the main factors influencing housing affordability, incorporating factors such as household income, regional house prices interacting with the mortgage rate, saving and equity, unemployment rate, and demographic factors such as employment status and marital status. In research by Bramley (2012), the findings indicated that, for mortgaged homeowners, household income and house prices and the mortgage rate are found to have the most significant impact on housing affordability. The unemployment rate in each location had a sizeable positive effect on difficulties with housing affordability, while working status at the individual level had a negative effect. Employment status is a proxy for household income, revealing that being unemployed results in a deterioration in housing affordability, due to unemployment reduces the prospective household income. Conversely, being employed helps to mitigate housing difficulties, and therefore contributing to overcoming housing affordability difficulties. Demographic factors, including age, marital status, and number of children, have a significant impact on housing affordability difficulties.

Ying et al. (2013) employed data at the household level to estimate the potential determinants concerning the probability of suffering housing affordability problems. They employed Ordered Probit Models (OPM), with the dependent variables being the self-reported ordered levels of the housing affordability indictor, representing household's ability to afford house prices, down payments and monthly repayment separately. The theoretical independent variables employed included households' permanent income, transitory income, occupational sectors, and demographic factors such as educational achievement, marital

status, and housing policy (i.e. HPF and housing assistances). They evidenced that an anticipated increase in income over the following three years has a significant impact on housing affordability, after controlling for permanent income and transitory income. This suggests a household's income growth potentials in the short-term may vary with its predicted long-term growth, and thus have a strong impact on a household's ability of achieving homeownership. In addition, the structure of income and households' financial capacity also influences housing affordability in terms of home purchases, revealing that, a household would have a considerable capacity to afford housing costs if they have additional sources of income, i.e. returns from investment in stocks and funds.

3.5   Housing Affordability in the Context of the Chinese Housing Market

Following the above discussions concerning the theoretical framework, housing affordability issues are discussed based on Chinese data and policy context in the section. Prior to the housing reform, Chinese urban housing was fully planned and funded by the government, as the housing stock and associated housing ownership were predominantly funded and managed by local governments (Wang and Murie, 1999, 2000). As with the planned economic regime, the investment and supply of new housing depended on investments from local governments, leading to shortage of housing and inequality in terms of the allocation (Gao, 2010; Yang and Chen, 2014). Following the complementation of the housing reform in 1998, the housing market in China was transformed into a market-oriented system. In association with the housing reform, houses could be transacted in the marketplace, and households were encouraged to purchase housing at a market-price (Tang et al., 2006). As a consequence, this has led to a continuous growth in house prices over years. As Kuang and Li (2012) criticised, house prices have remained a substantial rise, as a result of the imbalance between housing demand and supply since 2001 in China's major cities, leading to a deterioration in housing affordability (Chen et al., 2010; Kuang and Li, 2012). Rosen and Ross (2000) reported that the house price to income multiple in China ranges between 10 and 20, in comparison to that in the US, where it remains at 5 (Kuang and Li, 2012).

Alongside developments in the housing market, the HPF system was founded, in association with the establishment of the mortgage finance system in China. As discussed in Chapter 2, the key intention behind establishing HPF was to provide housing assistance by means of granting a low-rate housing debt. This functions as a tax-free compulsory saving scheme, whereas employees' payroll contributions are matched by employers, with a given proportion of gross monthly income, set at around 7%-20% respectively (Wang and Murie, 2011; Chen and Deng, 2014). With the rising demand for housing, and the incremental growth in money supply, the mortgage market in China remains a rapid development. Ahuja et al. (2010, p.4) stated that ''by late 2009, loans to property developers and mortgages together accounted for about 20% of total loans, which sharply increased bank exposure to property''. As shown in Chapter 2, the total volume of household debt increased sharply over time, providing a high level of mortgage availability for borrowers, encouraging a boom in housing demand.

The structure of the mortgage market is fully regulated by the PBOC, granting the mortgages for a maximum duration of 30 years with adjustable rate mortgages (ARMs) (Duda et al., 2005; Deng et al., 2005). The down payment requirement is set within a range of 70% to 80%, capped at 80% when housing demand remains a booming. The mortgage interest rates have been predominately controlled by the PBOC, whereas the long-term mortgage interest rate follows the long-term base lending rate, as set by the PBOC with a slight fluctuation band, depending upon the lending conditions at each bank and the monetary transmission in each region (Deng et al., 2005). The ARMs require that existing mortgagors should follow the adjustment of the rate without caps starting from the beginning of the following year; however, this type of mortgage rate creates potential risks during each stage of housing market development, in which is affected by quantitative easing monetary policy, interacting with capital markets. More specifically, in expansionary monetary policy, an increase in money supply expands the credit availability in the market, promoting mortgage accessibility and increase the growth in housing demand and homeownership (Ahearne et al., 2005; Xu and Chen, 2012). However, this would ultimately raise house prices, thus widening the gap between income and house price.

The development of urbanisation turns to be an important factor of influencing housing affordability, as continuous urbanisation contributes significantly to the growing demand for housing (Chen et al., 2011; Wu et al., 2012). Currently, the urbanisation is accompanied with the implementation of the 'hukou' system, remaining a stable increase with an average growth rate of 1.5% per annum. As illustrated by Peng et al. (2011) and Ding and Zhao (2011), the increase in urbanisation creates job opportunities, along with industrialisation and economic development (Chaolin et al., 2012). This in turn raises incomes, thereby generating growing demand for housing (Chen et al., 2011) and increasing house prices. However, it also has placed housing difficulties for low-income groups, as the homeownership inequality is exacerbated among different income groups, raising a need for pay particular attention to housing affordability issues in China, as discussed below.

3.5.1 Housing Affordability Policies in China

The above discussions provide theoretical understanding concerning housing affordability in China, forming empirical specifications for empirical investigation. This section evaluates the housing policy, HPF, interpreting existing studies that have debated its importance and effectiveness in encouraging homeownership and reducing housing affordability challenges in China. In addition, based on discussions concerning factors impacting house price in section 3.3, this section provides a short discussion about the relationship between the role of HPF and house prices.

Linking to lifecycle theory, homeownership is regarded as a lifelong pursue across a household's lifecycle path (Brueckner, 1994). However, shortages in savings and liquidity constraints have been the main cause that prevents households from entering the mortgage and homeownership markets (Campbell and Cocco, 2003). The HPF just takes up the shortage in saving and liquidity, by means of absorbing compulsory savings for housing purposes, and providing tax-free financial assistance for housing by granting down payments and a low-rate housing debt. Such types of housing debt generate a relatively low risk when compared with the mortgages. In relation to the effectiveness of housing policies on housing affordability, Ying et al. (2013) observed that both HPF and housing subsidies significantly contribute to

improving the affordability of the home purchases. More significantly, HPF works effectively as a housing assistant in home purchasing through the granting of low-rate of housing debt. This finding acknowledged discussions undertaken by Wang (2000) and Burell (2006), which state that housing policy interventions have a significant impact on overcoming housing affordability difficulties by improving the households' financial strength. However, a number of researchers have argued that HPF does not expand HPF holders' economic capacity, since they regarded HPF as a form of unpaid salary, rather than a type of housing assistance (Yeung and Howes, 2006).

In the research of Tang and Coulson (2017), they documented the effectiveness of the HPF in increasing the likelihood of achieving homeownership. By the inclusion of the household survey data, their results evidenced that participation in HPF is found to have a positive impact on the likelihood of being a homeowner, in cooperation with demographic factors, such as being married and employed. The authors found that participating in HPF generates a greater likelihood of entering the homeownership market for households aged under 40, rather than for the whole sample, revealing that HPF works effectively to improve the affordability for owner-occupancy (Tang and Coulson, 2017). In addition, what interesting in their study is, the length of time participating in HPF was included in the model, showing a negative impact on the likelihood of being homeowners. This reveals that the contribution of HPF is not only linked to variables connected with the participant themselves, but also to the number of years they undertaken the HPF enrolment. This can be seen to have an even stronger impact on younger aged groups, because they have relevant short periods of working experience. This is in line with life cycle theory, which specifies that younger households are liquidity constrained due to shortages in working experience and household income.

Zhou (2017) comprehensively discussed the effectiveness and the contributions of the HPF, examining the impact of the HPF's two schemes on demand for housing respectively. Zhou (2017) evidenced that the demand for housing, and the size of a households' preferred housing increased significantly under the HPF system, showing a percentage rise of 11% and 21% respectively. In relation to the age groups, HPF encourages to achieve homeownership

for households age under 45. Comparatively, the impact of HPF on the size of housing works throughout the whole age groups. When considering the two schemes of the HPF, the tax-free compulsory savings and low-rate housing debt, Zhou (2017) captured the difference between them in terms of the impact on homeownership rate and the size of housing. More interestingly, the author stated that compulsory saving is not effective as a means of promoting demand for housing, stating that if the deposit proportion is below the officially required proportion in the absence of the policy, households keep their private savings equal to the HPF optional savings; therefore, households can make housing choices in the absence of housing assistance. In relation to the effect of low-rate housing debt, Zhou (2017) stated that it is effective for households aged over 30 to achieve homeownership and increase the size of housing with a wealth effect generating from the low-rate housing debt. Conversely, for households aged under 30, the housing policy of low-rate housing debt fails to work on their home purchase. This is consistent with life cycle theory, revealing that households under 30 lack of sufficient family wealth to meet down payment requirement and access credit.

However, Chen and Deng (2014) criticised the major challenges and imperfections of the HPF, pointing out that the HPF scheme to date is only transitional, and such as is experiencing efficiency and equality issues. Firstly, the authors stated that the numbers of beneficiaries for the HPF scheme are limited when compared with the number of participants engaged in the HPF scheme, taking less than 20 per cent of HPF participants. Secondly, Chen and Deng (2014) argued that the HPF scheme generates the problem of hybrid identities, since it behaves as a multi-functional policy: on the one hand, the HPF account is owned by individual participants, whereas on the other hand, it serves as an official housing policy. Therefore, issues may arise in relation to defining the role of public and private housing assistance project; and how the government takes up its responsibilities (Chen and Deng, 2014, p.995). Following these arguments, recommendations were proposed by Chen and Deng (2014), suggesting that HPF functions should split saving and lending separately, funding affordable housing equitably by improving the centralised management of the HPF.

3.5.2   Regional Variations in Housing Affordability in China

Regional differences were discussed in Chapter 2, linking data concerning regional economic performance, level of income, and the house prices in three selected regions. This section illustrates the existing empirical studies on housing affordability in three regions, which is Beijing, Shanghai and Guangdong, illustrating differences in monetary transmission between these three regions and the rests of the country.

Alongside the overheated development of the housing market in China, the central government issued a number of national initiatives to slow persistent rises in house prices. Monetary policies are therefore transmitted into the housing market by adjusting borrowing rates and controlling money supply. However, due to variations in regional economic development in China, the transmission of monetary policy varies with regions (Ahuja et al., 2010). Economic theories have stated in a number of channels that monetary transmission varies between regions, including an interest rate channel, and credit channels (Mishkin, 2007; Calza et al., 2013; Taltavull and While, 2016). For economically developed regions, like Beijing, Shanghai and Guangzhou (the provincial capital of Guangdong), they have a more rapid response to monetary policies when compared with other regions in China's mainland; therefore, they are more sensitive to changes in monetary policy. This section discusses regional monetary transmission in combination with three aspects: (1) the development of the financial market; (2) regional economic development and its sensitivity to interest rate changes; and (3) the development of the housing market.

Firstly, considering the mechanisms of monetary policy in China, monetary policy is issued by the central bank, then transited to financial centres, and followed by individuals and businesses. However, since the development of the financial market varies with regions, alongside macroeconomic performance, this generates a significant imbalance between economically developed regions and economically developing regions. More exhaustively, when it comes to consider the development of financial markets, including market liquidity, the performance of financial businesses, and the number of financial institutions, those regions have advanced financial markets that can rapidly respond to monetary policy. Beijing

is the capital of China, and as a result benefits from both political and economic advantages, absorbing high volumes of investments and liquidity into its economy; Shanghai, as the financial centre of China, attracts investment and migration from all over the world; and Guangdong exerts stronger economic power across the country. Unsurprisingly, therefore, these regions have greater and more advanced economic and financial advantages than the other regions, thus they are quick respond to monetary policies.

Secondly, changes in interest rates vary regionally as a result it may link with the mix of interest-sensitive industries. For those regions have a high volume of investments, with interest-rate industries and credits, such as Beijing, Shanghai and Guangdong, being more sensitive to changes in interest rates when compared with other regions. As noted previously, this is significant because increases in interest rates directly influence the level of borrowing costs, and reducing the activities of investments, affecting imports and exports, and employment, therefore influencing the liquidity in the market.

Thirdly, when considering the monetary transmission in relation to regional heterogeneity in the housing market, it has been documented that an expansionary monetary policy results in an increasing trend towards house price appreciation in economically developed regions and tier-1 cities (Yu and Huang, 2016). Accordingly, Beijing, Shanghai and Guangdong are distinctly different from the other regions in China. This can be ascribed to the fact that the economically developed regions absorb millions of migrants alongside the process of industrialisation and urbanisation, accompanied with a growing trend and demand for housing, as well as mortgage credit. In addition, the housing market in these three regions is developed, absorbing large investments and supply in the market. Consequently, changes in monetary policy, especially an increase in interest rates, can directly influence the stability and development of the housing market, via influencing housing costs and housing investment. By contrast, the support of quantitative easing and interest rate regime contributes to the increased lending and liquidity, this also has a significant influence on regions with developed housing markets, such as Beijing, Shanghai and Guangdong, because the expansion of money supply fuels house price rise by increasing the availability of credit. As Yu and Huang (2016) evidenced, monetary policy has a weak influence on house prices for

economically developing regions, and a relatively stronger impact on house prices for economically developed regions, such as Beijing, Shanghai and Guangdong.

In addition to differences in monetary transmission, there are some empirical studies concerning housing affordability in relation to Beijing, Shanghai and Guangdong. Lau and Li (2006) examined issues of housing affordability in Beijing, incorporating time series data over the period from 1992 to 2001. As discussed earlier, the ratio approach has been adopted by many countries to examine housing affordability, requiring the threshold for the house price to income multiple to be less than 3 (Gabriel et al., 2005; Laird, 2007; Yates et al., 2007; Demographia, 2016). In the study of Lau and Li (2006), a similar approach was used to obtain the house price to income multiple in Beijing. The results revealed the house price to income multiple fell from 13.31 to 6.69 over the period 1997 to 2004, but still remained high level at 9.12 in 2006, revealing that Beijing is experiencing an extensive and more severe housing affordability issue. In addition, the authors captured differences in housing affordability across different income groups, showing that the high-income group and medium-high income group have less severe affordability issues, having the house price to income multiple of 5.04 and 7.33 in 2001 respectively (Lau and Li, 2006). Conversely, for low-income group and medium-low income group residing in Beijing, the housing affordability issues turn more severe, in particular for those on a low-income, the house price to income multiple was 13.55 in 2001, taking 2.7 times of that of the high-income group. In relation to this, it is therefore implied that the inequality in housing affordability arising from income equality has prevented the low-income groups from entering the housing market; therefore, considerations should be given to reduce the inequality in housing affordability and income.

Drawing on discussions concerning the impacts of the housing reform and the increases in house prices, Yang and Shen (2008) and Yang et al. (2014) undertook research concerning the affordability of owner-occupancy in Beijing. As the political and economic centre of China, Beijing attracts a considerable amount of benefits, which stimulates the economy, attracting a large amount of labour, financial flows and investments. This leads to persistent house price appreciation in the city, making housing significantly more expensive, and housing affordability becoming a significant issue. Yang and Shen (2008) identified that house price

increased at an average rate of 25% per year between 1998 and 2004, while disposable income remained at 12% per year, i.e. considerably lower than the increase in house prices. In this situation, high housing costs resulted in an increasing number of households having trouble in affording the cost of housing, thus preventing potential homebuyers, especially young households from entering the homeownership market.

Yang and Shen (2008) stated that, due to the influence of housing reform, Beijing had a homeownership rate of 55.12% in 2000. This is due to Beijing having, under the welfare-allocation system, a large stock of houses allocated for state-owned institutions, enterprises and government sectors, while also experiencing more extensive public housing privatisation than any other city over the periods of housing reform (Yang and Shen, 2008). In addition, a large number of state-employed employees and administrative staff at government departments residing in Beijing, they were granted improved housing subsidies, exaggerating housing inequalities in Beijing (Zhang, 2000). Indeed, housing affordability difficulties in Beijing created a number of inequalities: (1) during the housing reform, the number of households permitted to purchase allocated housings was greater than those with no such permission; (2) following the housing reform, households owning allocated houses were transformed by homeowners at a lower cost; and (3) an increasing number of young households and migrants were unable to afford the high level of housing costs.

In addition to the discussion in relation to Beijing, a number of scholars have undertaken research concerning housing affordability in the context of Shanghai. Shanghai is the leading financial centre in China, and its housing market is considered to mirror the development of national housing policies (Chen et al., 2010). An emerging residential mortgage market was first established in Shanghai, leading to a forty-fold increase in gross mortgage lending between 1999 and 2008 (Chen et al., 2010). As a result, house prices surged in Shanghai, exceeding those in Beijing between 2003 and 2005 (see Figure 2-28). This was due to the removal of obstacles to the development of the owner-occupied housing market under the housing reform, leading to a rapid increase in urban development (Chen et al., 2010). In addition, the housing market, and house prices in Shanghai, was supported by a more developed mortgage market, leading to a rapid increase in mortgage lending (Chen et al.,

2010). Moreover, alongside the continuous growth in GDP, and a consistently low rate of inflation, this acted to stimulate housing demand, encouraging households in Shanghai to improve their living standards (Mostafa, 2005).

The development of the housing market and homeownership in Shanghai, was significantly influenced by housing reform. This was evidenced by Chen and Yang (2017), indicating that 80% of urban houses in Shanghai were owned by the state in the early 1980s, while 65% of them were transformed from public-owned houses to owner-occupied houses by the end of 2013, as a consequence of the housing reform. This has led to housing affordability issues in Shanghai, revealing the existence of housing inequalities, i.e. households owning public housing have benefited from the housing reform, while high housing costs represented a heavy burden to most potential homebuyers, especially young and low-income households. Chen and Fleisher (1996) and Chen et al. (2010) established significant differences in the proportion of income growth between different income groups. Housing affordability inequality arising from income differences was also evidenced by Chen et al. (2010), showing that the incomes of the highest income group continued to increase rapidly between 1990 and 2003, whereas the lowest income groups experienced sluggish income growth over these years. Consequently, income inequalities, to some extent, reveal that the rich experience greater affordability, while the poor experience relatively more housing affordability difficulties.

Mostafa et al. (2005) obtained a relationship between household income and down payment requirements by including relevant mortgage factors, establishing that with the assistance of the HPF, it would have taken up to eight years of savings to enable a young household of two employed individuals to afford their first instalment on a house of 66 square meters in 2000. A similar approach was taken by Chen et al. (2010), examining the mortgage payment to income ratio in Shanghai between 1995 and 2008. Mortgage payment is calculated based on the assumption of a standard house of 90 square meters, and a LTV of 80%, with a 20-year mortgage and a base interest rate. The results revealed that the mortgage payment to income ratio decreases over time, but the average ratio remains 68.5%, which considerably exceeded the threshold ratio, although this threshold adjusts to a 50% maximum in China (Mostafa et

al., 2005; Chen et al., 2010). Therefore, it is notable that residing in Shanghai is more likely to have housing affordability difficulties, due to the excessive housing costs. This indicates that, for the majority of home-buyers, housing remains unaffordable in Shanghai.

The housing market and housing finance markets in Shanghai and Beijing have, in comparison with most other Chinese cities, obtained considerable experience and success, which also led to a number of issues relating to housing affordability. As a result of the housing reform, the majority of publicly-owned houses have been transformed into privately-owned houses, thereby raising the local homeownership rate and benefiting those households that had acquired publicly-owned houses in those cities. Under the influence of the market-dominated housing market, new homebuyers were encouraged to enter the housing market, stimulating demand for housing. Households who had formerly owned public houses benefited from the housing reform by obtaining public houses at a lower cost, while persistent house price appreciation stagnates the possibilities of achieving homeownership for an increasing number of potential homebuyers. Nevertheless, Beijing and Shanghai established a developed housing finance market in comparison with the other regions in China, providing additional housing finance availabilities, and have high liquidity in response to the development of the housing market and the demand for mortgage loans (Lau and Li, 2006; Li, 2010; Yang et al., 2014). As a result, Beijing and Shanghai responded quickly to monetary policy, in which an increase in money supply fuels the house price rise via expanding the credit availability; while an increase in interest rate reduces the investments and liquidity in the housing market, due to the higher increased borrowing costs. In relation to the implementation of the housing policy, Shanghai was the first city to fully enact the HPF system, subsequently followed by Beijing, long periods of development have expanded the coverage of the HPF in these cities; thus absorbing a greater amount of savings capable of providing higher borrowing funds for HPF owners.

3.6   Tenure Choice

Studies concerning tenure choice have been widely discussed in relation to economic factors, stating that a household's tenure choice is closely related to the economic circumstances, such as level of income, inflation, demand for housing, and liquidity constraints (Goodman, 1988; Kan, 2000; Lee et al., 2016). Meanwhile, other academics have discussed the choice of housing tenure in relation to demographic factors, comprising household formation, and the characteristics of life cycle paths (Coulson and Fisher, 2002; Boehm and Schlottmann, 2014). A number of scholars have stated that the choice of tenure for each household maximises a household's utility under a given budget constraint (Arnott, 1987; Ho and Kwong, 2002; Davidoff, 2006). It has been stated that homeownership increases the motivation to improve the quality of the housing, as it is generally regarded as a means of protecting a household's investment (Linneman and Megbolugbe, 1992). Being owner-occupiers brings a settled life for homeowners, while also generating family wealth. Therefore, many scholars have stated that, in comparison to renters, homeowners experience improved housing conditions (Elsinga and Hoekstra, 2005; Iwata and Yamaga, 2008), and a greater level of family financial capacity. Households make their decisions in relation to housing tenure according to their housing needs, life-cycle path, liquidity constraints, distribution of future wealth, and their housing affordability (Davidoff, 2006). Accordingly, questions concerning what factors impacting the likelihood of achieving homeownership are of interest to this thesis. Prior to further discussions, a summary of theoretical understandings about tenure choice is presented below, illustrating the theoretical framework of tenure choice.

Figure 3-2: A summary of the theoretical framework for tenure choice
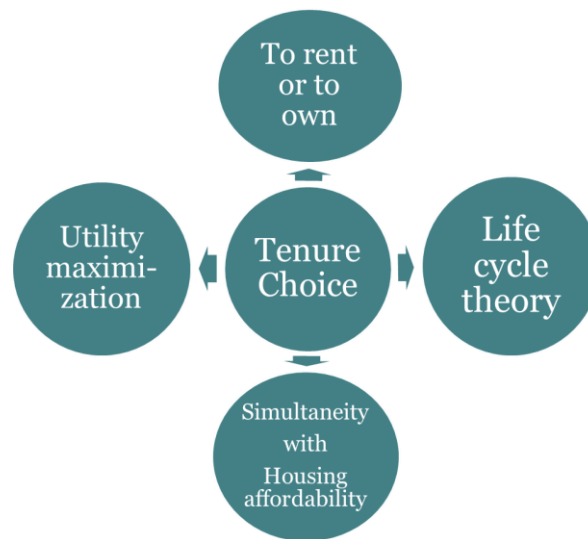
(Source: Author's own)

As Figure 3-2 presented, housing tenure choice is a discrete choice, referring to a household choose to own or rent a property in the given income level. Therefore, the estimation technique of Probit and Logit has been widely employed in existing studies concerning tenure choice and homeownership (Boehm and Schlottmann, 2014; Bourassa et al., 2015; Huang et al., 2015; Chen, 2016). In addition, as shown in in Figure 3-2, two theories have been widely applied in studies of tenure choice, these are utility maximisation theory and life cycle theory, and they act as significant theoretical support in discussions of tenure choice (Brueckner, 1994; Leece, 2004). In relation to utility maximisation theory, owner-occupation contributes to accumulating the household's family wealth in the long term, thus maximising household's utility (Davidoff, 2006). However, this is subject to households' budget constraints and the distribution of future wealth (Ho and Kwong, 2002; Davidoff, 2006). When discussing the choice of housing tenure, lifecycle theory supports that a household's housing consumption depends on its wealth position, income, and relevant demographic factors across the life cycle path (Leece, 2004). Whereas key demographic factors have been employed as the proxies for household income, such as marital status, household size, employment, and educational achievement (Boehm and Schlottmann, 2014; Bourassa et al., 2015; Lee et al., 2016).

More importantly, existing studies (Koblyakova et al., 2014) suggest that there might be a simultaneity between tenure choice and housing affordability, implying the level of a

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household's housing affordability, and its tenure choice are jointly determined by similar factors. More specifically, a household chooses to own or rent a house depends on their wealth position, their ability to afford the housing expenditure, and relevant demographic factors (Davidoff, 2006; Bourassa et al., 2015; Chen and Yang, 2017). Simultaneously, the level of a household's housing affordability is determined by its level of wealth capacity, income, and demographic factors (Campbell and Cocco, 2003; Gan and Hill, 2009). Referring this to lifecycle theory, homeownership is regarded as a lifelong pursue over a household's lifecycle path (Brueckner, 1994). However, shortages in savings and liquidity constraints have been the main cause that prevents households from entering the mortgage market and the homeownership market (Leece, 2000; Campbell and Cocco, 2003). Households experiencing liquidity constraints are therefore suffering difficulties in meeting down payment requirement and affording the mortgage payments.

The literatures focused on tenure choice have undertaken a broad empirical examination of the factors influencing the likelihood of homeownership. As observed in existing studies, the probability of achieving homeownership, is dependent upon a number of factors, including house prices, income, financial constraints, demographic factors, policy implications and families' lifecycle stage (Quigley and Raphael, 2004; Tiwari and Hasegawa, 2004; Andrew et al., 2006; Iacoviello and Pavan, 2013; Deng et al., 2016; Fu, 2016; Chen and Yang, 2017).

Household income is regarded as a significant factor influencing the likelihood of achieving homeownership through a liquidity constraint or leading to an issues of housing affordability where households experience income shortages. Leece (2000) stated that a down-payment constraint can become obstacle to obtaining a mortgage loan for households with specific levels of income, in particular low-income and poor households. Gan and Hill (2009) further proposed, in relation to purchase affordability and repayment affordability, that the level of a household's financial capacity determines whether a household was able to borrow housing debt for a housing purchase, and whether a household experienced housing-induced-burden, due to repaying the mortgage. Households lack of financial capacity can hardly access to a mortgage loan, and therefore being prevented from the homeownership market. A number of studies have described the negative relationship between a household's liquidity

constraints and the likelihood of being homeowners has been well evidenced in a number of studies (Leece, 2000; Quercia et al., 2003; Diaz-Serrano, 2005).

Evidence suggests household income has a positive impact on the likelihood of choosing owner-occupancy (Boehm and Schlottmann, 2004). The higher the level of household income and family wealth, the greater the likelihood that a household will be able to achieve homeownership and meet housing expenses without falling into any housing or mortgage payment burden. However, low-income families would be expected to take longer to achieve homeownership due to insufficient family wealth or a relatively lower level of expected future income. Younger households, in particular, have relatively low levels of both income and family wealth, and therefore experience constraints in terms of achieving homeownership (Haurin et al., 1996). There is also a need for the policy makers to pay attention to promoting homeownership for low-income households.

In addition to household income, a number of key demographic factors, which are employed as proxies for household income have significant effects on tenure choice. These include age, employment, education achievement, marital status, and household formation (Painter, 2000; Tan, 2008; Fu, 2016). Tiwari and Hasegawa (2004) stated that age creates different outcomes across the life-cycle path of housing consumption within each income level. Guest (2005) pointed out the impact of life cycle involved a particular circumstance on age path, indicating that younger households experience down payment constraints and issues related to repayment constraints, resulting from a lack of sufficient housing deposits and discretionary income.

A number of studies have established that, demographic characteristics, such as employment status, educational achievement and job stability also have a crucial influence on the likelihood of owning (Bourassa et al., 2015; Ying et al., 2013; Chen, 2016). In relation to life cycle theory, these factors can be employed as proxies for household income, and are found to have a positive effect on achieving homeownership. Employment presents a household in possession of an income, while being married brings additional income sources, enhancing the possibility of achieving homeownership (Tang and Coulson, 2017). However, when

considering risks to income, a number of scholars discussed the impact of income uncertainty on tenure choice, arguing that income uncertainty arises from losing jobs, divorce, may reduce the likelihood of choosing to own a house (Diaz-Serrano, 2005; Fisher and Gervais, 2011). Households with volatile levels of income experience restrictions when applying for a mortgage (Diaz-Serrano, 2005), preventing them from entering the homeownership market.

Tenure choice is of greater significance than any single investment or consumption, and it is directly related to the family's life-cycle path. Therefore, due to their contribution to the level of household income, educational achievement, marital status and household formation all have a significant impact on tenure choice (Mayer and Engelhardt, 1996). Marital status is regarded as an important factor in terms of tenure choice. This is due to housing costs, for the majority of households, absorbing the greatest proportion of household assets, leading, as stated above, to the timing of achieving homeownership being closely related to lifecycle status. Marriage leads to increased stability for a family, thus increasing the demand for an owner-occupied house, therefore stimulating the likelihood of achieving homeownership (Xu, 2016). This is in accordance with Drew (2015), suggesting that marriage is a key factor supporting the transition from renting to homeownership. Haurin et al. (1996), Thomas and Mulder (2016) and Uunk (2017) documented the fact that when a family comprises of two earners, this increases the possibility of achieving homeownership, specifying the move to homeownership tends to follow the creation of a two-income household, which also significantly increase the speed of achieving homeownership. However, Di Salvo and Ermisch (1997), who considered partnership and housing decisions as independent factors, refuted this view.

A considerable number of scholars have undertaken research concerning the choice of tenure in the context of the Chinese housing market, focusing on factors influencing homeownership related to the implications of the housing reform. As discussed previously in Chapter 2, the success of the housing reform, and the establishment of the market-oriented housing market led to households being encouraged to enter homeownership market. This stimulated the demand for housing and a willingness to achieve homeownership. Factors influencing the likelihood of achieving homeownership were intimately related to issues concerning housing

affordability. Studies concerning the tenure choice in relation to the effects of housing policy have been documented in a number of literatures. Xu (2016), Tang and Coulson (2017) and Chen and Yang (2017) undertook the empirical investigations regarding the effectiveness of the HPF on promoting homeownership, and the results reveal a positive relationship between HPF and the likelihood of being homeowners.

In the research of Deng et al. (2016), the authors stated that amongst younger households, especially potential homebuyers, there is unequal access to homeownership. The tenure choice of young households is influenced by their financial capacity, demographic characteristics (age, marital status), political affiliation (being a member of political party), organisational affiliation (parents are employed in the government or state-owned-enterprise), territorial affiliation (hukou type), and market ability (education level, household income, parental income, etc.). The authors reported an interesting finding, stating that the reason for housing inequality is arising from the "redistributive power[1] of the socialist system" (Deng et al., 2016, p. 17). Families with privileges benefited from the housing allocation system (being allocated good quality houses) and accumulated equity via the housing reform (they purchased allocated houses at a very low price). The redistributive power mechanism was passed on from one generation to another, and as a result, younger households from privileged families had a greater likelihood of achieving homeownership than others. Accordingly, Deng et al. (2017) criticised the lack of policy attention concerning younger households' housing demand; they highlighted the shortage of affordable and secured rental sector designated for younger households.

In relation to the impact of housing policy on access to homeownership, Xu (2016) evidenced that the HPF system is effective in mitigating constraints of accessing mortgage and offering the support to obtain a down payment from compulsory savings, stressing the importance and significance of HPF to homebuyers. The compulsory saving scheme is a promising housing policy that relates to assisting housing difficulties. However, it contributes greater benefits to households with a double enrolment in the HPF rather than those of single enrolment (Xu,

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[1] Households would attain privilege through territorial, political, and organisational affiliation, if they are a member of the political party, or if working for the government or state-owned-enterprises (Deng et al., 2016).

2016). This reveals that the contribution of HPF is closely linked to the level of household income and the amount of compulsory savings deposited, generating HPF inequality due to high-income groups depositing more than low-income groups, given the same deposit proportion.

Chen and Yang (2017) disaggregated their data samples into native and migrant groups, and owner and rents groups. The group-based estimation shows that the HPF has a strong impact on natives rather than on migrations. This is in association with the current situation arising from the 'hukou' system, which shows that migrants are excluded from the local social welfare scheme, including participation in the HPF, pension system, and health care (Wu and Wang, 2014; Chen and Yang, 2017). Therefore, it has been documented by other academics, arguing that the 'hukou' system results in inequality and the constraints of housing (Wu, 2004; Wu and Wang, 2014). Similarly, the HPF has a stronger impact on renters than owners, revealing that people involved in in renting require more housing assistance when deciding to achieve homeownership.

3.7 Conclusion

The literature review undertaken in this chapter discussed the essential points of examining housing affordability, including definition of housing affordability, measurement of affordability, and differences between these measurement approaches. This chapter further revealed a lack of any universal definition and measurement by which to examine housing affordability, along with a growing acknowledgment of the need to develop a more comprehensive understanding of housing affordability.

A number of discussions in this chapter have highlighted the existence of three distinguished approaches for the measurement of housing affordability, widely employed by housing policy makers and academics across the world. In particular, the most commonly-used approach is to consider housing expenditure as a percentage of housing income, whereby that housing expenditure should not exceed more than a given percentage of household income, to ensure households avoid experiencing issues of housing affordability. Housing expenditure was

established as generally referring to the costs of rentals, mortgage payment, and relevant utility bills, which the need to represent less than 30% of household income. When it comes to the house price to income multiple approach, it is required that gross house price should not exceed a maximum of three times household income, otherwise it would generate housing affordability issues for homebuyers.

As previously discussed, the ratio approach includes a number of imperfections, including failure to consider households on a varied income and the standard of housing, as this is an easy straightforward method to understand and calculate, and forms an appropriate approach for generating dependent variables for empirical investigation. This led to this approach being employed in this current thesis, thereby leading to the establishment of a housing expenditure to income ratio, contributing to further empirical investigations.

A key discussion in this chapter concerned factors influencing housing affordability, in relation to discussions on macroeconomic performance. Housing affordability is an economic issue, with close links to a number of economic factors, including GDP, house prices, inflation, unemployment and money supply. Moreover, there are a number of key financial factors that have a significant effect on housing affordability, including influencing house prices. More specifically, changes in interest rate, liquidity constraints, and monetary policies have affected on housing affordability by influencing house prices. Mortgages interest rates and LTV form key factors influencing mortgage costs, also determining whether households have housing affordability difficulties that relate to being constrained from entering the housing market, or being unable to afford a given mortgage payment to income ratio.

The performance of the housing market depends on macroeconomic conditions and the housing finance market, corresponding with changes in house prices, thus influencing housing affordability. In addition, since house price volatility is directly impacted by monetary policies through the adjustment of the interest rate, an increase in interest rates raises borrowing costs and repayment costs for mortgaged homebuyers, leading to issues relating to mortgage payment. Given the sensitivity of mortgage borrowing to the implementation of borrowing constraints, changes in LTV have a significant influence on affordability for potential

homebuyers; in particular those in low-income groups, who could be prevented from achieving homeownership as a result of a lack of family wealth and sufficient income. In terms of regional development, it has also been stated that regional differences in economic performance, and monetary transmission influences the development of the housing market, therefore promoting regional differences in terms of housing affordability. Discussions in the context of the Chinese housing market have revealed that cities with successfully economic conditions could experience severe housing difficulties than other cities, such as Beijing and Shanghai, although such cities have progressive policy implications and advanced mortgage accessibilities.

This thesis focussed on the factors influencing housing affordability and homeownership, illustrating factors influencing the likelihood of achieving homeowners, including economic and demographic factors. Discussions concerning tenure choice in this chapter established theoretical understanding of the relationship between housing affordability and homeownership, including the housing affordability difficulties that constrain potential homebuyers from becoming homeowners, thus providing theoretical evidence for the empirical analysis presented in the subsequent chapters.

This literature review illustrated the borrowing constraints caused by a lack of sufficient family wealth and income, which impedes households from becoming homeowners, resulting in issues relating to purchase affordability. It is suggested that demographic factors linked to lifecycle theories have a crucial impact on household's tenure choices. In addition, employment and education level serve as proxies for household income, and these have positive effects on the likelihood of achieving homeownership. Furthermore, marital status dominates the sources of household income, with married couples having additional income sources than individual households, improving possibility of achieving homeownership, and reducing the possibility of experiencing housing affordability issues.

This chapter contributed to this thesis by establishing the lack of empirical literature in relation to empirical investigations. It also considered the context of the Chinese housing market, discussing housing affordability in combination with the implications of the housing

reform, the impact of the HPF, and differences in the regional market. In addition, this chapter illustrated how housing affordability is influenced by economic and financial factors. Furthermore, this chapter detailed those factors influencing homeownership through discussions concerning the relationship between housing affordability and homeownership, offering theoretical support for empirical investigations. All the associated empirical findings and econometric specifications are interpreted in Chapters 6 and 7, according to the type of data involved.

The following chapter discusses the research methods and econometric estimation techniques employed in this thesis.

Chapter 4   Methodology

4.1   Introduction

This research examines factors impacting housing affordability and household tenure choice, generating and estimating a number of econometric models. Chapter 3 established a theoretical understanding of housing affordability and tenure choice, providing theoretical support for empirical investigation. This chapter explains the empirical research processes undertaken for this study, detailing the methods and approaches employed, the technical issues raised, and the methodology employed for empirical analysis. The chapter is structured as follows: the next section introduces the research philosophy; then section 4.3 illustrates research approach and research deign; and is followed by a section providing a theoretical understanding of the econometric methodology employed for the empirical investigation. Finally, the conclusion completes the chapter.

4.2   Research Philosophy

Research philosophies reflect researcher's beliefs about how to view the world. Saunders et al. (2009) pointed out that a research philosophy reflects a researcher's assumptions that underpin the research strategy and the research method (p.108). From a similar point of view, Creswell (2014) defined a research philosophy as "a general philosophical orientation about the world and the nature of research that a researcher brings to a study" (p.6). Research philosophy is therefore used as guidance when embarking upon research, helping to understand the nature of research, and leading to the embrace of appropriate research methods. Having a good understanding of research philosophy helps researchers to justify their own research strategies and the methods applied in the study, enabling researchers to be more creative and innovative. As Saunders et al. (2009) stated, 'through this you will be better equipped to explain and justify your methodological choice, research strategy and data collection procedures and analysis techniques' (p.125).

In this discussion, two principal approaches to thinking about research philosophy are addressed, enhancing the understanding of how best to associate with the research methodology applied in this study. These are ontology and epistemology.

Ontology is concerned with the nature of reality (Saunders et al. 2009, p. 110), and refers to discussions concerning the nature of being, becoming, and existence. In relation to thinking about ontology, common questions may arise by asking 'What is it? What is existence? What is the world like? Are all entities objects?' Ontology works for two main aspects: objectivism and subjectivism. Objectivism describes how the social entities that exist in reality are external to social actors, indicating that knowledge is determined by the nature of reality, rather than being created by people's thoughts and beliefs. Subjectivism, on the other hand, indicates that social phenomena are created from the perceptions and consequent actions of social actors (Saunders et al., 2009. p.111), emphasising that there is no external or objective truth.

Epistemology concerns the theory of knowledge. The epistemological position questions "What knowledge is? How can we know what we know? What kinds of contribution to knowledge can be made?" (Saunders et al., 2009. p.111). In light of this, epistemology enables researchers from different academic disciplines to adopt different epistemological positions supported by targeted research methods in their research. As Creswell (2014) addressed, there are three broad epistemological positions and research philosophies that evolve from the following perspectives: positivism, interpretivism, and transformative. The following paragraphs discuss the two perspectives that most closely relate to this current thesis.

Positivism

Positivism expresses the deterministic philosophy of cause and effect (Creswell, 2014). Researches that adopt this perspective are required to identify the causes that would generate effects. Thus, positivism usually adopts a deductive approach that proposes hypotheses based on existing theory, testing hypotheses by employing an appropriate method. Numeric data and empirical estimations play a significant role at this stage.

Therefore, positivism is also named positivist, or empirical science. However, the results of testing are not always perfect, as it is necessary to justify a level of failure to reject the hypothesis, as this is also required to check the validity of the research findings. This research adopts the 5 per cent critical value to indicate failure of rejecting a hypothesis. In light of this, positivism makes the research more accurate and objective using deductive methods, statistical techniques and a large amount of numeric data. Consequently, positivism has been widely adopted for quantitative rather than qualitative research.

Interpretivism

Interpretivism is typically associated with the qualitative research methodology, as it refers to the development of knowledge based on individuals' subjective experiences. Interpretivism relied on inductive method that generating theories or information. Therefore, this position is typically worked with open-ended questions because it is a good way to share views. It is also applicable to small-scaled research, as it generally relied on interviews, in-depth investigations, and face-to-face talks. Interpretivism philosophy is also widely used in secondary data analysis. In relation to this current study, interpretivism is employed as a qualitative component, since the household level data employed in this thesis contains some qualitative information regarding households' tenure choice decisions and demographic factors. The study of tenure choice is heavily reliant on household level data, since it requires qualitative information to represent tenure choice decisions and the life cycle stage of each household (interviewee). As a secondary user of household level data, the qualitative variables generated via the interpretivism position provide a high level of validity; specifically in terms of the reliability and trustworthiness of the information.

Research Philosophy in this Research

All research requires the application of an appropriate and specified research philosophy to direct it. The principle philosophy underpinning this research is positivism. This is a deterministic philosophy that requires identification of factors that would impact or determine results (Creswell, 2014). Positivist philosophy has been widely employed for

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quantitative research, especially economic research, as it typically works to examine the examinations for the relationship between theories and research (Bryman and Bell, 2015). The positivist philosophy employed in this research guides the research strategy, to test the relationship between factors and the dependent variable. In order to conduct this research approach, those factors impacting housing affordability and tenure choice were identified according to existing theories, as discussed in Chapter 3. Secondly, the secondary economic data obtained from the official database and secondary household level data obtained from a household survey were employed to the empirical investigations. Statistical description and estimation techniques were used to present the feature of economic data and to obtain empirical findings. The values of mean, standard deviation, maximum and minimum were tabled in the subsequent chapters to present the features of the data.

4.3   Research Approach

After addressing the research philosophy, it is necessary to clarify the research approach that was employed to achieve the research aims. The research approach describes a brief research plan, and details the research methods employed to collect the data, describing how the data will be analysed and how the results will be interpreted. The sub-section of this chapter introduces the concepts of two major research approaches, comparing their differences, and justifying the appropriate approach applied in this thesis.

Qualitative research aims at exploring social or human problems. As Creswell (2014) emphasised,

> The process of qualitative research involves emerging questions and procedures, data
> typically collected in the participant's setting, data analysis inductively building from
> particulars to general themes, and the research making interpretations of the meaning of
> the data (p.4).

This clarifies the features of qualitative research in terms of data collection, data analysis, and the interpretation of the results. Therefore, it can be recognised that the qualitative research

is frequently linked to the inductive approach, developing and building theories rather than testing theories.

A purely qualitative research approach is not applicable to this current thesis, because the methods used to collect primary data via qualitative methods (such as interviews, face-to-face talks, questionnaires) are not as efficient for this thesis, and could result in sampling bias due to the large population base in China. This research employs some qualitative components, especially qualitative data in the household level dataset, to conduct quantitative research (empirical investigation). In terms of the data collection procedure, the qualitative research approach obtains data using surveys and interviews, involving the specific methods, such as questionnaires, face-to-face interviews, or case studies (Creswell, 2014; Saunders et al., 2009). For this current research, as a secondary user of household level data, the survey has been conducted by an institution,[1] to provide precise and reliable information at the household level.

The purely qualitative research approach normally works with words rather than numeric data and is employed for building theories using the qualitative information (information or data obtained from in-depth interviews, case studies, or group studies) (Saunders et al., 2009). However, in relation to the current research, qualitative data at the household level were employed in the process of empirical investigation. This underscores the uniqueness of the research, because research concerning tenure choice can only be achieved by employing qualitative variables (introducing some dummies into the dataset), since quantitative data fails to present adequate information concerning households' demographic information (such as marital status, employment status, gender, etc.).

When considering the techniques of data analysis, the qualitative approach fails to conduct the empirical investigation to examine relationships. Thus, this current thesis employs a quantitative research approach.

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[1] The Survey and Research Center for China Household Finance at the Southwestern University of Finance and Economics (SWUFE).

Quantitative research is the most common approach employed in economic research studies, and is appropriate when applying the positivism paradigm. Positivism typically supports quantitative examinations of the relationship between theory and research questions (Bryman and Bell, 2015). The quantitative research approach emphasises collecting quantitative data and numeric data is based on close-end questionnaires. More importantly, the quantitative approach works with numbers rather than words, which has been regarded as the most effective way to examines the relationships (Bryman and Bell, 2015).

This thesis employed a quantitative approach after employing numeric data obtained from an official database, in order to meet the stated research aims and objectives. The data used in this thesis comprises both national level data and household level data, providing accurate information upon which to perform an overview of the Chinese housing market. Data at the national level were obtained from the CEIC database, and the People's Bank of China. Meanwhile, data at the household level were obtained from the China Household Finance Survey, which is a representative microeconomic survey conducted in China, encompassing 8438 households across 25 provinces. The survey was conducted in the summer of 2011 in the format of face-to-face questionnaires comprising closed-end questions. This is the first such representative household survey in China, providing valuable information concerning household wealth capacity, mortgage information, tenure choice, demographics, housing policy and regional locations (Gan et al., 2013).

The reasons for employing a quantitative research approach in this current thesis were that quantitative research requires a well-developed theoretical understanding of the theories associated with a research topic, as it demands high quality data to produce highly reliable results. More specifically, theory verification is a crucial aspect of quantitative research, because it begins with a foundation based on existing theories which are then deepened or disproved through empirical investigation. Hypotheses to test developed theories are examined through statistical application (Bryman and Bell, 2015). In a quantitative study that utilises econometric techniques to answer the research questions, the data sample is required to be as large and representative as possible, to ensure statistically reliable results (Saunders

et al., 2009). Therefore, a good understanding of econometrics is required when working engaging in empirical investigations to either reject or accept hypotheses (Bryman and Bell, 2015). In this current thesis, the theoretical framework for housing affordability, and the factors believed to impact housing affordability and tenure choices were identified based upon existing theories. Quantitative data at the national and household level were then employed to test the suggested theories empirically. Next, econometric models were performed to conduct the empirical investigations, and to capture the factors impacting on housing affordability, and tenure choice.

This thesis employs following the research methods: descriptive statistics for data used in the econometric modelling, and empirical investigations using econometric techniques, followed by interpretations of empirical results, finalised in discussions about the implications of the research. Descriptive statistics contribute to descriptions of the basic features and numerical summaries of the data, and indicate outlier cases in the dataset. The value of means, maximum, minimum and standard deviations could then be tabled, according to the featured variables. Next, a specification for significance level is required to clarify the circumstances that arise when rejecting a hypothesis in an econometric analysis. This also relates to the validity of the research findings (Saunders et al., 2009). In an econometric analysis, it becomes apparent that the null hypothesis can only be rejected when there are strong evidences against it (Diamantopoulos and Schlegelmilch, 2000). Therefore, it is necessary to assume a minimised probability of error when rejecting the null hypothesis. The less risk we are willing to assume, the lower the significance level (Diamantopoulos and Schlegelmilch, 2000, p.139). This current thesis employs a statistically significant level of 5%, presenting the significant levels as *** for a p-value <5%, and ** for a p-value <10% in the empirical results table. The statistical package, STATA 14.0, is employed to obtain empirical results, since it offers more appropriate and advanced support for econometric analysis, and provides specific techniques with which to address the econometric issues that arise from the model. Whereas, SPSS 22.0 was employed at the preliminary data sorting and cleaning stage. In addition, Microsoft Excel 2016 produced the graphs displayed in Chapter 2.

4.4   Research Methodology

As emphasised in the previous section, this research aims to determine what factors impact housing affordability and tenure choice. To answer the research questions and obtain the empirical results, this thesis employs an econometric methodology to empirically examine the relationship between theoretical variables and the housing affordability ratio, and the choice of housing tenure. This subsection elucidates the estimation techniques employed in the empirical investigation.

Econometric methodology is a broadly employed application that utilises various empirical techniques to examine the economic relationships between the theoretical variables and economic theories (Wooldridge, 2009). The relationship between the theoretical variables and economic theories was generated according to existing research, and expressed according to the format of a single equation or multiple equations. Econometrics is a well-developed theory widely adopted in quantitative research, one that offers significant contributions when analysing economic relationships incorporating quantitative data. The econometric methodology employs a sizeable numeric dataset and statistical packages to estimate equations, and helps to identify the parameters and empirical results generated from the econometric estimates (Wooldridge, 2009; Stock and Watson, 2015). The results of the empirical analysis were interpreted to reveal the relationships between the variables, and these comprised the research findings.

The validity of the empirical results obtained is important, as it relates to the efficiency of the econometric methodology. Meanwhile, the validity of the empirical results establishes whether the findings clearly evidence the theory, and whether the variables are theoretically and empirically correlated. In this regard, it is necessary to select a precise research deign, to attain high-quality working data, delivering an unbiased estimation and logical interpretations of an econometric model, to improve methodological and econometrical validity (Wooldridge, 2009; Saunders et al., 2009; Imbens and Wooldridge, 2009). In this thesis, the econometric methodology is employed to examine the factors that would influence housing affordability and tenure choice by incorporating two types of data in the econometric model separately,

i.e. time series data at the national level and cross-sectional data at the household level. These two types of data deepen the investigative capacity of housing affordability research, since this is the first time that both national level data and household level data were employed to study Chinese housing affordability issues and tenure choices.

4.3.1 Estimation Techniques

<u>Two-Stage Least Squares</u>

Multiple regression models are a widely used econometric methodology in economic studies. The technique of ordinary least squares (OLS) is the most basic estimation technique used to obtain estimated coefficients (Wooldridge, 2009). In relation to econometric theory in a linear regression model in corporation with cross-sectional data, the OLS estimator is required to satisfy the following conditions (see Table 4-1), in order to generate the best linear unbiased estimator (BLUE) (Wooldridge, 2009; Greene, 2008; Stock and Watson, 2015). Whereas, the 'Best' indicates the lowest variance of the estimate; the term 'Linear' means the estimator is linear relative to the independent variable, and hence is linear in the error term. In econometrics, 'Unbiased' requires the error terms to denote zero conditional mean, homoscedasticity, and have no correlation with each other. It is noticed that the following assumptions only applied to cross-sectional regression, the time series and panel regressions have similar features with those for the cross-sectional regression, but also contain some significant differences with cross-sectional case (Wooldridge, 2009, pp.349-351). [2, 3]

Table 4-1: Gauss-Markov Assumptions (for cross-sectional regression)

> **Assumption 1: Linear in Parameters,** which can be expressed as:
> $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \mu$
> Where β_i is the estimated parameters, and μ is an unobserved error term.

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[2] Assumption 6: No serial correlation (for time series regression): Conditional on X, the errors in two different time periods are uncorrelated: $Corr\ (\mu_t, \mu_s | X) = 0$, for all $t \neq s$.

[3] Assumption 7: Normality (for time series regression): The errors μ_t are independent of X and are independently and identically distributed as $Normal\ (0, \sigma^2)$.

Assumption 2: Random Sampling

A random sample of n observations, $\{(X_i, Y): I = 1,2, \ldots n\}$, following the population model in Assumption 1.

Assumption 3: No Perfect Collinearity

In the sample (and therefore in the population), none of the independent variables is constant, and there are no exact linear relationships among the independent variables.

Assumption 4: Zero Conditional Mean

The error term μ has an expected value of zero given any values of the independent variables.

$E(u \mid X_1, X_2, \ldots, X_k) = 0$

Assumption 5: Homoskedasticity

The error term μ has the same variance given any value of the explanatory variables.

$Var(u \mid X_1, X_2, \ldots, X_k) = \sigma^2$

(Source: Wooldridge, 2009, pp.104-105)

More importantly, the OLS assumption of consistency requires that the explanatory variables be uncorrelated with the error term (Wooldridge, 2009). However, as a result of the omitted variables, measurement errors, or simultaneity, the error term is correlated with some explanatory variables (at least one explanatory variable), this arises endogeneity issues (Wooldridge, 2009; Greene, 2008; Stock and Watson, 2015). Many econometricians have stressed that endogeneity can arise from a single issue, such as measurement errors, or issues with joint causes, including omitted variables, measurement errors and simultaneous causality. As a result, the OLS estimators are then 'biased' and 'inconsistent' due to violates the OLS assumptions (Wooldridge, 2009; Stock and Watson, 2015). Thus, the OLS estimation technique is not appropriate for this current thesis.

The two-stage least squares (2SLS) estimation is employed in this current thesis, helping to resolve endogeneity issue and generate unbiased and consistent estimators (Wooldridge, 2009; Stock and Watson, 2015). The 2SLS techniques is the most advanced technique

employed to resolve the endogeneity issue, and it is rarely used in empirical investigations of housing affordability. Using the 2SLS technique in this current thesis produces unbiased and consistent results, contributing the uniqueness of this thesis.

Prior to conducting the estimation, obtaining appropriate instruments is required to satisfy the following conditions: instrumental variables should be non-correlated with the error terms, and correlated with the endogenous variables; in addition, the number of instruments should be no less than the number of explanatory variables (Cameron and Trivedi, 2010; Wooldridge, 2009). In addition, it is essential to check the validity of the instruments, pertaining to the identification of instrumental variables and the weak instruments test, in order to affirm the efficiency of the instruments employed in the model (Cameron and Trivedi, 2010). Finally, in the context of a large sample size, employing more instruments can help to generate more effective estimators (Davidson and MacKinnon, 1993). The theoretical discussion concerning how endogeneity issues may arise and how IV estimation performs would be discussed when it comes to empirical investigation (please see Chapters 6 and 7).

As discussed above, it is a challenge to obtain valid and sufficient exogenous variables as identification criteria are strict. For time series data, the lagged value of an endogenous variable can be used as a valid instrument (Stock et al, 2002). Endogenous variables can also be used as instrumental variables. Theories revealed that examination of the validity and efficiency of instruments can be conducted based on empirical results. Bowden and Turkington (1994) and Cameron and Trivedi (2010) pointed out that if the F-statistic of 2SLS estimations in the first stage are greater than 10, this could indicate that the instruments are effective instrumental variables.

Probit

Moreover, as the research question stressed, this research aims to examine the factors that influence the probability of households choosing to achieve homeownership. This is a choice-related investigation, and a probit model would be employed for the empirical analysis. In a probit model, the dependent variable is a binary choice; where '1' refers to the probability of

choosing one option, and '0' refers to the probability of choosing the alternative option (Wooldridge, 2009).

It is noteworthy that the investigation focuses on households' tenure choice, for which applications of a non-linear binary response model have been widely performed employing either a logit or a probit model (Ioannides and Rosenthal, 1994; Wang and Li, 2004; Bostic and Lee, 2008; Chen and Yang, 2017). To justify a probit estimation technique comparative to a logit approach, and to elucidate the differences between 'logit' and 'probit', the common conceptual features of both approaches are established: Firstly, the logit model and the probit model are both increasing functions, and are S-shaped. Each increase most rapidly at $z =$ 0, $G(z) \rightarrow 0$ as $z \rightarrow -\infty$, and $G(z) \rightarrow 1$ as $z \rightarrow \infty$ (Wooldridge, 2009, p. 576). Secondly, the primary goal of both the logit and the probit model is to capture the effects of the explanatory variable on response probability. Therefore, for both the logit model and the probit model, the direction of the estimated effect of an explanatory variable on probability remains the same, and both take on the value to strictly satisfy $0 < G(z) < 1$, $for\ all\ z \in R$ (Wooldridge, 2009).

However, the logit and probit models also exhibit distinctive differences in terms of theoretical understanding, model specification and the interpretation of results (Agresti, 2002; Wooldridge, 2009; Stock and Watson, 2015). Firstly, the general structures of both models vary, to holding different assumptions concerning the distribution of the function. More specifically, the probit model follows the cumulative distribution function (cdf) of a standard normal distribution (Φ), as is defined in equation 7-4 (see Chapter 7), while the logit follows the cdf logistic function, which is expressed in terms of the exponential function $(P(Y = 1 \,|x) = \frac{\exp(x)}{1+\exp(x)} = \Lambda(x))$. In the economic analysis, the assumptions for the error term tend to favour the normality assumption, therefore the probit model is being more widely employed in economic analysis than the logit model (Wooldridge, 2009).

Secondly, although the logistic function and standard normal cdf can be graphed as an S-shaped curve, the standard normal cdf has thinner tails compared to logistic distribution; showing probability approaches 1.0 or 0 more quickly when employing the probit model

rather than the logit model (Agresti, 2002). In addition, as the cdf standard normal distribution has thicker tails, the estimated parameters in the probit model display a smaller magnitude relative to those in the logit model, if both models are fitted well (Agresti, 2002, p. 73; Börsch-Supan, 2012). The slope of a straight line is drawn at a tangent to the curve if any value for explanatory variables describes the effect of x to the probability at that point. The steepest slope for the logit model occurs when the probability is at 0.5, while "the slope approaches 0 as the probability approaches 1.0 or 0" (Agresti, 2002, p. 101). Consequently, the effect of the explanatory variable on probability performs a smaller role when probability approaches 1.0 and 0, in comparison to that of 0.5.

Thirdly, the binary response model can be employed to capture the expected changes in the possibilities of Y, as a result of a change in x. However, when interpreting the regression results for both models, the methods are found to differ, because probability is nonlinear. The logit model employs an odds ratio to interpret the regression results, while the probit results can be interpreted by following three methods: (1) computing the predicted probability for the initial value of the explanatory variables; (2) computing the predicted probability for the changing value of the explanatory variables; and (3) taking differences (Stock and Watson, 2015, p.394).

The above discussions established that the probit model was more appropriate for this current thesis, due to its ability to establish precisely estimated results for empirical investigations. Due to the non-linear features of the probit model, it was not applicable to use OLS and 2SLS techniques; therefore, the MLE technique was employed in the probit model through an iterative process (Cameron and Trivedi, 2005). Probit estimators are constant, asymptotically normal and efficient under general conditions (Wooldridge, 2009; Cameron and Trivedi, 2005). The Pseudo-R^2 value is employed to evaluate the goodness-of-fit of a given probit model. The Pseudo-R^2 uses a similar scale to OLS R^2, ranging from 0 to 1. However, it should not be interpreted as OLS- R^2, because different Pseudo-R^2 indicates different values on the same model. Thus, Pseudo-R^2 cannot be interpreted independently, it needs to be compared with another Pseudo-R^2 on the same model with the same data. Thereby the value of the Pseudo-R^2 indicates that the higher the value, the better the model's

predictive capacity (Cameron and Trivedi, 2005). Consideration of the empirical results of a probit model take the form of odds ratios, which are not easy to interpret; thus, the marginal effects of these estimators are captured through statistical packages, which are then used to discuss the impact of theoretical variables on the probability of taking on homeownership.

Robustness Check

Robustness checks are a common practice in empirical studies, examining "how the core regression coefficient estimates behave" (Lu and White, 2014, p.194). A number of methods have been employed when testing the robustness of the estimators, comprising adding or dropping some explanatory variables, replacing regressor by employing its alternative variable, employing different estimation techniques, or conducting a test automatically using Stata commands (Lu and White, 2014). The criteria for examining the robustness of estimators require that if coefficients do not generate a significant change in a robustness test, implying that the estimators are plausible and robust. This current thesis conducted the robustness check based upon the implication of the robustness test in existing studies (Chang and Wang, 2013; Lu and White, 2014; Mian et al., 2015; Coulibaly and Li, 2016; Yang et al., 2017). For the aggregate level model, the robustness check is conducted by replacing the explanatory variable with its alternative variable for the aggregate level model. In relation to previously discussions, the process of industrialisation creates working opportunities alongside the urbanisation, increasing employment in the urban areas in China (Chan, 2010). Therefore, the *number of people in urban employment* is replaced by *urbanisation rate*, when checking the robustness of the estimators in the aggregate level model. For the household level model, an alternative estimation technique, Limited-Information Maximum Likelihood (LIML) and Generalised Method of Moments (GMM), are employed to perform the robustness check. As Cameron and Trivedi (2010), the LIML estimator predates is asymptotically equivalent to the 2SLS estimator given homoscedasticity. In addition, a comparison between logit and probit estimation is undertaken to perform the robustness check for the tenure choice equation. The results of robustness checks are presented in Appendix 2 and 3.

4.5   Conclusion

This chapter discusses the research approach, the research design, research questions, and research methodology. A quantitative research approach was employed herein, aiming to examine those factors that would impact housing affordability and tenure choice in China. Econometric methodology was used for empirical investigations. Due to suspected endogenous issues, OLS estimators are biased and inconsistent. Therefore, the 2SLS was employed in this current thesis, in order to resolve endogenous issues. A number of instrumental variables were employed for the suspected endogenous variable, helping to obtain unbiased and consistent results. Due to the requirement of finding an efficient instrumental variable, it is a challenge to obtain a good instrumental variable to specify the suspected endogenous variable. Thereby, it is necessary to test the validity and efficiency of the instrumental variables. In addition, a probit equation was employed in this thesis, to examine factors influencing the likelihood of choosing homeownership in cooperation with household level data. Tenure choice was modelled as a probit model, where MLE estimation was used to estimate the model. The marginal effects of the probit model could then be obtained to interpret the results. The details of econometric specifications would then be discussed in Chapters 6 and 7, detailing the potential issues that might arise in the models. The next chapter describes the data analysis, including key data sources, data transformation, and data organisation.

Chapter 5   Data

5.1   Introduction

As stated in previous chapters, this thesis aims to examine those factors that influence housing affordability and households' tenure choice in China. The methodology chapter (see chapter 4) explained that econometric modelling was applied to the data collected for this thesis, incorporating two data types: macro and micro data, which were obtained from reliable databases. Micro level data refers to the data at the household level, and was obtained from the China Household Finance Survey. Macro level data refers to the national level macroeconomic data collected from the CEIC database, the National Bureau of Statistics and the People's Bank of China. This chapter highlights data used in this thesis by illustrating various data sources, data characteristics, and data samples and data organisation in detail. Meanwhile, the working data file employed in the empirical investigation is introduced, including the sample size for household level data and data coverage of the national level data. This chapter is structured as follows: Section 5.2 discusses data at the household level, introducing the CHFS 2011 survey, which includes the justification for the data, the survey contents and its characteristics, the sample coverage, file linkages and variable transformation. Meanwhile the subsequent section, section 5.3 illustrates macro data at the national level, including descriptions of data sources, and introducing key variables. Section 5.4 finalises this chapter by discussing the final working data file used for the empirical investigation.

5.2   Household Level Data

5.2.1   The China Household Finance Survey (2011)

The data utilised in the empirical investigation were collected in a household survey. The China Household Finance Survey (CHFS) was conducted by the Survey and Research Centre, which was established in 2010, with the aim of conducting a nationwide household finance survey, to produce reports regarding households' financial situations and household

expenditure (Gan et al., 2013). As a non-profit academic research institution, the centre is based out of the Research Institute of Economics and Management, located at the South-western University of Finance and Economics. The CHFS was conducted in the summer of 2011 to collect information regarding finance, economic status, and demographic features at the household level, to enhance understanding of how micro level data reflects households' decision making. The CHFS 2011 is the principal household finance survey in China, and covers the entire population with random sampling. The overall refusal rate for the CHFS 2011 was 11.6 per cent, which is far below that of similar national surveys (Gan et al., 2013). The primary contribution of the CHFS 2011 is that it provides high quality and representative data at the individual and household level, on a cross-sectional scale, including housing assets and financial wealth; liabilities and credit constraints; income; household expenditure; social security and insurance; demographic characteristics, and employment. The main advantage of the CHFS 2011 was that it reflects changes in social, demographic and financial data, which respond to the economic and policy environment in China, and comprise valuable variables for empirical investigation.

The sampling design for the China Household Finance Survey (CHFS) comprises two major components, one being overall sampling, and the other on-site sampling based upon field mapping. The survey collated data from a random sample to represent the overall population of Chinese households; providing valuable and high-quality data detailing households' microeconomic and financial status, based on family assets, mortgage information, and housing properties. The sampling design employed stratified three-stage sampling, and considered the probability population to size (PPS) technique, where the PPS technique dominated each stage of the sampling process. At the first stage, the primary sampling unit targeted 2585 cities at the country level, excluding Xinjiang and Xizang; in the second stage, the survey matched the proportion of the sampling in urban and rural areas to real data in China. In the third stage, the survey used RS (Remote Sensing), GIS (Geographic Information System), and GPS (Geographic Position System) techniques to map geographical information and household distribution. Households were selected randomly for the survey, and the interviews conducted with people engaged in economic activities living in sample areas, which were targeted for more than 6 months, excluding those not holding Chinese nationality

and those who had migrated abroad. Of 8438 households, 29463 individuals across 25 provinces in mainland China, were interviewed during the summer of 2011 for the CHFS survey, with a 1 per cent sampling error (Gan et al., 2013).

5.2.2   The CHFS 2011 Variables and Definitions

As explained above, the CFHS 2011 was conducted in the summer of 2011, and in-person interviews with head-of-household and telephone follow-up interviews were conducted. Detailed information was collected regarding housing components, home values, and financial assets (including down payments, mortgage payments, interest rates, and mortgage durations). In addition, the CHFS 2011 included an ID[1] indicator that clarifying whether a household is registered as holding a rural or an urban 'hukou'. According to the survey questionnaire, a **household** can be defined as:

- People living under the same roof sharing at least one meal a day comprise household members. A single household is an individual living alone. Moreover, if people have an ongoing economic connection with a family dwelling, they should be regarded as a household member whether they are studying elsewhere, migrant works, members of a monastic order, visiting relatives or friends, serving prison sentences, active soldiers, overseas (including travelling, studying, working, family visiting, etc.), or a married couple leaving the parental home. Housekeepers and private drivers should not be included when identifying household members.

This research aims at examining factors that impact housing affordability and households' tenure choice. When considering the research questions posed in this thesis (see Chapter 1), the data provided by the CHFS 2011 was found to satisfy the requirements of theoretical variables, contributing to organising econometric modelling. The formal CHFS 2011 questionnaire comprised four major parts: demographic details; family assets and debt;

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[1] Termed as 'hukou' in Chapter 2.

insurance and securities; and income and expenditure. The main content of the survey relating to this research is illustrated as follows:

- **Demography.** This involves detailed demographic information about each household member, including data relating to household size, gender, year of birth, educational achievement, employment status, 'hukou' identification, marital status, and profession, in connection to household life cycle theories.

- **Assets and Debts.** This comprises all the information on property assets (including tenure choices and the year of tenure commencement), housing expenditure based on current tenure status (including rental payments), and housing costs (including purchase costs and estimated current market value). With regard to debt information, it provides data on borrowing for housing expenditure (including mortgages, HPF, and other forms of debts), the interest rates on borrowing, down payments for a home purchase, the starting year for any borrowing, and the duration of the borrowing period. This section provides the most important information for this research concerning housing debts and tenure choice, capturing the variables for the econometric modelling.

- **Insurance and Securities.** This section provides valuable information on HPF with respect of research into housing policy and its implications. HPF as an important policy factor contributes to analysing the likelihood of people with HPF choosing homeownership. Considering the target and coverage of this housing policy (see Chapter 2), and discussions on how it can be improved are given in subsequent chapters, according to empirical analysis.

- **Expenditure and Income.** Income data are provided at the individual level, concerning wealth positions, working status and household expenditure. This research employs total household income at the household level, representing the aggregation of all sources of individual income in a single household.

5.2.3 Justification

The main reason for using the CHFS 2011 in this thesis was that it is a relatively new survey not formerly employed within research addressing Chinese housing affordability issues. The majority of existing research on housing affordability and tenure choice in China focuses on generating housing affordability ratios, rather than on conducting an empirical investigation of those factors impacting on housing affordability and the probability of achieving homeownership. Therefore, the CHFS 2011 affords this research valuable and high-quality data regarding the financial status of households, with information on family wealth and housing assets being particularly useful. This study represents the first time that data at the household level has been incorporated in an empirical investigation of examining the factors impacting on housing affordability and tenure choice. More importantly, regional dummies and housing policy indicators obtained from the CHFS 2011 assist with empirical investigation, by offering valuable findings concerning regional diversity in terms of housing affordability and tenure choice. Correspondingly, since the dataset provides valuable information pertaining to households' family wealth, housing assets and demographics, it is significant as a means to assist in econometric modelling and to obtain findings at the household level. In addition, the CHFS 2011 fulfils the need for data regarding housing assets and expenditure, enabling researchers to fill in the gap between existing research regarding housing affordability theoretically and empirical investigations regarding housing affordability, while minimising costs by avoiding a time-consuming data collection process.

However, the use of the CHFS 2011 dataset introduces potential limitations to the study. First, this survey was conducted in Chinese and this thesis is in English, and some terminologies cannot be accurately translated. Therefore, there might be some inaccuracies in data reporting (Saunders et al., 2009), involving a significant amount of time being spent transcribing variables. Thus, it may be a barrier to the data user when seeking to capture information about the variables. Additionally, the dataset includes some instances of misreporting, which the limit the data quality; i.e. measurement error, typing mistakes, and missing values. In reality, misreporting is a common problem that is present in most survey data; however, it is necessary to avoid this when employing data for further investigation.

5.2.4   Survey Instruments

The CHFS 2011 survey employed the following survey instruments: (1) field mapping, (2) electronic mapping, (3) face-to-face interviews, and (4) telephone follow-up interviews. The main working instruments for the survey are described below:

- Field Mapping and Electronic Mapping. Filed mapping provides information on household location and distribution using RS, GPS, and GIS techniques, to minimise the possibility of discrepancies in the survey data. Mapping is a technical-based process that requires utilisation of advanced drawing techniques, computer skills and a sense of direction. A questionnaire about data quality control is typically designed for the surveyors, and serves to assist them in contacting the community, regulating survey procedures and checking the quality of the collected data. At the mapping stage, the surveyors examine the referred map according to actual graphical locations, remarking on households' distribution by marking out are in residential housing; and identifying the number of occupied houses, vacant houses, and empty houses in a community.

- Face-to-face Questionnaire. Applying the concept of Computer-assisted Personal Interviewing (CAPI), the Survey and Research Centre developed an interviewing system to allow participants to answer questionnaires and manage the collected data. This platform minimises the non-sampling error caused by manual factors, and improves data quality. Face-to-face questionnaires were answered via this platform using a computer.

- Telephone Follow-Up Questionnaire. Subsequently, to allow for interviews, telephone follow-up interviews were conducted after the questionnaire interviews, using Computer-Assisted Telephone Interviewing (CATI), to confirm the accuracy of the information and to maintain data quality.

5.2.5   Sample Representativeness

The CHFS 2011 is considered to have a good level of representativeness when achieving the overall refusal rate of 11.6 per cent, having drawn on a random sample to represent the overall population of Chinese households. We examine the representativeness of this survey by referring to the figures published in the statistical yearbook. The results suggest high consistency between the national level data obtained from the National Bureau of Statistics and the CHFS survey data.

The CHFS 2011 reveals urban to rural participation is 51.4:48.6, while the sixth national population censor in 2010 reports the proportion of Chinese urban to rural households is 51.6: 48.5 (NBS, 2011). In reference to the annual statistics for 2011, the urban population in 2011 was 51.3 per cent, representing a 0.01 per cent deviation from that specified in the household survey. Therefore, we can conclude that CHFS 2011 is highly representative. Moreover, the comparisons captured and displayed in the table displayed below indicate demographic characteristics at the national and the household level.

Table 5-1: A comparison of demographic information between the Household Level and the National Level

Index	Household Level (CHFS 2011)	National Level (NBS, 2011)
Total population of 2011	29,324	1,347,350,000
Average Household Size	3.03	2.89
Average Urban Household Size	3.76	3.98
Mean Age	38.09	36.87

Note: The CHFS index is adjusted by weight, and one household on the CHFS represents 45,947 households in the survey area.

(Source : Gan et al., (2013), Table 1.10, p.15)

Comparing total population figures in Table 5-1, it shows that the entire national population was 1.3 billion, while the data relating to the household level was 29324 households. Meanwhile, the average household size was 2.89 at the national level; whereas the household data suggests 3.03, and is slightly below the national level. For the size of the average urban household, the figure at the national level is 3.98, while the data at the household level is

3.76. Therefore, we conclude that the CHFS sample is wholly representative when comparing with national population, average household size, age structure, and the proportion of urbanisation.

5.2.6   Merge Dataset

As stated above, a household is taken to mean several people living under the same roof sharing at least one meal a day; whereas a single household designation is given to an individual living alone. The CHFS 2011 is a household survey; therefore, each household member needs to be interviewed. Data are collected at different levels, by interviewing all the individual members of each house (individual level), and the head of each household (household level). Data at the individual level comprises information concerning individuals' labour incomes, residential locations, demographic factors, employment status, and job features, while the household-level file incorporates information on household income, household's financial status, and family assets and expenditure, which are important variables. Therefore, the CHFS 2011 is complex, since it contains different forms of data structure with variable focuses. The original dataset is distributed online comprising two different data structures with three separate files: one referring to data at the household level, and the other two to data on individuals within households.

In view of the above, when using the CHFS 2011 for this research, it was necessary to reformat the data into different structures. Since the CHFS 2011 is the first representative micro household survey in China, there is no guide detailing the proper management of that data. Based on the experience of the British Household Panel Survey (BHPS), merging the different structures of files together by attaching one data file to another emerged as a reasonable approach to capturing the entire value of the dataset, while providing additional scientific information for quantitative analysis. Important aspects of linking files relates to the 'key variable' for each data file, clarifying the records of each file at the household and individual level. Meanwhile, 'key variables' also serve to indicate which components of the files can be reasonably merged.

Technically, there are three simple ways to connect different file structures together. First, data at a particular level can be 'matched' with other files that are structured at a similar level. Matching involves merging two or more files at a similar level, by selecting the 'key variable' that all files contain. Moreover, data at a particular level could be 'aggregated' at a higher level, i.e. by merging data from the individual level with that at the household level. After this, higher level data can then be 'distributed' to a lower level. More specifically, the records on file at household level can be assigned to correspond to the individuals in each household. Within these operations, the range of particular data files was expanded, and the data applied to different approaches for analysis. In addition to what was discussed, multiple types of statistical packages provide linkage techniques that have corresponding commands. For instance, SPSS and STATA provide operations to complete different types of linkage.

The CHFS 2011 is organised as a set of files based on statistical packages; these include a set of STATA files, and a set of SAS files. In order to obtain a merged file, we can carry out commands in STATA by selecting the 'key variable' in each file. The result is that records from individual file can be attached to household file according to the household ID of the head-of-household; whereas the sample size of the merged data file is 8438, which is equivalent to the sample size for the household file. The restructured data file heightens the value of the survey, providing a more usable information format and expanding the diversity of the variables.

5.2.7   Missing Data and Erroneous Data

It is very common that survey processes generate erroneous data and missing values, as a result of respondents misunderstanding questions, interviewers not transcribing questions properly, and due to other simple errors, such as those made when typing and editing. Non-response is also a relatively common phenomenon when conducting a survey. This might arise when the interviewee refuses to reply, or if individuals or households do not know the answers for some questions. Surveyors and the data providers sought to minimise these types of problems by training surveyors, monitoring the survey process, and checking data quality. Some potentially erroneous data has also been involved in the CHFS file, including

measurement errors and missing values. This affects the quality of the research, possibly resulting in spurious estimates or biased estimates (Rubin, 1987). Thus, it is necessary to take measures to resolve these so as to avoid adversely affecting further research.

Researchers have suggested procedures such as imputation and weighting as mechanisms to resolve the problem of missing data that applies in a survey (Rubin, 1987; Heeringa et al., 2010). Imputation is an advanced method used to deal with such problems, with the aim of reducing the bias caused by non-response and missing data, including techniques of hot-desk imputation, regression imputation, and cross-wave imputation (Little and Rubin, 2002). Imputation can be progressed in a statistical package. However, the method for adjusting the confidence interval of an estimation is not necessarily as straightforward as otherwise identified. Alternatively, weighting is proposed as a possible technique that can be employed to address this case. The CHFS provides weights that can be calculated for both at the households and individual level, allowing data users to employ appropriate weighting when conducting data analyses.

5.2.8   Working Data Sample

It has previously been stressed that individual data file is merged into household data file, by selecting 'key variable' from each dataset. The sample size of the merged data file is 8438, which is equivalent to that of a household data file. Under further analysis, it is necessary to organise a working file for empirical investigation by obtaining useful observations and reducing unnecessary components. Linking the research objectives of this thesis with the dataset, results in data pertaining to housing consumption being regarded as an important variable when organising the working file. More specifically, household tenure choice and mortgage borrowing are crucial as mechanisms to guarantee useful observations. The steps taken when organising a working data file are as presented below:

Firstly, the variable 'current tenure choice' in the merged data file was selected as the key variable for filtering unnecessary observations. Originally, three types of tenures were involved in this variable: owner-occupied (7097 households), renting (992 households) and

living-for-free (346 households) (i.e. they are living with parents or relatives, or living with somebody else with no charge) separately. Considering the research objectives, we only targeted households renting or owning a house with a given amount of housing expenditure. Therefore, those samples do not have housing expenditure on housing were excluded, including groups of 'living for free' and those 'owning inherited houses', as housing affordability was not expected to be a problem for those groups. More specifically, 346 of 'living-for-free' households were excluded from the working file, accounting for 4.1 per cent of the 8438 households. Moreover, 61 renters were not charged rents, and so were removed from the dataset. Regarding information detailing rental payment and frequency, this was the most problematic proportion of the dataset, since it contains many missing values and potentially erroneous data. Where typing mistakes were evident, i.e. when erroneous figures and extreme values appeared in the data set, it was removed.

Secondly, considering the influence of housing expenditure on housing borrowing, households without a mortgage were excluded, including those groups owning an inherited house, those purchasing public houses via the housing reform, and those who had have paid off their mortgages. Based on this consideration, the variable 'whether have housing borrowings' was selected as the second key variable when forming the working file. According to the descriptive statistics, 6961 observations were removed, because the households did not have to meet mortgage payment. In addition, linked to the research questions, this current thesis interested in housing affordability for households with mortgages, therefore, the research data sample were further filtered based on type of mortgages. The key variable, 'what type of housing borrowings you have' was employed to filter irrelevant sample data. After making these adjustments, the data sample was reduced to 426, comprising households with either a mortgage, HPF debt, or a mortgage in conjunction with HPF debt. Those with housing borrowings from commercial debt or via non-regulated channels were excluded from the data sample, because these types of borrowing generate higher costs and offer relevant shorter terms.

Next, the working file was organised by cleaning those observations containing erroneous income data, and deleting records with missing values, extreme values and erroneous data.

The criteria for organising the working sample size was that, if the income at the household level was between a given range of national income, then the data could be retained in the data file; otherwise it should be classified as unusual data and dropped. The national level income data for both urban and rural households in 2010 were collected, and were used the data as a reference to clear the erroneous income data in the CHFS 2011 dataset. Income data were collected for the low-income and high-income groups. According to the national statistics, the 1st quintile represented the low-income group, having an average annual income[2] of 13970 yuan in 2010; while the 5th quintile represented the high-income group, having an average annual income of 45344 yuan. As this figure was measured per capita, it is necessary to obtain the total household income by multiplying the average number of working people in the household. According to the statistics, the average number of working people in a household was 1.5 in 2010 (NBS, 2010). Accordingly, the total household income for the 1st quintile of urban household was 20685 yuan, and for the 5th quintile was 68016 yuan. Therefore, observations in the income ranged between 20685 yuan and 68016 yuan were retained in the working file, and all others were dropped. Following the same procedures, income data at the national level for rural households were observed. The statistics show that for the 1st quintile the average annual income was 3566 yuan, while for the 5th quintile it was 18327 yuan. However, the average number of working people in a rural household was 2.85, because the birth control policy was not implemented in rural area. The average household income for rural households were computed, the 1st quintile was 10163 yuan, whereas that for the 5th quintile was 53231 yuan. Therefore, the observations at the income range of 10163 yuan and 53231 yuan were kept, all the other observations were dropped. The following step is moved on to clarifying the housing expenditure to income ratios.

This thesis employs the ratio approach to obtain the housing expenditure to income ratio. To achieve this, household level data were used to calculate the housing expenditure to income ratio for both renters and homeowners. According to the definition of the ratio approach, if housing expenditure exceeds 30 per cent of total household income, this should be classified

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[2] The income data in the national official database is measured as yuan per capita.

as a housing affordability issue (Hulchanski, 1995). With regard to the mortgage lending criteria in China, the China Banking Regulatory Commission (CBRC) stated that the mortgage payment to income ratio should not exceed 50 per cent of total household income, otherwise mortgagors should be regarded as having severe difficulties in meeting their mortgage payments. After reviewing the descriptive statistics in our dataset, it became apparent that the mortgage payment to income ratio exceeded 50 per cent; and so those observations with extreme values affecting the housing expenditure to income ratio were removed. Finally, considering the effects of age across the lifecycle path, data pertaining to individuals aged over 20 years old were kept. After taking the steps detailed, the final sample size for the working file was 675, comprising 301 homeowners and 374 renters.

In addition, in relation to the existing studies concerning tenure choice in China and lifecycle theory, this current thesis aimed at examining the variations in terms of housing affordability and tenure choice among different social groups. A number of existing studies have applied similar considerations. Wang and Li (2004), Deng et al. (2005), and Tang and Coulson (2017) investigated variations in homeownership among different age cohorts by splitting the data sample for those aged under and over 40. In addition, Chen (2016) examined the heterogeneity of tenure choice by focusing on the different social groups in China's urban population. Chen and Yang (2017) captured the likelihood of achieving homeownership by introducing different levels of educational attainment to their model. Accordingly, based on these approaches, this current model examines differences in housing affordability and tenure choice by introducing different social groups, including: (1) age groups (households aged under or over 40); (2) 'hukou' location (Households have urban or rural 'hukou'); (3) income groups (income less or greater than the average annual household income); and (4) education groups, including households with high educational achievement (i.e. college or above) or basic educational achievement (i.e. A-level or below).

5.2.9   Variable Calculations

The research questions considered which housing consumption variables were necessary to generate the econometric model. Unfortunately, the CHFS 2011 offers no specific variables

for modelling, such as housing expenditure to income ratio, LTV ratio, age, or regional dummy indicators. Thus, the following content details the formula used to compute the requisite variables for econometric modelling.

- **Age.** Calculation regarding age of the head of household in the survey year and the birth year of the head of household, as given in the dataset. The equation is:

$$\text{Age} = \text{Survey Year (2011)} - \text{Birth Year of the Head of Household} \qquad \text{5-1}$$

- **Mortgage Payment.** The calculation for mortgage payment employs data pertaining to mortgage rates, mortgage terms, and the mortgage principal. The mortgage information provided by the CHFS 2011 is measured on a yearly basis, and the mortgage payment data is therefore computed by employing the the following equation, whereby all the relevant data employed in the formula were transformed into monthly basis:

$$PMT_{monthly} = P \frac{IR(1+IR)^n}{(1+IR)^n - 1} \qquad \text{5-2}$$

where,

PMT = monthly mortgage payment

P = amount borrowed, also known as the mortgage principal

IR = monthly mortgage rates, expressed as a decimal, not a percentage.

   = yearly mortgage rate / 12 / 100

n = the total number of payments or periods, also named as the mortgage term

   = length of mortgage $\times$ 12(months)

It is assumed that the mortgage debt in the CHFS 2011 applied to a fixed-rate mortgage. Therefore, according to Equation 5-2, making a fixed monthly payment depends upon amount borrowed, the mortgage rate, and the mortgage terms. Additionally, the mortgage payment paid every month equals the amount paid the previous month, plus interest on that amount, minus the fixed monthly payment. Since the data concerning income in the CHFS 2011 were measured on a yearly basis, in order to obtain the mortgage payment to income ratio, it is

essential to convert the computed monthly mortgage payments to an annual basis by multiplying by 12, as specified below:

$$\text{Annual Mortgage Payment} = \text{PMT}_{monthly} \times 12 \qquad \text{5-3}$$

- **Housing Expenditure to Income ratio.** As specified previously, housing affordability was typically defined as the level of housing expenditure as a percentage of the household income, pertaining to the level of rentals, and mortgage payments for renters and mortgaged homeowners (Bourassa, 1996; Chaplin et al., 1994; Stone, 2006). In relation to the two types of tenure status in the dataset, the housing expenditure to income ratio comprised both the rent to income ratio and the mortgage payment to income ratio, which were obtained with the following formulas:

$$MGT_{ratio} = \frac{Annual\ Mortgage\ Payment}{Annual\ Household\ Income} \times 100 \qquad \text{5-4}$$

where,

MGT_{ratio} = mortgage payment ratio, expressed as a percentage, not as a decimal.

$$\text{Rent}_{ratio} = \frac{Annual\ Rental\ Payment}{Annual\ Household\ Income} \times 100 \qquad \text{5-5}$$

where,

Rent_{ratio} = Rent to income ratio, expressed as a percentage, not a decimal

$\text{Annual Rental Payment} = \text{Rental payment} \times \text{Payment Frequency}$

- **Loan to Value Ratio**. LTV requires mortgage borrowers to satisfy the requirement to make the down payment for a desired house, measuring the liquidity constraints for homebuyers (Gan and Hill, 2009).

$$LTV_{ratio} = 100 - \left(\frac{Downpayment}{Total\ House\ Price} \times 100\right) \qquad \text{5-6}$$

where,

LTV ratio = loan-to-value ratio, expressed as a percentage

This research used household level data in the empirical investigation, employing valuable information regarding housing features, mortgage payments, demographics, housing policy indicators and regional dummies. Data were obtained from the CHFS 2011 dataset, a representative micro survey providing information about Chinese households' financial assets and housing expenditure. Organising the CHFS 2011 data was difficult due to the missing data, erroneous data and the presence of extreme values in the dataset. In addition, it is technically complicated to link two data files collated at different levels. However, this section described the processes implemented to resolve these difficulties, including dropping erroneous and missing data, and merging two files in a statistical package. In addition, this section presented the formula that was used to obtain the variables that relevant for the empirical investigation.

5.3   Aggregate Level Data

As mentioned in the introductory section, this research employs two types of data. Data at the household level was introduced in the previous section, including information regarding the survey design, data organisation, file linkages, and transformation of variables. This section focuses on the time series data employed herein; including data frequencies, data sources, and data transformation. The time series data were drawn from various sources; e.g. the CEIC database, the World Bank, and the national statistics, comprising data on macroeconomics. Quarterly time series data obtained from these sources assisted the empirical estimations at the national level. The sample size for a time series dataset is the number of time periods of variables that we observed (Wooldridge, 2009). The dataset spans the period between 2000 Q1 and 2015 Q1, encompassing 61 periods, which covered a sufficient quantity of data on which to perform a time series regression. The reason for concentrating on this period was because it provided broad and detailed information about the residential market, following the implementation of the nationwide housing reform. Drawing on discussions in the literature review chapter, macroeconomic factors were expected to impact housing affordability, including average house price, average household income, gross money supply, urbanisation rate and unemployment rate. Meanwhile,

variables from the supply and demand side were collected, including gross floor spaces completion and loans to housing investment companies. Additionally, a further demographic factor was included in this thesis a proxy for housing demand, i.e. marriage rate. Section 5.3 is structured as follows: the next two subsections provide detailed interpretations of the data sources, including the sources for the CEIC database and related national statistics. Data measurements and definitions are involved in each subsection. These are then followed by discussions about data transformation, including the measurements of average house price, average gross household income, and the house price to income ratio. This section is finalised by discussions detailing the estimation features involved in time series data.

5.3.1 Data Source: CEIC Statistics

CEIC is a superior data resource that delivers high availability and accessibility to 1.2 million macroeconomic time series data sets from more than 128 countries. CEIC utilises different databases; i.e. Global Databases and the China Premium database. The Global Database for various countries, includes a Premium database for India and Russia, and provides industry and macroeconomic time series data. The China Premium Database provides data about the China market for different frequencies, including time series data on the macroeconomic environment, such as national economic performance, inflation and interest rates, monetary, banking statistics, property market, demographic and labour market, and financial market. The macro level data used in this thesis was collected from the China Premium Database, including quarterly data relating to macroeconomic content, interest rates, the housing market, and monetary factors.

The quarterly data employed in this current thesis was directly collected from the CEIC database, and then organised using SPSS. The measurements of key macro data relating to this research were illustrated as follows:

- **Average House Price** (unit: Yuan per square meter)
  Average house price is measured in Yuan per square metre. This is the most significant factor when seeking to obtain the house price to income ratio; therefore, we

transformed the house price per square metre figure, to house price per flat, as will be discussed in the subsequent section.

- **Disposable Household Income** (unit: Yuan per capita)

Disposable income per capita measures the income that remains after deducting income tax, and personal contributions to social security, which can be used as a proxy for housing demand. Theoretically, increases in household income would mitigate housing affordability difficulties when house prices are rising slower than household income (Mostafa et al., 2005). As the available income data only relates to urban households, it was measured as per capita income. This was the most impact factor when obtaining the house price to income ratio, the per capita income was then transformed to total household income, as will be discussed in the subsequent section.

- **M2 Supply** (Trillion Yuan)

M2 is a measure of money supply that includes all elements of M1 as well as all sources of savings deposits, including money market securities, households' deposits and other time related deposits made during the reference period.

- **Net Increase in National Household Savings** (Trillion Yuan)

The sources of household savings pertain to both demand and time deposits. The data employed in this current thesis measures the net increase in national household savings by each quarter end.

- **Floor Space Completed for Sale** (10 000 sqm)

Floor space completed for sale can be used as a proxy for the newly-build housing supply, and is measured by gross floor areas, as completed during the reference period. Linking this to the theoretical discussions, the increase in the new housing supply would lead to a corresponding downward change in house prices if demand remained stable, thereby mitigating housing affordability difficulties (Quigley and Raphael, 2004; Tsai, 2013).

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- **Number of People in Urban Employment** (10 million people)

  The number of people in urban employment refers to the total number of people with an active a job in urban areas, and is a proxy for supply of labour in urban areas.

- **Urbanisation Rate** (in percentage)

  The urbanisation rate refers to the percentage of people residing in urban areas. Urbanisation is a policy perspective that dominates the progress of industrialisation, economic development and labour demand in urban areas. Urbanisation can be used as a proxy for household income, as can housing demand, because it introduces labour sources and social productivity into urban regions.

- **Inflation rates** (in percentage)

  Inflation rate, as employed in this thesis is measured as a year-on-year inflation rate.

- **GDP** (Trillion Yuan)

  This measures the amount of quarterly GDP by each quarter end.

- **Housing Investment Volumes** (Trillion Yuan)

  This measures the volume of housing investment devoted to residential housing, and can be used as a proxy for supply side factor.

5.3.2   Data Source: Nationwide Statistics

In addition to the CEIC database, time series data concerning marriage rate, long-term HPF borrowing rate, and LTV are collected from official reports, the PBOC website and the China Civil Affairs' Statistical Yearbook.

- **Marriage Rate** (annual basis, in percentage, the China Civil Affairs' Statistical Yearbook)

Married rate is a measure of the total number of registered couples divided by the current average population. Linked to lifecycle theory, getting married can increase the likelihood of owning a house because married couples require a better living condition as their age path changes (especially after having a baby). Married couples experience fewer affordability difficulties than individual households, because being married increases access to different sources of income (Mayer and Engelhardt, 1996; Moore and Skaburskis, 2004). The data on the national married rate was obtained from the China Civil Affairs' Statistical Yearbook.

- **Annual HPF Borrowing Rate** (Long-term, in percentage)

  The HPF and its corresponding borrowing rate function as a housing assistance project, aiming at mitigating housing affordability difficulties by granting low-rate housing debt. Therefore, the level of the HPF borrowing rate is of significant in generating the empirical results. Accordingly, this thesis employed the long-term HPF borrowing rate in the aggregate level model. This figure was measured on a yearly basis, according to the annual long term HPF borrowing rate and its relevant adjustment (see Appendix 1 for more information about the relevant adjustment).

5.3.3   Variable Calculations

Linking to the theoretical discussions on the measurement of housing affordability, the ratio approach has been widely used to obtain housing affordability indicators (Bourassa, 1996; Chaplin and Freeman, 1999). Considering empirical investigations, this research employed the ratio approach to obtain the dependent variables. Therefore, the house price to income ratio can be obtained by considering house prices and household income at the national level. The following section interprets computing the house price to income ratio.

- **Total Household Income**

As discussed previously, the data on income were measured as per capita income. However, calculations for the house price to income ratio required data on household income. Therefore, it is necessary to compute total household income prior to obtaining

the ratio. Considering the average number of working people in a household, we based this figure on the national statistics yearbook. Over the sampled periods, the average number of working people in a household fluctuates around 1.68; thus, it is assumed this figure to be 2. The total household income was captured by multiplying per capita disposable income by the number of average working people in a family. The resultant equation was as follows,

Total Household Income= Disposable Household Income × Average Working People in a Household   5-7

Where,

Average Working People in a Household $= 2$

- **House Price**

Total House Price = House Price per square meter × Standardised House Size   5-8

Where,

Standardised House Size $= 90$ square meters

- **House Price to Income Ratio (Multiple)**

The ratio approach has been used as the most common method employed to examine housing affordability, measuring the relationship between house prices and household income (Hancock, 1993; Hulchanski, 1995). Considering with the research questions, this research employs a ratio approach for the empirical investigation, examining the factors impacting housing affordability. Since data on median income and house prices were not available, this research employed average data alternatively, corresponding to research into housing affordability on China (Huang, 2004; Lau and Li, 2006; Chen et al., 2010). According to the measurement in the ratio approach, the formula of house price to income multiple was written by following:

$$House\ Price\ to\ Income\ Ratio = \frac{Average\ Total\ House\ Price}{Average\ Total\ Household\ Income} \qquad 5\text{-}9$$

where,

$$\text{Total House Price} = \text{Average House Price Per Square Meter} \times 90 \text{ m}^2$$

$$\text{Total Household Income} = \text{Quarterly Disposable Income Per Capita} \times$$

$$\text{Average Working People in a Family} \times 4 \text{ (quarters)}$$

5.3.4 Data Estimation Features

Time series data are organised by one or more observations across a particular time span, and are recorded daily, weekly, monthly, quarterly and yearly. The effect of time is a particular feature of time series data, and is embodied in the value of the observation, which correlates with a previous or subsequent period of time. For instance, data on income at t period would be linked to its likely range in the $t + 1$ period. Similarly, the unemployment rate in the t period precedes that for the $t + 1$ period.

The key feature of time series data is difficult when involving a time series in an empirical investigation, because it is difficult to assume that each observation is independent over time (Wooldridge, 2009). Some variables may display clear time trends, and so Wooldridge (2009) pointed out that data modification work needed to be finalised for time series models before generating a standard econometric model. Such processes result in working with time series data are more difficult than cross-section data. Moreover, as time series data are recorded at particular frequencies, this results in data that displays a significant seasonal trend. This is a significant factor when analysing the time series data, because the seasonal effects might result in values that differ across months or quarters. As this research focuses on empirical investigation regarding those factors impacting housing affordability, the seasonality of a quarterly tendency need not be considered, as it will not influence the housing affordability ratio.

Most economic time series data are non-stationary as they experience increases and reductions over time. Therefore, employing non-stationary data in a linear regression will lead to a spurious regression, including a non-stationary residual series, a high R-squared value (adjusted R-squared value), and a significant t-value. However, the value of the DW statistics is low in a spurious regression. This is because the non-stationary time series data are unreliable as a means to explain causal relationships in a linear model (Wooldridge, 2009).

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Many economic time series data sets highlight trends that are associated with time, and display a particular tendency over time, i.e. one that is either decreasing or increasing. Theoretically, trending variables do not violate the assumptions of classical linear regression, although it should be stressed that some unobserved trending variables could influence the dependent variables, as these are simultaneously correlated with independent variables. This might result in a spurious relationship between dependent variable and multiple independent variables (Wooldridge, 2009, pp. 363).

5.4   Conclusion

Linked with the research questions, this thesis aims to generate empirical investigations to examine those factors that would impact housing affordability and tenure choice in China. However, as stated in Chapter 3, the shortage of empirical research regarding housing affordability issues, and the limited data sources covering the research area were significant limitations influencing this study. Therefore, data at both the national and household level were collected, making it possible for the first time to explore factors impacting housing affordability and tenure choice in China. This represented a unique attempt to examine China's housing affordability issues at the macro and micro level. This chapter introduced the working data file used for empirical investigations presented in the subsequent chapters. The detailed descriptions of descriptive statistics for each type of data would be presented in subsequent chapters, in accordance with economic modelling and the specified estimation techniques.

Data at the national level were employed in an aggregate model and interpreted in Chapter 6. This quarterly time series data consisted of 61 periods, spanning from 2000 Q1 to 2015 Q1. Those data were obtained from the secondary data sources that as stated in section 5.3, pertaining to information on housing, macroeconomic, monetary, housing demand factors, demographics and labour. Most importantly, the dependent variable, house price to income ratio, was obtained via calculations as stated in section 5.3.3. The CHFS 2011 data was employed in the empirical investigation, in corporation with a two reduced form of simultaneous model, which will be discussed in Chapter 7. The dependent variable for the

housing affordability equation in the simultaneous model was the housing expenditure to income ratio, which has been given in 5.2.9.

Chapter 6   Empirical Investigation by Employing Aggregate Level Data

6.1   Introduction

This chapter presents the process of empirical investigation, developing an econometric model that employs aggregate level data. The econometric estimation presented in this chapter was designed to examine the main factors which influence housing affordability in the Chinese housing market. The ratio approach to measuring housing affordability was employed in this thesis; this involves, using the house price to income ratio as a dependent variable in the empirical equation. As was discussed in Chapter 3, housing affordability issues are closely associated with changes in housing costs. House price was therefore identified as being the predominant factor that significantly impacts housing affordability. Therefore, prior to generating an econometric equation for housing affordability, it is reasonable and essential to produce an equation to examine the factors impacting house prices. On the basis of the theoretical discussions presented in Chapter 3, it is anticipated that theoretical macroeconomic factors are expected to have a significant impact on house prices, thus influencing housing affordability. Therefore, the econometric model at the national level consists of two equations: the first equation examines factors that impact house prices, and the second equation examines the factors that influence housing affordability. Both equations are specified and interpreted theoretically on the basis of the discussions put forward in Chapter 3, and by the use of national level data.

This chapter is structured as follows: it begins by illustrating hypotheses in section 6.2, in line with the basis of theoretical discussion and research questions. Section 6.3 illustrates econometric modelling, including interpretations of theoretical econometric equations, and describes the type of estimation techniques employed in the model, the identification of instrumental variables, and the estimation issues that might be predicted to arise in the model. Section 6.4 presents the discussion turns to the definition and specification of theoretical variables obtained from the theoretical discussions in Chapter 3, detailing the model's econometric framework. Then, section 6.5 provides descriptive statistics regarding

the variables applied in the empirical investigation, comprising the value of the mean, maximum, minimum, and standard deviation. Section 6.6 illustrates the empirical results and discusses the findings of the estimations and, finally, section 6.7 finalises the chapter by offering a conclusion.

6.2 Hypotheses

This section presents the key hypotheses on the basis of the theoretical discussion and research questions, providing a basis for appropriate model specification and the understanding of the empirical investigation.

Hypothesis 1: Theoretical factors from the housing supply and demand side have a significant impact on house prices and the housing affordability ratio.

More specifically, housing supply is proxied by housing investment volumes and floor space completed for sale; while housing demand is proxied by the number of people in urban employment.

Hypothesis 2: Theoretical factors arising from the demographic approach have a significant impact on house price and housing affordability.

Demographic factors, as captured by the marriage rate, are employed in both the house price equation and the housing affordability equation.

Hypothesis 3: Macroeconomic factors have a significant impact on house price and housing affordability.

This hypothesis suggests employing the number of people in urban employment and GDP in the model.

Hypothesis 4: Monetary policy and liquidity constraints influence housing affordability.

According to this hypothesis, M2 supply and LTV are involved in the housing affordability equation.

Hypothesis 5: The housing policy factor is effective in mitigating housing affordability difficulties.

> *Referring to the effect of long-term HPF borrowing rate, which is employed in the housing affordability equation.*

Hypothesis 6: Variations arising from the effects of housing policy date to before and after the recent financial crisis.

> *It is assumed that the variations arising from the housing policy factor are a consequence of the financial crisis. As referenced in Chapter 2, the Chinese government issued a number of policies during the financial crisis, regulating the housing mortgage market. A regression is, therefore, performed by splitting the sample in both the house price equation and the housing affordability equation, in order to capture the variations caused by the financial crisis.*

6.3   Econometric Modelling

This research aimed to empirically investigate the factors that impact housing affordability. This section illustrates the econometric model developed by the use of the national level data. The econometric model was developed on the basis of the research questions discussed in the previous chapter and the hypotheses proposed in the previous section, and were used specifically to examine the factors impacting housing affordability. Prior to conducting an empirical investigation, it is necessary to justify the framework of econometric modelling. Thus, the following subsections describe the modelling framework, and the types of estimation techniques that were employed, the identification and validity checks that were undertaken for the instrumental variables.

6.3.1   Modelling Framework

As discussed in Chapter 3, house price is the crucial factor influencing housing affordability. Linked with discussions in Chapter 2, during the 15 years, house prices in China have continuously been increasing, resulting in an extremely high house price to income ratio. In

this case, we are interested in the house price appreciation in China, and therefore would like to examine factors impacting house prices, prior to identify factors influencing housing affordability. On the basis of the research questions and the hypotheses stated above, an econometric model consisting of two equations were proposed. The first equation comprises factors that impact house prices, while the second equation examines factors influencing housing affordability. In this model, quarterly time series data at the national level are employed, comprising data covering macroeconomic, demand and supply side factors, demographic factors, housing finance factors and housing policy indicators. The formal framework of the model is presented as follows:

House price equation

$$Y_{1t} = \beta_0 + \beta_t X_t + \mu_t \qquad \text{6-1}$$

Where,

Y_{1t} = *house prices*

$\boldsymbol{\beta_t} = \beta_1, \beta_2, \dots, \beta_k \ (k \neq 0)$

$X_t = x_{t1}, x_{t2}, \dots, x_{tk} \ (k \neq 0)$

μ_t = *error term*

Housing affordability equation

$$Y_{2t} = \gamma_0 + \gamma_t X_t + \varepsilon_t \qquad \text{6-2}$$

Where,

Y_{2t} = *house price to income multiple*

$\boldsymbol{\gamma_t} = \gamma_1, \gamma_2, \dots, \gamma_k \ (k \neq 0)$

$X_t = x_{t1}, x_{t2}, \dots, x_{tk} \ (k \neq 0)$

ε_t = *error term*

Equations 6-1 and 6-2 express the theoretical relationship between factors impacting house price and housing affordability respectively. Given the particular features of time series data, observations involve a temporal ordering; t in the equations represents variables indexed by time, comprising $t = 1, 2, 3, \dots, j$; whereas k denotes the number of explanatory variables. The econometric specifications of the two equations are discussed as follows:

<u>House Price Equation</u>

The house price equation is expressed in Equation 6-1, where $\boldsymbol{Y_{1t}}$ is the dependent variable,[1] representing total house price over time; and the subscript 1 of $\boldsymbol{Y_{1t}}$ is used to distinguish it from $\boldsymbol{Y_{2t}}$. Formally, Equation 6-1 indicates that house price is a function of the theoretical variables; therefore, the variables of interest and associated empirical findings will be interpreted in detail in subsequent sections. Variable $\boldsymbol{X_t}$ represents a set of k explanatory variables that are expected to have impact on house prices, comprising variables $x_{t1}, x_{t2}, ...,$ x_{tk}. The term $\boldsymbol{\beta_0}$ is the intercept parameter, also referred to as the constant term. The term $\boldsymbol{\beta_t}$ is the estimated parameter, denoting a set of estimated parameters $\beta_1, \beta_2, ..., \beta_k$, which characterise the role and contribution of $x_{t1}, x_{t2}, ..., x_{tk}$, respectively. The estimated parameter $\boldsymbol{\beta_t}$ has a partial effect interpretation; for instance, it measures the effect of x_t on the dependent variable when holding all other factors fixed (Wooldridge, 2009). This is of primary interest to the empirical investigation undertaken in this thesis. The term μ_t is the error term, indicating the extent to which the model cannot fully explain the dependent variable, comprising the unobservable factors other than $\boldsymbol{X_t}$ that affect the dependent variable. It is important to deal with the error term in the econometric analysis; therefore, a number of assumptions about error term μ_t were made. Mathematically, the assumptions can be expressed as:

$$E(\mu_t) = 0 \qquad\qquad 6\text{-}3$$

$$E(\mu_t \,/ x_{t1}, x_{t2}, ..., x_{tk}) = E(\mu_t) \qquad\qquad 6\text{-}4$$

Equation 6-3 assumes the average value of μ_t in the population is zero; whereas, Equation 6-4 assumes the average value of μ_t does not depend on the value of any independent variable $\boldsymbol{X_t}$ in any period. When Equation 6-4 holds, it indicates that μ_t is **mean independent** of $\boldsymbol{X_t}$ (Wooldridge, 2009). Combining Equations 6-3 and 6-4, the **zero condition mean assumption**, which can be mathematically expressed as:

$$E(\mu_t \mid \boldsymbol{X_t}) = 0 \qquad\qquad 6\text{-}5\,(1)$$

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[1] Formally the time series model is expressed as Y_t, the subscript 1 of Y_{1t} herein is used to distinguish it from Y_{2t}, whereas t is the temporal ordering of each variable.

Equation 6-5(1) is a key important assumption, indicating that for each t, the expected value of μ_t, given the explanatory variables for all time periods, is zero. In the time series analysis, the error term μ_t is required to be uncorrelated with the explanatory variables dated at time t (Wooldridge, 2009, p.347), thus giving:

$$E(\mu_t / x_{t1}, x_{t2}, ..., x_{tk}) = E(\mu_t \mid X_t) = 0 \qquad \text{6-5 (2)}$$

When Equations 6-6(2) holds, this indicates that X_t are contemporaneous exogeneity. Equation 6-5(2) implies that μ_t and the explanatory variables are contemporaneously uncorrelated (Wooldridge, 2009, p.347):

$$Cov(X_t, \mu_t) = 0 \qquad \text{6-6}$$

When considering Equations 6-6(1) and 6-6 jointly, it can be ascertained that the **zero condition mean assumption** requires more than contemporaneous exogeneity, the explanatory variables X_t must also be exogenous. Therefore, Equation 6-5(1) (the **zero condition mean assumption**) requires not only that μ_t and X_t are uncorrelated, but that μ_t is also uncorrelated with past and future values of X_t (Wooldridge, 2009, p.348). When Equation 6-6(1) holds, it indicates that the explanatory variables are strictly exogenous. This further indicates that OLS is unbiased when Equation 6-6(1) holds. Any situation leading μ_t to be correlated with any of the independent variables in any time period results in Equation 6-6(1) failing. Such as when omitting some important variables, leading to the biased OLS estimated results. In relation to this current thesis, the issues of simultaneity do not exist in this model, because the dependent variables Y_{1t} and Y_{2t} do not appear as an explanatory variable in the other equation.

Housing Affordability Equation

Housing affordability is expressed in Equation 6-2, where Y_{2t} is the dependent variable[2], house price to income multiple, as measured by total house price divided by total household

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[2] Formally, the time series model is expressed as Y_t. The subscript 2 of Y_{2t} herein is used to distinguish it from Y_{1t}, where t is the temporal ordering of each variable.

income. X_t represents a set of variables that impact housing affordability, comprising theoretical variables $x_{t1}, x_{t2}, ..., x_{tk}$. Term γ_0 is the intercept parameter. Term $\boldsymbol{\gamma_t}$ is a set of estimated parameters, indicating estimated parameter $\gamma_1, \gamma_2, ..., \gamma_k$, (corresponding to independent variable $x_{t1}, x_{t2}, ..., x_{tk}$). The estimated parameter $\boldsymbol{\gamma_t}$ has partial effect interpretations, which characterise the roles and the contributions of $x_{t1}, x_{t2}, ..., x_{tk}$, respectively. The meaning of the estimated parameter is of interest to this empirical investigation, it indicates that γ_1 measures changes in dependent variable due to a one-unit increase in x_{t1} when holding other independent variables fixed (Wooldridge, 2009). Similar to what has been discussed about Equation 6-1, the value ε_t is the error term of Equation 6-2, and assumption were made about error term ε_t:

(1) The error term has zero conditional mean;

(2) The error term is uncorrelated with any explanatory variables in any time period;

(3) The covariance between the error term and the independent variables is required to be zero.

Mathematically, these assumptions are expressed as below:

$$E(\varepsilon_t) = 0 \qquad \text{6-7}$$

$$\mathrm{E}(\varepsilon_t \mid x_{t1}, x_{t2}, ..., x_{tk}) = \varepsilon_t \qquad \text{6-8}$$

$$\mathrm{E}(\varepsilon_t \mid x_{t1}, x_{t2}, ..., x_{tk}) = 0 \qquad \text{6-9}$$

$$E(\varepsilon_t) = 0$$
$$Cov(x_{t1}, x_{t2}, ..., x_{tk}) = 0 \qquad \text{6-10}$$

Theoretically, in any multiple regression, the key assumption is that OLS is unbiased. However, there might be some situations that violate this assumption, deriving biased estimators when one of the key variables has been omitted from the equation. The following subsection discusses the process by which the biased OLS is derived, and also discusses which method can be employed to resolve these issues and to obtain unbiased estimators.

6.3.2 Estimation Techniques: Two-Stage Least Squares

As discussed in Chapter 4, under the classical linear model assumptions, the OLS estimator is the best linear unbiased estimator (BLUE), conditional on X_t; it requires that the multiple linear model should be linear in parameters, no perfect collinearity, zero conditional mean, homoscedasticity, no serial correlation and normality (Wooldridge, 2009, pp.47-58). Considering the type of data used in the aggregate level model, the assumption of random sampling is relaxed in the time series analysis. This is because the economic data satisfies the requirements for random variables, since the outcomes are not foreknown (Wooldridge, 2009). Theoretically, the reasons for endogeneity issues are omitted variables, measurement error, and simultaneity between some regressors (Wooldridge, 2009). In a time series analysis, this requires not only that μ_t and X_t are uncorrelated, but that μ_t is also uncorrelated with past and future values of X_t (Wooldridge, 2009, p.348). This follows the assumption of strict exogeneity, and unbiasedness OLS (Wooldridge, 2009). However, in some cases, that which is unobservable at time t might correlate with an explanatory variable in any time period, resulting in the failure of the assumption of a strictly exogenous assumption. Consequently, this leads to issues of endogeneity, thus resulting in biased OLS estimators (Wooldridge, 2009).

In relation to the model presented in this chapter, it is noted that:

House Price Equation	$Y_{1t} = \beta_0 + \beta_t X_t + \mu_t$
Housing Affordability Equation	$Y_{2t} = \gamma_0 + \gamma_t X_t + \varepsilon_t$

As discussed, in the house price equation, the error term μ_t is required to be uncorrelated with the past and future values of X_t. Similarly, in the housing affordability equation, the error term ε_t must be uncorrelated with any X_t at all time t. However, resulting from omitting variables and measurement errors, the error term μ_t may be correlated with the explanatory variable in the house price equation, $Cov(X_t, \mu_t) \neq 0$. Similarly, the error term ε_t may be correlated with at least one explanatory variable in the housing affordability equation, $Cov(X_t, \varepsilon_t) \neq 0$. Consequently, at least one explanatory variable in the equation, for example x_{tk}, is assumed to be an endogenous variable (Stock and Watson, 2015). As a result, this

violates the **zero condition mean assumption**, leading to a biased OLS estimator. This is because some effects involved in the error term would be attributed to the regressor. As a result, the OLS estimation is not being applied to this thesis.

Alternatively, the 2SLS approach is employed to resolve the endogeneity issue and obtain the consistent and unbiased estimator. When employing the 2SLS approach, observable variables $Z_t = z_{t1}, z_{t2}, \dots, z_{ti}; \ i \neq 0$) are required for the suspected endogenous variables, satisfying the following conditions:

1) **Instrument relevance condition:** Z_t are correlated with the endogenous variables (Stock and Watson, 2015, p.426)

$$Cov(Z_t, x_{tk}) \neq 0$$

6-11

2) **Instrument exogeneity condition:** Z_t are uncorrelated with the error terms (Stock and Watson, 2015, p.426)

$$Cov(Z_t, \mu_t) = 0$$
$$Cov(Z_t, \varepsilon_t) = 0$$

6-12

Equation 6-11 requires that Z_t correlates with the suspected endogenous variable x_{tk}. If condition (1) holds, indicating that instruments are relevant, thus 'variation in the instruments is related to variation in x_{tk}' (Stock and Watson, 2015, p.426). Equation 6-12 assumes that Z_t is exogenous. If condition (2) holds, then the variation of x_{tk} explained by the instruments is exogenous. More importantly, if conditions (1) and (2) (see Equations 6-12 and 6-11) hold, then Z_t would be regarded as the instrumental variables for the suspected endogenous variable x_{tk}, where $Z_t = (z_{t1}, z_{t2}, \dots, z_{ti})$. In addition, one of the most important assumptions made is that there is no perfect collinearity among the exogenous variables.

In this thesis, the 2SLS approach is applied to estimate both the house price equation and the housing affordability equation. The instrumental variables Z_t are used to replace the suspected endogenous variables x_{tk} in the equations. If the instruments satisfy the condition of instrument relevance and the condition of instrument exogeneity (see Equations 6-11 and 6-12), the estimated coefficients can be obtained by using technique two-stage least squares

(2SLS) (Stock and Watson, 2015, p.426). As the name suggests, a regression between x_{tk} and $\mathbf{Z_t}$ is generated as a first stage regression to obtain the fitted values by using OLS estimation (Wooldridge, 2009). In the second stage, the fitted value from the first stage regression is employed to replace the suspected endogenous variables, obtaining the estimated parameters of interest using OLS estimation. When employing the 2SLS, the procedures are expressed mathematically as follows. A linear population model is given as an example, in order to clarify each step of the 2SLS (see Equation 6-13):

$$Y = X\boldsymbol{\beta} + \boldsymbol{\mu}$$ 6-13

$Where, X = 1, x_{t1}, x_{t2}, \dots, x_{tk}, absorbs\ the\ constant$

$\boldsymbol{\beta} = estimated\ parameters$

$\boldsymbol{\mu} = error\ term$

In Equation 6-13, it is assumed that $E(\mu) = 0$, and $Cov(x_{t1}, x_{t2}, \dots, x_{tk-1}, \mu) = 0$, whereas $x_{t1}, x_{t2}, \dots, x_{tk-1}$ are exogeneous. The variable x_{tk} is assumed to be endogenous due to measurement errors and omitted variables, thus $Cov(x_{tk}, \mu) \neq 0$. Linked to Equations 6-12 and 6-11, the procedures of the 2SLS are illustrated step by step:

$First\ Stage\ regression:$ 6-14

$x_{tk} = \alpha_0 + \alpha_1 x_{t1} + \alpha_2 x_{t2} + \dots + \alpha_{k-1} x_{tk-1} + \theta_t \mathbf{Z_t} + v_t$

$Where,$

$\theta_t,\ \alpha_{t1}, \dots, \alpha_{tk-1} = estimated\ parameters$

$v_t = error\ term$

$\mathbf{Z_t}$ are a set of i instrumental variables $= (z_{t1}, z_{t2}, \dots, z_{ti}).$

$Requiring,$

$E(v_t) = 0;$

$Cov(x_{t1,} x_{t2}, \dots x_{tk-1}, v_t) = 0$

$Cov(\mathbf{Z_t}, v_t) = 0;$

$Cov(\mathbf{Z_t}, x_{tk}) \neq 0;\ \theta_t \neq 0$

$Second\ Stage\ regression:$ 6-15

$Y = \beta_0 + \beta_1 x_{t1} + \beta_2 x_{t2} + \dots + \beta_{k-1} x_{tk-1} + \delta_t \mathbf{Z_t} + \tau_t$

$Where,$

$\tau_t = \mu + \beta_k v_t = error\ term\ of\ the\ reduced\ form$

$\delta_t = \beta_k \theta_t$

Equation 6-14 is the first stage regression for the 2SLS regression, expressing the linear projection of x_{tk} onto all exogenous variables. Equation 6-14 is the reduced form equation for x_{tk}, relating endogenous variable x_{tk} to all the observable exogenous variables, including the regress of interest $x_{t1}, x_{t2}, \dots, x_{tk-1}$ and the instruments $\boldsymbol{Z_t}$. Variables $\boldsymbol{Z_t}$ are required to satisfy the condition of instrument relevance and the condition of instrument exogeneity (see Equations 6-11 and 6-12). In addition, this procedure requires that the error term v_t be uncorrelated with all exogenous variables $Cov(\boldsymbol{Z_t}, v_t) = 0, Cov(x_{t1}, x_{t2}, \dots, x_{tk-1}, v_t = 0)$, and $E(v_t) = 0$. Crucially, $\theta_t \neq 0$ is the key condition of this linear projection, indicating that $\boldsymbol{Z_t}$ is partially correlated with x_{tk} if the effects of other exogenous variables $x_{t1}, x_{t2}, \dots, x_{tk-1}$ have been netted out (Wooldridge, 2002). For example, where x_{tk} is the only explanatory variable in a model, condition $Cov(\boldsymbol{Z_t}, x_{tk}) \neq 0$ and condition $\theta_t \neq 0$ are identical (Wooldridge, 2002, p.84).

Equation 6-15 is the second stage regression of the 2SLS regression, representing a reduced form of Y by plugging Equation 6-14 into Equation 6-13. The 2SLS estimator $\widehat{\boldsymbol{\beta}}_{2sls}$[3] is given by Wooldridge (2002, p.86):

$$\widehat{\boldsymbol{\beta}}_{2sls} = (\boldsymbol{Z'X})^{-1}\boldsymbol{Z'Y} \qquad \qquad 6\text{-}16$$

Where,

$\boldsymbol{Z}$ and $\boldsymbol{X} = N \times K$ data matrices,

$\boldsymbol{Y} =$ the $N \times 1$ data vector on the Y_t

6.3.3 Identification of the Instrumental Variables

The 2SLS approach requires to find an appropriate number of instrumental variables according to the following rules: (1) instruments are usually selected according to the data availability; and (2) explanatory variables can be used as valid instrumental variables (Wooldridge, 2009). In addition, it is important to check the identification of instrumental variables when it comes to conducting an empirical estimation. This section discusses

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[3] This applies to the case of just-identified, where the number of instruments is equal to that of explanatory variables.

identification of the instrumental variables, illustrating the theoretical rules applied to the identification.

In order to clarify the process of instrumental identification on a theoretical basis, a population model is employed as an example (see Equation 6-13). $\boldsymbol{X}$ is a $1 \times K$ vector and generally involves unity, assuming $\boldsymbol{Z_t}$ is a $1 \times I$ vector. The conditions applied to identification of the instrumental variables are specified as follows:

1) $E(\boldsymbol{Z_t} \mid \mu) = 0$

   The instrumental variable $\boldsymbol{Z_t}$ has no correlation with the error term (Stock and Watson, 2015).

2) $Cov(\boldsymbol{Z_t}, x_{tk}) \neq 0$

   The instrumental variables correlate with the endogenous variable; such that, the stronger the correlation between the $\boldsymbol{Z_t}$ and x_{tk}, the stronger the identification of the model will be (Stock and Watson, 2015).

3) a. rank $E(\boldsymbol{Z_t}'\boldsymbol{Z_t}) = I$; b. rank $E(\boldsymbol{Z_t}'\boldsymbol{X}) = K$ (rank condition)

   The rank condition is important for identification, indicating that instrumental variable $\boldsymbol{Z_t}$ must be sufficiently linearly related to x (Wooldridge, 2002, p.93). In addition, the rank condition holds if and only if $\theta_t \neq 0$ (see equation 6-14).

4) $I \geq K$ (order condition)

   The order condition is necessary for the rank condition, and is also the crucial condition for identification. This requires that the number of instrumental variables are at least equal to the number of explanatory variables $I \geq K$; otherwise an identification issue would arise, leaving $\widehat{\boldsymbol{\beta}}_{2sls}$ being unidentified (Wooldridge, 2002; Stock and Watson, 2015).

Besides, there are three cases of identification relative to the number of instrumental variables and explanatory variables (Stock and Watson, 2015):

1) When $I = K$, the number of instrumental variables equals the regressor, and it is said to be just-identified; therefore $\widehat{\boldsymbol{\beta}}_{2sls} = (Z'X)^{-1}Z'Y$ (Cameron and Trivedi, 2010, p.174)

2) When $I > K$, the number of instrumental variables is greater than the number of explanatory variables and is said to be over-identified, the 2SLS estimators are (Cameron and Trivedi, 2010, p.174):

$$\widehat{\boldsymbol{\beta}}_{2sls} = \{X'Z(Z'Z)^{-1}Z'X\}^{-1} X'Z(Z'Z)^{-1}Z'Y$$

3) When $I < K$, the number of instrumental variables is less than the number of explanatory variables, thus is said to be non-identified or under-identified. As a result, the estimator $\widehat{\boldsymbol{\beta}}_{2sls}$ is inconsistent.

Under-identification exists commonly in practice, due to the availability of appropriate instrumental variables. As a result of the existence of Cases 2 and 3, it is necessary to check instrument validity, as will be discussed in the next section.

6.3.4 Checking Validity of Instruments

As discussed previously, for instruments to be valid, they have to satisfy two conditions: the instrument relevance condition and the instrument exogeneity condition (Stock and Watson, 2015, p. 426). When employing instrumental variables in an empirical investigation, it is crucial to test the validity of the instrumental variables, because if the instrumental variables are not effective, then the estimator will be inconsistent, potentially delivering meaningless results. This section discusses how to check for instrument validity, and explains the weak instrument test, the under-identification test and the over-identification test; it also interprets how these tests can be performed on a statistical package.

Firstly, it is necessary to test for weak instruments. Theoretically, the correlation between Z_t and x_{tk} examines the strength of the instruments (Stock and Watson, 2015). The stronger the correlation, the more powerful the instruments. In a large sample size, the stronger the correlation between Z_t and x_{tk}, the better the normal approximation; therefore, the more precious estimator can be obtained (Stock and Watson, 2015, p.443). In situations where instruments have less correlations with x_{tk}, this results in weak instruments, leading to issues

of nonnormality,[4] badly biased estimators,[5] and poor confidence intervals (Stock and Yogo, 2005; Stock and Watson, 2015). Therefore, it is essential to employ a weak instrument test on estimations.

An approach has been widely suggested for checking weak instruments in principle, stating that if the value of the first-stage F-statistic is greater than 10, then the instruments will be valid (Stock and Watson, 2015; Wooldridge, 2009;). Alternatively, if a first-stage F-statistic is less than 10, this indicates that the instruments are weak, implying that the 2SLS estimator is biased, and the 2SLS t-statistics and confidence intervals are unreliable (Stock and Watson, 2015, p.444). When applying for the weak instruments test in a statistical package Stata, Stock and Yogo (2005) adopted Cragg and Donald's (1993) minimum eigenvalue statistic (Cragg-Donald Wald F statistic) as a principle for weak instruments. In a case, if only one endogenous variable in the model, then the minimum eigenvalue statistic equals the first-stage F-statistic. The null hypothesis for the weak instrument test proposed by Stock and Yogo (2005) is H0: instruments are weak. The statistical package Stata 14.0 was used to conduct the weak instrument test. According to the results reported by the Stata, the Cragg-Donald Wald F statistic is used to compare with one of the critical values: either the largest relative bias of the 2SLS estimator that the researcher is willing to tolerate or the largest rejection rate for a nominal 5% Wald test that the researcher is willing to tolerate. If the Cragg-Donald Wald F statistic (minimum eigenvalue statistic) exceeds the critical value, then it is possible to reject the null hypothesis; and conclude that the instruments are valid (Stock and Yogo, 2005; Cameron and Trivedi, 2010; Pflueger et al., 2015). In this thesis, the 10% 2SLS relative bias is employed as the critical value.

Secondly, it is important to test the under-identification test. As discussed in Section 6.3.3, an important assumption when employing the 2SLS approach is that instrumental variables are correlated with endogenous variables $Cov(\mathbf{Z_t}, x_{tk}) \neq 0$. In addition, another condition of employing instruments is rank condition holds, specifically: (a) rank $E(\mathbf{Z_t}'\mathbf{X}) = K$ (full column rank), and (b) $I \geq K$ (order condition). Therefore, the rank condition is employed to

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[4] The normal distribution provides a poor approximation (Stock and Watson, 2007, p.443)

[5] The estimator is biased towards the OLS estimator (Stock and Watson, 2007, p.443)

conduct the under-identification test, with a null hypothesis of H0: rank $E(\mathbf{Z_t'X}) = K - 1$; and the alternative hypothesis is H1: rank $E(\mathbf{Z_t'X}) = K$. If the rank condition holds, it explicitly indicates that instrumental variable $\mathbf{Z_t}$ is sufficiently linearly related to endogenous variable x_{tk} (Wooldridge, 2002). If rank condition fails, it would lead to the failure of rejecting the null hypothesis; thus implying that the instruments are meaningless.

The third test is the over-identification test. In addition to the condition of instruments relevance, the instrumental $\mathbf{Z_t}$ is also required to satisfy the instruments exogeneity condition (uncorrelated with error term). If $\mathbf{Z_t}$ are not exogenous, this produces inconsistent 2SLS estimators because $\mathbf{Z_t}$ cannot capture the variation in x_{tk} (Stock and Watson, 2015). An over-identification test cannot be undertaken on a just-identified model. It can be conducted if $I > K$ holds. When $I > K$ holds, it means that the number of additional instruments exceeds the number of endogenous variables; thus, it is necessary to test whether the additional instruments are exogeneous (uncorrelated with the error term) under the maintained assumption that the valid instruments are sufficient to identify the model (Stock and Watson, 2015, p.445). This null hypothesis is: H0: all instrumental variables are exogenous, and it is expected that it will be possible to accept the null hypothesis. Under the null hypothesis, the Hansen's J-statistic that has a chi-squared distribution with $i - \mathrm{k}$ degrees of freedom (χ^2_{i-k}) is employed (Stock and Watson, 2015), where the $i - \mathrm{k}$ degrees of freedom of the χ^2 distribution refers to the number of over-identifications (the number of redundant instruments) (Stock and Watson, 2015). In this thesis, the heteroskedasticity-robust standard errors were requested when performing the 2SLS technique in the Stata, the package reported a Wooldridge's robust score for the over-identifying test instead of the Hansen's J-statistic.

6.4   Empirical Specification

The model specification and variable interpretations correspond with the theoretical discussions in Chapters 2 and 3. The model specification helps to clarify the variables involved in the model, assisting in testing the hypotheses. Variable interpretations contribute to expanding the understanding of empirical results, and explain the effects of each variable.

The aggregate level model comprises two equations: the house price equation and housing affordability equation, which are specified below:

House Price Equation

$$House\ price =$$ 6-17

$$f \left\{ \begin{array}{l} Housing\ Investment\ Volumes, Floor\ Space\ Completed\ for\ Sale, \\ Average\ Marriage\ Rate, Number\ of\ people\ in\ Urban\ Employment, GDP \end{array} \right\}$$

Equation 6-17 provides the empirical specifications for the house price equation, in accordance with theoretical variables discussed in Chapter 3. In this equation, house price is written as a function of housing investment, floor space completed for sale, marriage rate, the number of people urban employment, and GDP.

Housing Affordability Equation

$$House\ Price\ to\ Income\ Ratio =$$ 6-18

$$f \left\{ \begin{array}{l} M2\ Supply, Number\ of\ Urban\ Employment, \\ Household\ Savings, Marriage\ Rate, LTV, \\ Housing\ Investment\ Volumes, HPFs\ Borrowing\ Rate_{long-term} \end{array} \right\}$$

Equation 6-18 represents the empirical specification for the housing affordability equation; comprising the theoretical discussions set out in Chapters 2 and 3. In addition, the measurement of the dependent variable was specified in Chapter 5, as the proxy for housing affordability at the aggregate level. According to Equation 6-18, housing affordability is a function of M2 supply, the number of people in urban employment, net increase in national household savings, marriage rate, LTV ratio, housing investment, and the long-term HPF borrowing rate.

The interpretations of theoretical variables are based on the discussions presented in Chapters 2 and 3 in order to address the research questions and hypotheses. First, Number of People in Urban Employment and Marriage Rate are identified as macroeconomic factors and demographic information, which serve as proxies for factors impacting housing demand. The marriage rate is expected to have a positive impact on house price (Li and Chand, 2013), because it has been evidenced that being married has a positive impact on demand for owner-

occupied housing in accordance with lifecycle theory (Deng et al., 2016). In addition, in relation to the lifecycle theory, the impending marriage-dominated housing demand is a recognised factor in Chinese culture,[6] and it has been proven to have a significant impact on both housing demand and house prices (Li and Chand, 2013). Second, population shift, in particular, urbanisation, encourages urban development and raises housing demand (Glaeser et al., 2005). The growth of urbanisation leads to an increase in jobs and career prospects, bringing about a growing trend towards entering the housing market and, subsequently raising the demand for housing (Goodman and Kawai, 1982; Feinstein and McFadden, 1989; Chen et al., 2011). Next, employment is treated as a proxy for economic development and income level. The growth of urban employment causes incomes to rise, thus increasing consumers' confidence in their financial capacity and their demand for housing (Deng et al., 2005; Ding and Zhao, 2011). Thus, in this thesis, the number of people in urban employment is expected to have a negative impact on the housing affordability ratio.

LTV is a key variable that indicates liquidity constraints in home purchasing, requiring home-buyers to pay a stated proportion of the total house price as a deposit. This is linked to the definition of repayment affordability and purchase affordability (Gan and Hill, 2009). In addition, according to life cycle theory, liquidity constraints have a strong relationship with the age path, measuring the wealth position of households. LTV is expected to have a positive impact on the housing affordability ratio, because the increased mortgage payment would lead to a problem of mortgage affordability if income growth remains unchanged or mortgagors suffering a job transformation from employment to unemployment (Deng et al., 2005).

Floor Space Completed for Sale and Housing Investment Volumes are supply side factors. Floor space completion is a proxy for new-build housing supply; whereas, housing investment volumes refers to gross investment volumes devoted to residential housing. The theory of supply and demand states that when housing demand remains constant, an increase in housing supply results in falling house prices. Therefore, these two factors are expected to

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[6] This is described as the 'mother-in-law effect on housing prices' in Li and Chand (2013).

have a negative impact on house prices; furthermore, both variables are expected to be negatively correlated with the housing affordability ratio when household income remained constant.

Changes in the macroeconomic environment, such as GDP growth, directly impact house price, since this dominates the development of the economy. Evidence shows a positive relationship between GDP and house price appreciation (Whitehead and Williams, 2011). Meanwhile, Money Supply is a crucial factor linking the housing market and the housing finance market, comprising housing demand, credit conditions, liquidity, and house prices (Taltavul and White, 2016). More specifically, money supply has been evidenced to have a positive correlation with the housing market (Greiber and Setzer, 2007). Money supply fuelled the housing demand by increasing the availability of mortgage debts, resulting in house price increases (Bernanke, 2010). Zhang et al. (2012) stated that since the success of the national housing reform in 1998 in China, the housing market functions as an important real capital market that essentially connects monetary growth and house price appreciation. A number of empirical studies have consistently shown that monetary expansion in China propelled house price growth in recent years (Zhang et al., 2012; Zhang et al., 2012). [7] In this model, the M2 Supply proxy for monetary supply, aiming to capture a positive impact from M2 Supply on housing affordability. Net Increase in National Household Savings is a significant factor related to a family's wealth power and liquidity. In this model, the objective was to examine whether household savings contribute to housing affordability and, if so, how this influences the housing affordability ratio.

In relation to the effects of housing policy, the aim was to explore whether housing policy functions to enhance the affordability of housing purchase at the national level. The majority of existing studies on HPF focus on efficiency and the impact on the likelihood of achieving homeownership, rather than on housing affordability. For the first time, the effect of housing policy on housing affordability was examined by incorporating data on Long-Term HPF Borrowing Rate. As discussed in Chapters 2 and 3, during the implementation of housing

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[7] (Zhang, An, and Yu, 2012; Zhang, Hua, and Zhao, 2012)

reform, the HPF became a tool of financing housing purchases by housing debt at a lower interest rate (Wang and Murie, 1996; Burrell, 2006; Barth et al., 2012). HPF is a dedicated housing policy for the demand side, aimed at mitigating housing difficulties through granting a low-rate debt for HPF holders. It was also designed to enhance the affordability of housing purchase and creates opportunities for households to enter the owner-occupied market. Accordingly, we expect to have a negative sign from the HPF long term borrowing rate on housing affordability ratio.

6.5 Descriptive Statistics and Data Explanations

As detailed in Sections 6.3 and 6.4, empirical investigation of the aggregate level model comprises two equations, employing the 2SLS approach to obtain the consistent estimator. This section presents the descriptive statistics for the empirical variables involved in the aggregate level model, presenting a clear understanding of the data sample, and delivering a supplementary understanding to interpret the empirical findings. Table 6-1 below presents the values for mean, standard deviation, minimum and maximum of each explanatory variable, and the corresponded measurement.

Table 6-1 Descriptive Statistics of Main Variables: 2000: Q1 ---- 2015: Q1 (unit: Chinese yuan[8])

Variable	Measurement	Mean	Std. Dev.	Min	Max
House Price to Income Multiple	Multiple	11.64	1.48	8.22	14.02
GDP	Trillion yuan	7.81	4.61	2.12	17.87
Average GDP Growth Rate	%	9.86	1.97	6.4	14.4
House Price	10 Thousand yuan	34.20	12.93	17.09	57.11
Total Housing Floor Spaces Completed for Sale	100 Million m^2	1.24	0.99	0.11	3.84
Housing Investment Volumes	Trillion yuan	0.62	0.54	0.04	1.82
M2 Supply	Trillion yuan	51.94	35.52	12.26	127.53

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[8] The average exchange rate is 1 US dollar = 6.8 yuan (in the first quarter of 2017)

Net Increase in Gross Household Saving	Trillion yuan	0.785	0.877	-0.303	3.743
LTV	%	73.85	4.42	70.0	80.0
The Number of people in Urban Employment	10 million people	31.19	5.25	23.15	40.41
Marriage Rate	%	0.79	0.15	0.61	0.99
Long term HPF Borrowing Rate	%	4.43	0.36	3.87	5.22
Long term Mortgage Borrowing Rate	%	6.41	0.57	5.76	7.83
Inflation Rates (Y-O-Y)	%	2.29	2.21	-1.63	8.03

(Source: CEIC database)

This current thesis employs a ratio approach to obtain the house price to income multiple. As discussed in Chapter 5, the House Price to Income Multiple is obtained on the basis of the measurement of total house price of a 90 m^2 house divided by total household income. In Table 6-1 the maximum house price to income multiple is 14.02 (in 2000 Q1), whereas the minimum value of that multiple is 8.22 (in 2015 Q1). Both values have far exceeded the theoretical affordable limit (see Chapter 1), indicating that housing costs in China are certainly high and that housing affordability issues in China are likely to be stressful for many homebuyers. Chapter 2 illustrated the fact that China has maintained a fast-paced rate of economic growth over time, resulting in an average GDP increase of 7.81 trillion yuan between 2000 Q1 and 2015 Q1. More specifically, the mean value of the year-on-year GDP growth rate is 9.86%, indicating that the national economy in China has been subject to a soaring increase over the years. The maximum GDP growth rate capped at 14.4% in 2007 Q2, while that of minimum was 6.4% in 2009 Q1 due to the influence of the GFC.

As discussed in Chapter 2 with regard to the relationship between macroeconomics and the housing market, it has been evidenced that economic growth stimulates housing consumption and house price appreciation. Accordingly, house price appreciation is associated with the development of the economy (Mueller, 1999). The data shown in Table 6-1 indicates that House Prices have gone through significant variation over the past years, with a minimum value of 17.09 (10,000 yuan) in 2000 Q3, and a maximum value of 57.11 (10,000 yuan) in 2015 Q1, and a mean value of 34.20 (10,000 yuan). Linking this with

discussions in Chapter 2, it becomes apparent that house prices in China have experienced a continuous increase over the years.

Floor Spaces Completed for Sale proxies for the new housing supply on the market. Table 6-1 shows that the mean value of Floor Spaces Completed for Sale was 1.24 hundred million m^2, whilst the maximum value was 3.84 hundred million m^2 in 2012 Q4. Besides, the Housing Investment Volumes refers to the gross amount of investment devoted to the housing market, which can be used as a proxy for the supply of new housing. As shown in Table 6-1, the mean value of housing investment was 0.62 trillion yuan, while the maximum was 1.82 trillion yuan (in 2014 Q2).

Money supply is a crucial factor that links housing demand, credit conditions, liquidity, and house prices (Greiber and Setzer, 2007; Mian and Sufi, 2011). An increase in money supply improves the accessibility to mortgages, thereby stimulating the demand for housing and driving the house prices up (Taltavul and White, 2016). The housing mortgage in China is an emerging sector alongside the establishment of the housing finance market. The Money Supply data shown in Table 6-1 reveals the significant development of the housing finance market along with increased money supply. More specifically, the minimum value of the M2 supply is 12.26 trillion yuan (in 2000 Q1), whereas the maximum value is 127.53 trillion yuan (in 2015 Q1), that is ten times the minimum value (see Table 6-1). Therefore, the M2 supply is expected to have a positive impact on the housing affordability ratio.

By contrast, the household savings as a proxy for the demand side factor is expected to have a negative impact on the housing affordability ratio. This is because the increase in household saving contributes to an increase in family financial capacity, thereby enabling the ability of paying for housing expenditure. According to Table 6-1, the value of the Net Increase in National Household Savings increased significantly between 2000 Q1 and 2015 Q1, presenting a minimum value of -0.303 trillion yuan (in 2014 Q3) and a maximum value of 3.743 trillion yuan (in 2013 Q1).

In relation to what has been discussed in Chapter 3, liquidity constraint has been identified as the main difficulty encountered by a number of younger households, due to the lack of sufficient family wealth and household incomes. Therefore, many younger potential homebuyers are constrained from entering the homeownership market, as manifested in their inability to stratify the down-payment requirement (Gan and Hill, 2009). In relation to government regulation in the mortgage market, adjustments in the LTV ratio are viewed as a measure regulating the housing market and lending conditions in China. Table 6-1 illustrates the maximum and minimum values of the LTV ratio for first-time buyers as at 70% (in 2000 Q1) and 80% (in 2003 Q3) separately, whereas the mean value of the LTV ratio was 73.85%. The descriptive statistics of the LTV ratio indicates that China's central government has established a moderate lending environment, compared with the lending environment of the Netherlands, the UK and the US.

The process of urbanisation is expected to create job opportunities; thus encouraging housing demand to expand into urban areas, accompanied by industrialisation and economic development (Ding and Zhao, 2011; Peng et al., 2011). Over the period depicted, China has maintained an average increase in urbanisation rate of 1.5 per cent per annum (see Chapter 2). Consequently, the number of urban employed individuals is increasing over years. The figure in Table 6-1 shows that the minimum Number of People in Urban Employment was 23.15 (10 million people) in 2000 Q1, and the maximum value was 40.41 (10 million people) in 2015 Q1. This means that the process of urbanisation has increased the level of urban employment, increasing the number of people in urban employment by 17.26 (10 million people) in 15 years.

When the data is linked to lifecycle theory, demographic factors, such as marital status at the household level have significant impact on housing market from the demand side. At the aggregate level, the national Marriage Rate is a demographic factor, which is given as a proxy for housing demand. Table 6-1 presents that the mean value for the marriage rate was 0.79%, a relatively low figure when compared with China's large population base and the gender

imbalance (Zhang et al., 2012). [9] As discussed previously, the marriage-dominant housing demand arising from the effects of the mother-in-law on housing prices (Li and Chand, 2013). Accordingly, an increase in marriage rate generates a continuous increase in housing demand and house prices, thus is expected to have a positive impact on the housing affordability ratio.

Furthermore, the borrowing rate and inflation rate have had a significant influence on the housing market. Table 6-1 shows that the maximum value of the Long-Term Mortgage Borrowing Rate was 7.83% (between 2007Q4 and 2008Q3), and the mean value was 6.41%; whereas the maximum value of the HPF borrowing rate was 5.22% (between 2007 Q4 and 2008 Q3). The HPF borrowing rate is comparatively lower than the mortgage borrowing rate, because HPF is designed as a relatively low housing debt when compared with the housing mortgages (see Chapter 2). As being a housing policy indicator, the HPF is expected to have a negative impact on housing affordability, in order to capture the effectiveness of housing policy in terms of mitigating housing affordability difficulties. The year-on-year inflation rate proved moderate between 2000Q1 and 2015Q1, maintaining an average value of 2.29 %, while the maximum value was 8.03%, resulting from the influences of the GFC.

6.6   Empirical Results

This section interprets the empirical results of two econometric equations: the house price equation and housing affordability equation, in combination with the empirical specifications discussed in the previous sections. The estimation results are presented in Table 6-2 and Table 6-3, comprising estimated coefficients, robust t-statistics, R-squared, first-stage F- statistic, and test statistics for weak instruments and over-identification. In relation to the hypothesis stated in the previous section, a further regression is carried out by splitting the samples in both the house price equation and the housing affordability equation, in order to capture the variations caused by the financial crisis. The results of group-based estimation are presented in Table 6-2 and Table 6-3.

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[9] The data show that the male to female sex ratio in China was 1.05 in 2015 (NBS, 2015).

A robustness check has been performed to examine whether the estimators are robust, by replacing the variable number of people in urban employment with the urbanisation rate. This is based on robustness checks in existing studies (Chang and Wang, 2013; Coulibaly and Li, 2016). The results of the robustness check for the aggregate level model are given in Appendix 2 (Tables 2 and 3). When comparing Table 6-2, Table 6-3 with the tables presented in Appendix 2, the results show that the signs for the core variables remain unchanged, while the parameters for the core variables do not change significantly, indicating that the estimated results are robust. In addition, we also checked the validity of the instruments in the robustness test, the results showing that F-statistic is greater than 10, implying that all instruments are effective. The weak instruments test and over-identification test have been done, confirming the validity of the instruments employed in the robustness check.

Table 6-2 Estimation Result: House Price Equation

Sample	(All)	(Year>=2007)	(Year<2007)
Variables	House Price	House Price	House Price
Estimation Techniques	2SLS	2SLS	2SLS
Housing Investment Volumes	-12.621***	23.440**	-36.255***
	(-2.81)	(1.96)	(-2.48)
Floor Spaces Completed for Sale	-1.669***	4.086***	-2.004***
	(-3.34)	(2.04)	(-4.36)
Number of People in Urban	0.83***	0.758***	-0.074
Employment	(2.70)	(3.14)	(-1.52)
Marriage Rate	10.796***	-0.259	-15.839**
	(2.02)	(-0.02)	(-1.71)
GDP	3.114***	-7.778***	9.273***
	(3.42)	(-2.18)	(3.87)
Constant	-14.536***	-165.258***	26.254***
	(-2.19)	(-3.32)	(2.19)
F-statistic	730.14	50.09	69.68
Observations	61	33	28
R-squared	0.978	0.908	0.954
Weak instruments test H0: instruments are weak	Cragg-Donald Wald F statistic: 11.387 > (9.08[a])		
Over-identification test H0: all instruments are valid	Wooldridge's robust score = 1.769 $p = 0.4130$		
Instruments	GDP; M2 Supply; Long-term Borrowing Rate; Natural Logarithm Inflation; Floor Spaces Completed for sale		

Robust t-statistics in parentheses

*** $p<0.05$, ** $p<0.1$

[a] Critical value at 10% 2SLS relative bias

The empirical results are based on Equation 6-17, demonstrating that house price is influenced by macroeconomic factors, demographic factors, policy factors, and supply side factors, comprising housing investment, floor space completed for sale, number of people in urban employment, marriage rate, and GDP. In order to obtain unbiased and consistent estimators for the house price equation, the 2SLS technique was used and the command of heteroskedasticity-robust standard errors was requested in Stata 14.0. The results show that most results were statistically significant at the 5% level.

Examinations of the validity of the instruments have been performed according to the theoretical considerations discussed in Section 6.3.4. As shown in Table 6-2, the first-stage F-statistic is 730.14, indicating that the instruments are effective. The weak instruments test evidenced that the instruments are not weak because the Cragg-Donald Wald F-statistic of 11.387 exceeds the critical value of 9.08 where at a 10% relative bias. As regards to the over-identification test, Wooldridge's robust score test for over-identifying restrictions was performed in Table 6-2, and the null hypothesis is accepted, implying that the variables are valid, and the model is specified correctly.

The empirical results demonstrate that housing investment has a negative impact on house prices, and that it is statistically significant at the 5% significance level. More specifically, the estimator coefficient shows that an increase in housing investment leading to a house price decrease of 12.621 (10,000 yuan). This is because the housing investment is being used as a proxy for supply side factors (Wigren and Wilhelmsson, 2007), and has been evidenced as a significant factor driving economic growth in China (Ahuja et al., 2010; Chen et al., 2011; and Deng et al., 2011). This finding is consistent with Lan (2014) and Wang and Kang's (2014) findings that total investment in the housing market, especially in the residential housing sector, has a negative impact on house price changes. Similarly, floor space completed for sale negatively influenced house price changes, and is significant at the 5% level (see Table 6-2). This variable is used as a proxy for supply side factors, representing the newly-built housing supply. Correspondingly, as evidenced by Deng et al. (2009), the new-build supply and its lag negatively correlated with house prices in the Chinese housing market. As can be seen in Table 6-2, an increase in floor space completed for sale results in a decrease in house

price of 1.669 (10,000 yuan).

As specified in Chapter 3, the housing market closely relates to the development of the national economy. Income level then increases as the economy grows, further stimulating the demand for housing, triggering house price rises (Wang and Kang, 2014). The aim of the house price equation devised for this thesis is to examine the effect of GDP on house price. The results presented in Table 6-2 illustrate a positive relationship between GDP and house price, demonstrating that an increase in GDP brings about a house price rise of 3.114 (10,000 yuan).

A number of researchers have drawn attention to the impacts of demographic factors on housing demand and levels of homeownership (Zhang and Shunfeng, 2003; Chen et al., 2011; Bourassa et al., 2015). The figures in Table 6-2 shown that the number of people in urban employment and marriage rate positively impact house prices, indicating that an increase in urban employment and marriage rate results in house price rises of 0.83 (10,000 yuan) and 10.796 (10,000 yuan) respectively. Linked to discussions in Chapter 2, the progress of urbanisation along with the 'Hukou' system, has been involved in a policy concern linked to strategies for economic development and industrialisation (Chan, 2010; Peng et al., 2011). Urbanisation creates job opportunities and supports both economic transition and industrialisation, consequently, encouraging a growing trend of housing demand. Accordingly, the parameter of number of people in urban employment is consistent with discussions by Chen et al. (2011) and Wu et al. (2012), emphasising that the impact of urbanisation and the subsequent increases in house prices are positively related. More specifically, Wu et al. (2012) found that, in 2009, one-third of newly-built residential housing were obtained by migrants to urban areas, thus providing evidence that urbanisation brings about a demand for housing.

In this equation, the marriage rate was employed as a demand side factor to investigate its impact on house prices. The empirical results given in Table 6.2 demonstrate that the marriage rate has a positive relationship with house prices, meaning that an increase in marriage rate leads to house price rises of 10.796. The effect of marriage rate on house prices has generated much discussion, focusing on its impact on housing demand and homeownership in relation to lifecycle theory. More specifically, marriage is considered as a

proxy for housing demand, since married couples are more likely to look for a stable living environment. This finding could be linked with studies conducted in the Chinese housing market, evidencing the positive impact of marital status on housing demand, thus leading to a rise in house price (Huang, 2004; Bourassa et al., 2015; Deng et al., 2016).

In order to capture the periodical changes in the house price, regressions were disaggregated, focussing on pre- 2007 and post- 2007 periods. The reason for choosing 2007 as a cut-off year is because that, since 2007, the central government has taken several actions to regulate mortgage borrowing and liquidity constraints for housing purchases, to mitigate the impact of the GFC and limit house price inflation. The aim of disaggregating the regressions, therefore, is to investigate whether the impact of policies on house prices differentiates before and after the GFC. From Table 6-2, when compared with the results of two groups (Year < 2007) and Year >= 2007), it can be seen that the impact of housing investment on house price display significant differences. More specifically, housing investment is found to be positively related to house price after 2007 (see cohort Year >= 2007). The impact is similar to that of floor space completed for sale, while the housing investment and floor space completed for sale remain negatively related to house price before 2007 (see cohort Year < 2007). This is due to the following reasons: (1) since 2007, the housing policy started to assist the housing purchase from the demand side, but it failed to control the house price appreciation from the supply side. The supply of affordable housing was restricted, while the profits that could be made from investing in the housing market were capped for developers; (2) As discussed in Chapter 2, the gap between newly-built houses and sold units is significant and continued to grow following the GFC. This explains the positive effect of housing investment and floor space completed for sale on house price in the group of post-2007, because the demand for housing increased significantly more than the supply; (3) Also, with the process of urbanisation, the housing demand continued to increase. The increase in housing demand exceeded the housing supply, resulting in an increase in house prices. In addition, the central bank loosened the mortgage requirement by adjusting the LTV from 70% to 80% during the financial crisis, reducing the down payment requirements for liquidity constrained homebuyers. Consequently, this stimulated in an increase in house purchases and drove house prices up

Table 6-3 Estimation Result: Housing Affordability Equation

Sample	(All)	(Year >=2007)	(Year <2007)
VARIABLES	House Price to Income Multiple	House Price to Income Multiple	House Price to Income Multiple
Estimation Technique	2SLS	2SLS	2SLS
M2 Supply	0.077***	0.059**	0.274**
	(3.45)	(1.93)	(1.67)
Number of People in Urban	-0.49***	-0.081***	-0.085***
Employment	(-6.89)	(-2.52)	(-2.12)
Net Increase in National Household	-0.779***	-0.335***	-0.220
Savings	(-4.26)	(-3.49)	(-1.05)
Marriage Rate	5.592***	4.808***	-4.827***
	(5.64)	(3.36)	(-3.49)
LTV	0.049***	-0.073***	0.008
	(2.26)	(-2.18)	(0.63)
Housing Investment Volumes	-3.635***	-1.594***	-5.185***
	(-3.95)	(-3.48)	(-2.02)
Long-term HPFs Borrowing Rate	0.147	-0.857***	1.763***
	(0.72)	(-4.20)	(7.16)
Constant	16.952***	41.588***	25.102***
	(12.21)	(4.24)	(2.82)
F-statistic	117.58	163.69	132.34
Observations	61	33	28
R-squared	0.897	0.915	0.945
Weak Instrument Test H0: instruments are weak	Cragg-Donald Wald F statistic = 11.50 > (10.83[b])		
Over-identification test H0: all instruments are valid	Wooldridge's robust score = 7.516 p = 0.1110		
Instruments	Instruments= GDP; LTV; Net Increase in National Household Savings; Housing Investment Volumes; Unemployment Rate; Inflation Rate; Long-Term Borrowing Rate; House Price		

Robust t-statistics in parentheses

*** $p<0.05$, ** $p<0.1$

[b] Critical value at 10% 2SLS relative bias

The empirical results presented in Table 6-3 are based on the econometric specifications of Equation 6-18. In this equation, the housing affordability ratio (house price to income multiple) is influenced by M2 Supply; Number of people in Urban Employment; Net Increase in National Household Savings; Marriage Rate; LTV; Housing Investment Volumes; and Long-term HPFs Borrowing Rate. In order to obtain consistent results, a 2SLS estimation technique combined with a heteroskedasticity-robust standard errors option was employed in STATA 14.0. In addition, an estimation was performed by splitting the sample into pre and post- 2007, in order to capture the periodical changes caused by the GFC.

Table 6-3 shows that six out of the seven variables are statistically significant at the 5% significance level, with the exception of the long-term HPF borrowing rate. Examinations of the validity of instruments were conducted according to the theoretical considerations discussed in Section 6.3.4. As shown in Table 6-3, the first-stage F-statistic is greater than 10, indicating that the instruments are effective (Stock et al., 2002). In addition, the equation passes the endogeneity test; thus, the null hypothesis is accepted, indicating that all variables are exogenous at the 5% level, and confirming the validity of the instruments, and the consistency of estimators. In terms of the weak instruments test for the 2SLS approach, a 10% relative bias will be tolerated. Applying this specification, it can be concluded that the instruments are not weak, because the Cragg-Donald Wald F statistic (minimum eigenvalue statistic) of 11.50 exceeds the critical value of 10.83. For the over-identification test, the Wooldridge's score test for over-identifying restrictions is used. This value is robust to heteroskedasticity, because the equation is estimated by requesting heteroskedasticity-robust standard errors in STATA 14.0. As Table 6-3 shows, the value of Wooldridge's score test is 7.516; therefore, the null hypothesis is accepted, indicating that the instruments are valid, and the equation is specified correctly.

The M2 supply positively relates to housing affordability, showing that an increase in M2 supply leads to an increase in the housing affordability ratio of 0.077. According to Meltzer (1995), the monetary expansion caused by injecting abundant liquidity into the market can trigger a rebalancing of assets, resulting in a trend of rising house prices. M2 supply dominates mortgage costs and borrowing availability on the market and has been evidenced to be

positively related with house price (Iacoviello, 2005; Mishkin, 2007; Muellbauer, 2007), thus, causing the housing affordability ratio to rise. The finding of this equation is consistent with existing empirical results focused on the Chinese housing market, demonstrating an expansionary monetary policy has accelerated the growth of house price since 2009 (Xu and Chen, 2012; Zhang et al., 2012). As a result, housing affordability issues are aggravated, and the housing affordability ratio is driven up.

The Number of People in Urban Employment are considered a proxy for the employment level of urban areas in China and have been found to be negatively correlated with housing affordability ratio. The results show that an increase in urban employment leads to a decrease in housing affordability of 0.49. The negative sign is expected and is consistent with the previous discussions outlined in this thesis. As specified in Chapter 3, improvements in urban employment are associated with the process of urbanisation and the economic development that creates continuously expanding job opportunities and rising income levels in urban areas (Ding and Zhao, 2011; Peng et al., 2011). In addition, as discussed by Deng et al. (2005), the urban employment situation serves as a proxy for the macro economic environment, as well as for consumers' confidence about the economy and their financial capacity. The level of employment is highly related to the payment risk and mitigates default risk, thereby reducing housing affordability difficulties. Household income in China is expected to increase along with increases in urban employment (Ding and Zhao, 2011); therefore, contributing to improve the affordability of buying a house.

The Net Increase in National Household Savings also has a negative impact on the housing affordability ratio and is statistically significant at the 5% level. The results presented in the table show that household savings have a stronger impact than the number of people in urban employment. Linking this result to Gan and Hill's (2009) finding, household savings are seen to be closely connected to housing affordability, especially in terms of purchase affordability and repayment affordability, because household savings dominate the family wealth power and liquidity. In this equation, an increase in household savings negatively impacts the housing affordability ratio, leading to a decrease in the ratio of 0.779.

In our estimation, the Marriage Rate is found have a positive relationship with the housing affordability ratio; an increase in marriage rate leads to an increase in the housing affordability ratio of 5.592 (see Table 6-3). This finding is consistent with the expectations and the results reported in some existing studies. Li and Chand (2013) used impending married rate as evidence, founding that it has a positive impact on house prices. Within the context of lifecycle theory, marriage is viewed as a proxy for housing demand, revealing that increases in the marriage rate drives house price rises (Zhang et al., 2012b), thus causing the affordability ratio to rise. More specifically, Wei and Zhang (2011) and Wei et al. (2012) found that the marriage rate accelerated the growth of the homeownership rate in China. This is because owning a house denotes a tangible wealth power, this boosted the competitiveness of male householders within the marriage market. Wei et al. (2012) found that the 'mother-in-law' effect intensified in response to high levels of gender imbalance in China, with the result that competition for an ideal spouse provided a motive for housing demand (Wei et al., 2012; Zhang et al., 2012). Accordingly, this stimulates house prise to rise, thereby aggravating the problems of housing affordability for more and more liquidity constrained households.

A number of studies consulted when reviewing the literature indicated that the easing of down payment limits contributed to house price rise, and that countries with high house prices are characterised by a relatively high LTV ratio (Goodhart and Hofmann, 2008; Muellbauer and Murphy, 2008; Duca et al., 2010). Similarly, Xu and Chen (2012) and Zhang et al. (2012) stated that any loosening of the mortgage down payment requirements tends to propel house price growth in China. In this current model, we captured the positive impact of LTV on housing affordability, evidencing that an increase in LTV leads to an increase in the housing affordability ratio of 0.049, and the result is statistically significant at the 5% level. Linking this to mortgage costs, the positive effects noted in relation to the LTV suggest that it can be used as a proxy for measuring the borrower's liquidity constraints, as a higher LTV means that home buyers are less liquidity constrained. However, a higher LTV may generate a higher probability of having a default risk for households with sluggish income growth or experienced unemployment; thereby potentially increasing housing affordability difficulties (Deng et al., 2005; Deng and Liu, 2009).

The sign of Housing Investment Volumes is theoretically consistent with that captured by the house price equation, showing that as housing investment has a negative impact on house price; it thereby negatively impacts on the housing affordability ratio. Table 6-3 indicated that housing investment has a negative impact on the housing affordability ratio, showing that an increase in housing investment leads to a decrease of affordability ratio of 3.635; and that this is statistically significant at the 5% level.

One of the aims of this is to investigate whether the housing policy works effectively in helping mitigate the housing affordability difficulties, and if so, how the housing policy factor make effects. The long-term HPF borrowing rate is of interest in this thesis; therefore, this variable was included as a housing policy indicator in the housing affordability equation, in order to capture its influence on housing affordability. As discussed in Chapter 2, the HPF offers a fully implemented legal policy to assist in the management of housing difficulties for individuals (Burell, 2006). From that point onwards, the HPF became a tool for financing housing purchases, by providing access to low-rate housing debt (Wang and Murie, 1996; Barth et al., 2012). However, this variable is not statistically significant in this equation.

In order to capture whether the effects of these variables on housing affordability were influenced by the financial crisis, a further estimation was undertaken by splitting the sample for pre- and post- 2007. The results, as presented in Table 6-3, align with the results of all the samples. More interestingly, when comparing the results of presented in Table 6-3, the sign of the long-term HPF rate changed in the cohort of 'Year >= 2007', showing a good significance. According to this finding, an increase in the long-term HPF borrowing rate contributes to a reduction in the housing affordability ratio by 0.857. However, HPF shows a positive relationship with the housing affordability ratio in the group pre- 2007 (Year < 2007).

Changes in the signs of HPF in two disaggregated groups reveal that, the effectiveness of the HPF has been improved significantly, due to the following reasons: As discussed previously, 2007 is a cut-off year because the central government has taken several actions to regulate mortgage borrowing. Meanwhile, the central government has enhanced the implications of the HPF by following actions, in order to mitigate the housing affordability difficulties: (1) To

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entitle the HPF deposits to assist the social-renting house, helping to buffers the down payment pressures for liquidity constrained households, making a significant contribution to the affordable housing project. (2) To expand the accessibility to the HPF, which enables an increasing number of household to access the housing market, thus increasing their ability of purchasing a house by participating in the HPF. As a result, the accessibility of the HPF expanded significantly from 2014 to date. In relation to discussions in Chapter 2, by 2014, 324 cities had set up the HPF Centralised Management Centre, and the number of work units providing HPF had increased to 2.065 million, covering 11.88 million of employees (MOHURD, 2014). Consequently, the HPF performs more effectively since 2007.

6.7   Conclusion

This chapter introduced an econometric model with 2SLS approach estimation, in order to investigate factors impacting housing affordability by employing aggregate level data. The model consists of two equations: the house price equation and the housing affordability equation. Linking the model to the research questions and hypotheses, a number of theoretical factors that would influence house price and housing affordability were involved in the model, comprising housing demand-supply factors such as GDP, housing investment volumes, floor space completed for sale, M2 supply, LTV and number of people in urban employment. In order to examine the effect exerted by housing policy on housing affordability, the effects of the housing policy on housing affordability were further investigated by adding it to the housing affordability equation.

The 2SLS approach was used to obtain the estimator by requesting heteroskedasticity-robust standard error in the statistical package Stata 14.0. The estimators were consistent and unbiased. In addition, the first-stage F-statistic was greater than 10, confirming the validity and efficiency of the number of instruments. The weak instruments test and the over-identification test were conducted with good test statistics, further approving the validity and effectiveness of the instruments.

Based on the empirical findings, it is suggested that house prices in China were significantly influenced by the factors connected to demand and supply side factor. Moreover, money supply and LTV are found to have a positive impact on the housing affordability ratio. Demand side proxies, such as the number of people in urban employment, are negatively correlated with housing affordability. Just as Ding and Zhao (2011) observed, the growth of urban employment leads incomes to rise, and brings about consumer confidence in their financial ability. This reflects the fact that the urbanisation process brings a growth in income, further enabling people's ability to pay for housing purchases.

In order to examine whether the effects of these variables on housing affordability were influenced differentiated by the financial crisis, the data sample was disaggregated into two groups, pre- and post- 2007 for a further investigation. Comparing the results of two disaggregated groups, the effect of the HPF was found to be statistically significant at the 5% level, and negatively correlated with the housing affordability ratio in the group post- 2007 (Year >= 2007). HPF showed a positive relationship with the housing affordability ratio in the group pre- 2007 (Year < 2007). This is of interest in this current thesis, contributing the significant finding that the housing policy is effectively to mitigate housing affordability difficulties, especially since the year of 2007. The HPF is therefore identified as a feasible and effective tool for central government to employ when designing measures to mitigate housing affordability difficulties. As regards to the implications of this result, it is suggested that the HPF be further developed, by making it accessible to any homebuyer who need housing assistance. More specifically, it is essential to encourage all types of employers (working units) to participate in the HPF, thus increasing the accessibility of HPF to disadvantaged households, such as migrants, part-time and low-skilled employees.

This study also investigated the effect of marriage on house prices and housing affordability. The marriage rate was included in the model, and used as a proxy for housing demand. The results shown that marriage rate was positively related to both house prices and housing affordability, demonstrating that increases in the marriage rate propel house price growth, thereby exacerbating housing affordability difficulties. This finding coincided with those reported by Wei and Zhang (2011) and Wei et al. (2012), revealing that the marriage market

accelerated the growth of homeownership rate in China due to marriage competition-dominated housing demand. This in turn led to house price rises, ultimately aggravating the problems of housing affordability for many younger households. In this circumstance, the suggestion is to take measures to close gender gap in the long run, and eliminate the concept of marriage competition-dominated housing demand.

Further research focused on the factors influencing housing affordability and the choice of housing tenure at the household level. The next chapter will present a two-reduced-form simultaneous equations model, examining factors influence housing affordability and tenure choice by the use of household level data. With the considerations of the macroeconomic differentiations and the possibility of an asymmetric response to monetary policy across regions, the regional difference in housing affordability and tenure choice is investigated by including three regions in the model. Interpretations and discussions of the model and the results will be provided in Chapter 7.

Chapter 7   Empirical Investigation Employing Household Level Data

7.1   Introduction

This chapter presents the process of empirical investigation, developing an econometric model that employs household level data. In relation to the research aims, the econometric estimation presented in this chapter was designed to capture intensive information concerning factors influencing housing affordability and the likelihood of choosing homeownership. This current chapter performs the structures of the econometric model at the household level, illustrating its features and potential issues, and presenting the results of an empirical investigation in combination with household level data.

The issue of housing affordability has become a main difficulty that prevents an increasing number of potential homebuyers from achieving homeownership. The Chinese government has issued a number of housing policies as regards to mitigate housing affordability difficulties. The household level model was therefore designed to examine factors impacting housing affordability, and to capture whether housing policy is effectively improving housing affordability. To answer the research questions, an econometric equation was therefore generated, employing the housing expenditure to income ratio as the dependent variable. Theoretically, owner-occupation has been found to maximise a household's utility and can be regarded as a means of protecting a household's investment costs (Arnott, 1987; Linneman and Megbolugbe, 1992), while ensuring improved housing conditions and a higher level of family wealth (Elsinga and Hoekstra, 2005; Iwata and Yamaga, 2008). However, the issues relating to housing affordability have led to questions concerning difficulties in achieving homeownership. Accordingly, an econometric equation was developed to examine factors impacting household's tenure choice of achieving homeownership. The development of the tenure choice equation was examined in combination with the life-cycle theory.

Accordingly, a two reduced form simultaneous equations model was developed in response to these considerations, consisting of: (1) a housing affordability equation; and (2) a tenure

choice equation. The first equation examines factors influencing housing affordability, using the housing expenditure to income ratio employed as the dependent variable; whereas the housing expenditure to income ratio involves figures concerning both renters and homeowners. The second equation investigates factors influencing the likelihood of achieving homeownership, with a binary choice variable employed as the dependent variable in the equation. Considering the regional variations in housing affordability and households' tenure choice that might arise as a result of differences in regional economic development, this research examined whether there are regional differences in housing affordability and tenure choice through the incorporation of three regional dummies in the model. As specified in Chapter 5, the empirical investigation in this chapter employed data from the China Household Finance Survey 2011 (CHFS), including information concerning households' financial and economic capacity, and demographic status. In addition, considering the heterogeneity of households, this current research attaches some macro level information in the dataset.

This chapter is structured as follows: Section 7.2 presents hypotheses based upon the theoretical discussion in Chapter 3. Following this, econometric modelling applied in this chapter is the described, detailing the structure of the simultaneous equations model, the identification of the simultaneous model, and the estimation techniques for each equation in the model. Section 7.4 illustrates the definition and specification of variables employed in the model. Section 7.5 then discusses the limitations of the dataset, detailing the purpose of employing attached macro-economic variables in the dataset. Section 7.6 presents descriptive statistics of the key empirical variables applied in the model, comprising the values of the mean, and standard deviation. Section 7.7 interprets the empirical findings, including a discussion of the contributions of the investigation. Section 7.8 discusses the research findings and contributions, then section 7.9 finalises this chapter by outlining the implications of the research, followed by the conclusion.

7.2 Hypotheses

The research hypotheses proposed in this section are based on the theoretical discussions in Chapter 3, and are aimed at assisting the performance of the empirical investigations, as follows:

Hypothesis 1: It is assumed that a household's housing affordability and tenure choice simultaneously determines each other.

Hypothesis 2: Households' affordability and tenure choice are influenced by demographic factors, liquidity constraint, and the macroeconomic factors.

Hypothesis 3: Housing policy is effectively utilised in helping housing affordability and increasing the rate of homeownership.

This aspect is of interest in this thesis, as it aims to establish whether the HPF housing policy and its corresponding borrowing rate fulfil the targets of mitigating housing affordability difficulties, and encouraging households to achieve homeownership.

Hypothesis 4: It is proposed that regional variations in housing affordability and tenure choices might arise as a result of differences in economic development and the transmission of monetary policy.

This is the focus of this model, which aims to establish the differences in housing affordability and tenure choices found across the different regions.

Hypothesis 5: It is proposed that the effects of factors influencing housing affordability and tenure choices might vary with different social groups.

In order to examine whether the factors effecting housing affordability and tenure choice have different effects in different of social groups, this current chapter

undertakes group-based empirical investigations by introducing four different social groups in the estimation. The disaggregated groups are as follows: age group (households aged under or above 40), location (households located in urban or rural areas), income group (income under or above the annual household income) and education achievement group (households with high level or basic level of education).

7.3 Econometric Modelling

Following the hypothetical statements described in the previous section, this current section presents the framework of the econometric model at the household level. The hypotheses stated above provide a number of viewpoints used in generating the empirical equations concerning household's housing affordability and the tenure choice. The household level model was therefore developed as a SEM, consisting of two reduced form simultaneous equations: the housing affordability equation and the tenure choice equation. Prior to the empirical investigation, it is first necessary to establish a theoretical understanding of the econometric model. Thus, this section outlines the framework of the simultaneous model, states the identification of the simultaneous model, and introduces the appropriate estimation technique of the simultaneous model.

7.3.1 Modelling Framework of the Simultaneous Equations Model

Linking the research questions and hypotheses stated above, this thesis aimed to empirically examine factors influencing household's housing affordability, as well as those influencing the likelihood of a household achieving owner-occupation. This model comprises two reduced form equations: the single equation involves a continuous dependent variable, and the second equation includes a discrete dependent variable. The formal structure of the simultaneous equations model is illustrated as follows:

Housing Affordability Equation:

$$HA = \gamma_1 TC + \beta_0 + \beta_i X_{1i} + \mu_i \qquad\qquad 7\text{-}1$$

Where,

$HA = housing\ expenditures\ to\ income\ ratio$

$\boldsymbol{\beta_i} = \beta_1, \beta_2, \dots, \beta_{k-1}, (k \neq 0)$

$\boldsymbol{X_{1i}} = x_1, x_2, \dots, x_{k-1}, (k \neq 0)$

$\boldsymbol{\mu_i} = error\ term$

And,

Tenure Choice Equation:

$$TC = \gamma_2 HA + \alpha_0 + \alpha_i X_{2i} + \varepsilon_i \qquad\qquad 7\text{-}2$$

Where,

$TC = tenure\ choice$

$\boldsymbol{\alpha_i} = \alpha_1, \alpha_2, \dots, \alpha_k, (k \neq 0;\ \alpha_k \neq 0)$

$\boldsymbol{X_{2i}} = x_1, x_2, \dots, x_k, (k \neq 0)$

$\boldsymbol{\varepsilon_i} = error\ term$

$\gamma_1 \neq \gamma_2 \neq 0$

$\gamma_1 \gamma_2 \neq 1$

In a two-reduced form of SEM, dependent variables from the left-hand side of one equation simultaneously appear as an explanatory variable on the right-hand side of the other equation, requiring strong explanatory power (Maddala, 1983). When these variables show statistical significance in both equations, then simultaneity is empirically validated and evidenced (Wooldridge, 2009; Koblyakova et al., 2014). In this thesis, the dependent variable HA in Equation 7-1 simultaneously appears as an explanatory variable in Equation 7-2. Similarly, the dependent variable TC in equation 7-2 simultaneously appears as an explanatory variable in Equation 7-1.

Data obtained from the China Household Finance Survey (2011) were employed in this simultaneous model, comprising variables of households' economic and finance status, demographic status, tenure choice, housing policy indicators and regional dummies. Given the features of the cross-sectional data, i in the equations indicates variables indexed by each observation. In this model, HA and TC are two endogenous variables, whereas HA denotes the housing expenditure to income ratio (for both homeowners' and renters'), and TC

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denotes a household's tenure choice, indicating whether a household chooses to own or rent. The detailed specifications of each equation are discussed below:

Housing Affordability Equation

As expressed in Equation 7-1, HA is the dependent variable, measured by the housing expenditure to income ratio. X_{1i} is a set of $k - 1$ exogenous explanatory variables expected to have impact on the housing expenditure to income ratio, comprising $X_{1i} = x_1, x_2, \dots, x_{k-1}$ $(k \neq 0)$. The term β_0 is the constant term, while β_i forms a set of estimated parameters, comprising $\beta_1, \beta_2, \dots, \beta_{k-1}$, which characterise the contributions of $x_1, x_2, \dots, x_{k-1}$ respectively. This aspect, which is of key interest for the empirical estimation performed in this equation, measures the effects of X_{1i} on housing expenditure to income ratio, if other variables remain unchanged. The term μ_i is the structural error. From this equation, it can be seen that housing affordability is a function of a number of factors, comprising information concerning households' demographic status, financial and economic capacity, and some housing policy indicators.

Tenure Choice Equation

As seen in Equation 7-2, TC is the dependent variable. X_{2i} forms a set of k exogenous explanatory variables that are expected to have an effect on the possibility of choosing homeownership, comprising $x_1, x_2, \dots, x_k$ $(k \neq 0)$. The term α_0 is the constant term, while α_i is a set of estimated parameters, comprising $\alpha_1, \alpha_2, \dots, \alpha_k$. It is of key interest for the equation, and measures the effects of X_{2i} on the likelihood of achieving homeownership, if other variables hold constant. The term ε_i is the structural error, containing omitted variables that have an impact on the dependent variable.

In relation to the discussions concerning utility maximisation by Zorn (1989), Campbell and Coco (2003) and Davidoff (2006), a household's decision of owning a house maximises the expected utility. Accordingly, Equation 7-2 is modelled as a probit in combination with these considerations. The tenure choice equation therefore is developed as a binary response

equation, with the primary interest being the response probability. The dependent variable TC is designed as a binary choice variable, whereas '1' denotes households that choose to own; alternatively, '0' presents households choose to rent. Accordingly, Equation 7-2 can be expressed as follows:

$$P(Y_{2i} = 1 \mid X_{2i}) = G(\alpha_0 + \alpha_k X_k) \qquad \text{7-3}$$

Where,

$P =$ *the probability that a household chooses to be a homeowner*

$\alpha_k X_{2i} = \alpha_1 x_1 + \alpha_2 x_2 + \cdots + \alpha_k x_k \quad , \ (\alpha_k \neq 0)$

$0 < G(z) < 1, \text{for all } z \in R$

In Equation 7-3, $G(z)$ is a function taking on all values between 0 and 1, thus strictly keeping all estimated response probabilities between 0 and 1 (Wooldridge, 2009, p. 575). Given a non-linear function for $G(z)$, Equation 7-3 can be written as a probit:

$$P(Y_{2i} = 1 \mid X_{2i}) = \Phi\left(\sum \alpha_k X_k\right) \qquad \text{7-4}$$

Where,

$P =$ *the probability that a household choose to be a homeowner*

$X_k = x_1, x_2, \dots, x_k \ (k \neq 0)$

$\alpha_k = \alpha_0, \alpha_1, \dots, \alpha_k \ (k \neq 0)$

Equation 7-4 forms the formal structure of the second equation in this model, while Φ is the cumulative distribution function (cdf) for the standard normal distribution, ensuring that Equation 7-4 is strictly between 0 and 1 for all parameters and explanatory variables (Wooldridge, 2009, p. 576). X_k is a set of explanatory variables, and α_k is a set of key interests in this equation, representing the estimated parameters.

7.3.2   Identification of the Simultaneous Model

As specified in the previous section, a two reduced form of SEM was employed in this thesis, with the aim of examining factors influencing housing affordability and the likelihood of

choosing homeownership at the household level. This model consists of two equations: housing affordability equation (see Equation 7-1) and tenure choice equation (see Equation 7-4). It should be noted that each equation in the simultaneous equations models should have a ceteris paribus interpretation by oneself, in order to ensure the simultaneous equations models being meaningful (Wooldridge, 2009). In relation to this model, the housing affordability equation illustrates that housing affordability is a function of a number of factors, including a household's demographic status, family financial status, borrowing factors and policy indicators. The tenure choice equation shows that the likelihood of achieving homeownership is a function of a household's wealth position, demographic factors, housing expenditure, and housing policy indicators.

As with the discussions about the identifications for the aggregate level model, the simultaneous equation model also needs to be identified in order to consistently estimate the parameters. Linked to Equations 7-1 and 7-2, we have:

$$HA = \gamma_1 TC + \beta_0 + \beta_i X_{1i} + \mu_i \qquad \text{7-5}$$

Where,

$$X_{1i} = x_1, x_2, \dots, x_{k-1}$$
$$\beta_i X_{1i} = \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_{k-1} x_{k-1}$$

$$TC = \gamma_2 HA + \alpha_0 + \alpha_i X_{2i} + \varepsilon_i \qquad \text{7-6}$$

Where,

$$X_{2i} = x_1, x_2, \dots, x_k$$
$$\alpha_i X_{2i} = \alpha_1 x_1 + \alpha_2 x_2 + \dots + \alpha_k x_k$$
$$\gamma_1 \neq \gamma_2 \neq 0, \alpha_k \neq 0$$
$$\gamma_1 \gamma_2 \neq 1$$

The variable X_{1i} forms a set of $k - 1$ exogenous variables in the first equation, whereas X_{2i} is a set of k exogenous variables in the second equation. It can be seen that X_{1i} and X_{2i} involve different exogenous variables, as the exogenous variable x_k fails to appear in the first equation, or the first equation excluding x_k. This led to the imposition of exclusion restrictions on the model (Wooldridge, 2009), helping to identify Equation 7-5. The exclusion restriction implies that, in the system of Equations 7-5 and 7-5, it is the presence of an exogenous

variable in Equation 7-5 that allows Equation 7-5 to be estimated, and it is said that Equation 7-5 is identified. Wooldridge (2009, pp. 554-555) stated that the identification of the simultaneous model is as follows:

1) Rank Condition for the Identification of the Simultaneous Equations Model

If, and only if, the second equation contains at least one exogenous variable, which is excluded from the first equation, and the coefficient of that exogenous variable is nonzero ($\alpha_k \neq 0$), then the first equation in a two reduced form simultaneous equations model will be identified. This indicates that at least one exogenous variable is omitted from the first equation, and being involved in the second equation in the form of reduced equation. Therefore these variables can be used as instrumental variables for the second equation (Wooldridge, 2009, p. 554).

2) Order Condition for the Identification of the Simultaneous Equations Model

*The order condition is necessary for the rank condition. It requires that the equation being checked for identification, should exclude at least one exogenous variable (*Wooldridge, 2009, p. 555*). In order to simplify the order condition, the following assumption is made:*

G = total number of endogenous variables in the model

K = total number of variables (both endogenous and exogenous) excluded in the equation being checked for identification.

Then the order condition is:

If   K = G – 1   the equation is exactly identified
If   K > G – 1   the equation is overidentified
If   K < G – 1   the equation is unidentified

As specified, the order condition forms a necessary but not sufficient condition for the identification, while the rank condition is the necessary and sufficient condition for identifying

the first equation. When applying these considerations to this current model, the first equation (Equation 7-5) excludes the exogenous variable x_k, which satisfies the order condition; x_k is involved in the reduced form of the second equation (Equation 7-6). It is important that, under the assumption of $\gamma_1 \gamma_2 \neq 1$, reduced forms exist for Equations 7-5 and 7-6. Therefore, in this model, Equation 7-5 is identified if and only if the coefficient of x_k is nonzero, i.e. $\alpha_k \neq 0$ (Wooldridge, 2002; 2009).

7.3.3   Estimation Techniques

As specified in Chapter 6, the issue of endogeneity may arise from three types of causes, resulting in the OLS estimator being biased and inconsistent: (1) omitting variables; (2) measurement errors; and (3) simultaneity. In relation to this model, the dependent variable in one equation simultaneously acts as the explanatory variable in a separate equation, leading to the dependent variables being correlated with the structural errors within the model. Linked to Equations 7-5 and 7-6, HA and TC are endogenous variables due to the simultaneity, while X_{1i} and X_{2i} are exogenous variables. Accordingly, OLS cannot be used to estimate Equation 7-5, due to the OLS suffering from simultaneity bias. According to discussions concerning the identification of the simultaneous equations model, the first equation (Equation 7-5) is identified, so the two-stage least squares (2SLS) is employed to obtain the consistent and unbiased estimators. The mechanisms of 2SLS are similar to those described in Chapter 6. The difference is that, because a structural equation is specified for each endogenous variable, it is apparent whether sufficient instruments are available to estimate the identified equation (Wooldridge, 2009, p.552). As specified by Wooldridge (2009), the instrumental variables can be obtained from the set of exogenous variables involved in another equation. In this thesis, when employing 2SLS to estimate Equation 7-5, the instrumental variables consist of the exogenous variables involved in Equation 7-6.

The examinations of the validity of the instrumental variables are specified in the following section. As with the second equation in the model, this is a non-linear regression, because the tenure choice is modelled as a probit (see Equation 7-4). Therefore, the Maximum Likelihood Estimation (MLE) is employed to capture the estimators, which is obtained by interactive

methods, while the estimators of MLE follow an asymptotically normally distribution (Cameron and Trivedi, 2010, p.447).

7.3.3.1 Checking the Validity of Instruments

In order to perform the 2SLS estimation, it is first necessary to obtain the instrumental variables; and to check their validity. In relation to discussions in Chapter 6, checks for the identification and the validity of instruments were undertook in accordance with the following considerations:

Given X is a $1 \times K$ vector, and generally involving unity, and assuming Z_i is a $1 \times I$ vector, the conditions applied to the identification of the instrumental variables are specified as follows (Wooldridge, 2002; 2009):

$$1)\ E(Z_i \mid \mu) = 0;\ Cov(Z_i, x_k) \neq 0$$

$$2)\ \text{a. rank } E(Z_i{}'Z_i) = I;\ \text{b. rank } E(Z_i{}'X) = K \text{ (rank condition)}$$

$$3)\ I \geq K \text{ (order condition)}$$

The first condition requires the instruments to be correlated with the endogenous variables, but uncorrelated with the error term. The rank condition is significant for identification, indicating that the instrumental variables Z_i need to be sufficiently linear to x (Wooldridge, 2002, p.93) (Herein x represents the endogenous variable. In relation to this simultaneous model, the endogenous variable is TC). The order condition is necessary for the rank condition, requiring the number of instrumental variables are at least equal to the number of explanatory variables $I \geq K$; otherwise, the 2SLS estimators would be unidentified (Wooldridge, 2002; Stock and Watson, 2015).

In addition, it is necessary to test the validity of the instrumental variables when employing 2SLS estimation in an empirical investigation. If the instrumental variables are not effective, this results in estimators being inconsistent and biased. Following the discussions in Chapter 6, three tests were employed to check the validity of the instruments.

Firstly, it is essential to perform a weak instrument test on estimations, in order to examine the strength of the instruments by examining the correlation between Z_i and x (Stock and Watson, 2015); the stronger the correlation, the more powerful the instruments. An approach that has been widely suggested in principle for checking weak instruments, states that when the value of the F-statistic in the first stage regression is greater than 10, this implies that the instruments are valid (Stock and Watson, 2015; Wooldridge, 2009). As specified in Chapter 6, when technically applying the weak instrument test in Stata, a minimum eigenvalue statistic (Cragg-Donald Wald F statistic) is employed as a principle for a weak instrument test (Stock and Yogo, 2005). A critical value is then reported, in order to obtain a comparison with the Cragg-Donald Wald F statistic, i.e. if F statistic exceeds the critical value, this implies that the instruments are valid (Stock and Yogo, 2005; Cameron and Trivedi, 2010; Pflueger et al., 2015). The 10% 2SLS relative bias was employed in this current thesis as the critical value for the weak instrument test.

Secondly, it is important to test the under-identification test. The rank condition is related to the identification of the variables, and is employed to conduct the under-identification test. Specifically, rank condition requires $\text{rank } E(\mathbf{Z_i}'\mathbf{X}) = K$ (full column rank), indicating that instrumental variable Z_i must be sufficiently linearly related to x (Wooldridge, 2002, p.93). If the rank condition holds, the instrumental variables are considered valid (Wooldridge, 2002); otherwise, the instruments are considered meaningless.

The third test is the over-identification test, which is performed in association with the condition of $E(Z_i \mid \mu) = 0$. If Z_i is not exogenous, it fails to capture the variations in x, resulting in the estimators being considered pointless (Stock and Watson, 2015). Technically, a Hansen's J-statistic with a chi-squared distribution of $i - k$ degrees of freedom (χ^2_{i-k}) is employed when the over-identification test is performed in Stata (Cameron and Trivedi, 2010; Stock and Watson, 2015). With regards to the discussions in Chapter 6, since the 2SLS estimation was performed by requesting heteroskedasticity-robust standard errors, the critical value employed for overidentifying test in this thesis is a Wooldridge's robust score.

As previously discussed, there are a number of difficulties in interpreting the estimators of probit regression. As a result, Average Marginal Effect (AME) is employed to explain the estimated results for the probit equation. Mathematically, the marginal effect is given through the use of the finite-difference method, as follows:

$$Marginal\ Effect = \frac{\Delta y}{\Delta x} \qquad\qquad 7\text{-}7$$

Equation 7-7 implies that the changes in Y are caused by a one-unit change in x_i (Cameron and Trivedi, 2010, p.335). In this thesis, Stata was employed to compute the average marginal effects for the estimators, measuring the average of the marginal effect at each $x_i = x_j$ (Cameron and Trivedi, 2010, p.334).

7.4 Model Specifications and Variables Interpretations

This section illustrates the model specifications and the interpretations of variables, in association with the theoretical discussions described in Chapter 3, along with the hypothetical considerations specified in the previous sections. Model specification is based on the discussions concerning the framework of the econometric model, and contributes to the understanding of the model and the specification of the meaning of the variables involved in the equations. This section theoretically interprets the variables employed in the model, expanding the understanding of the variables, and thus contributing knowledge to test the hypotheses and establish the empirical results. As noted previously, the household level model forms a simultaneous equations model, consisting of two reduced form equations, as specified below:

$$Housing\ Affordability\ Equation$$
$$Housing\ Affordability\ Ratio = \qquad\qquad 7\text{-}8$$
$$f\{Tenure\ Choice, Employed, Married, Urbanization\ Rate, House\ Price,$$
$$Housing\ Policy\ Indicators, Regional\ Dummies\}$$

Tenure Choice Equation

$$Tenure\ Choie =$$ 7-9
$$f\{Housing\ Affordability\ Ratio, Household\ Size, Employed, Married,$$
$$LTV, Inflation, Housing\ Policy\ Indicators, Regional\ Dummies\}$$

This forms a simultaneous model, in which the dependent variable in the first equation is simultaneously performed as an explanatory variable in the second equation. Consequently, as Equations 7-8 and 7-9 displayed, there is a simultaneity relationship in the model between housing affordability ratio and tenure choice. Based on the theoretical discussions reviewed in Chapter 3, Equation 7-8 represents the empirical specification for the housing affordability equation, stating that the housing affordability ratio is a function of a household's tenure choice, demographic factors, urbanisation rate, house price, housing policy indicators, and the regional dummies. As specified in Chapter 5, the dependent variable housing affordability ratio is measured in terms of the housing expenditure to income ratio. Equation 7-9 outlines the empirical specification for the tenure choice equation, and follows the previously outlined theoretical discussions and hypothetical considerations. In Equation 7-9, tenure choice is a binary choice variable in which '1' represents households choosing owner-occupation and '0' denotes households choosing to rent. The development of the tenure choice equation is based on utility theory, stating that owner-occupation maximises households' family wealth and improves their living conditions (Campbell and Coco, 2003; Davidoff, 2006). It is stated that the likelihood of choosing to own is a function of the housing affordability ratio, household size, demographic factors, LTV, inflation changes, housing policy indicators, and the regional dummies.

The discussions in Chapters 2 and 3 contribute to interpretation of the theoretical variables employed in the model, thus expanding understanding in order to answer the research questions and analyse the empirical findings. As previously evidenced, a household choosing to own, or rent is subject to the affordability of the corresponding housing expenditure (Li and Yi, 2007; Ying et al., 2013), while a household's housing affordability and tenure choice have a simultaneous influence on each other, within a given income level and family wealth.

Demographic factors related to lifecycle theory, such as employment status, marital status and household formation, are important to housing affordability and tenure choice, as they contribute to both household income and demand for housing (Mayer and Engelhardt, 1996; Moore and Skaburskis, 2004; Ying et al., 2013; Chen, 2016). In particular, it has been theoretically evidenced that income levels increase with employment, thus promoting homeownership in China (Li and Yi, 2007), while being married also increases the possibility of having additional income resources and family wealth (Ying et al., 2013). In addition, the likelihood of achieving homeownership tends to be highly correlated with household size and marital status (Chen, 2016). Existing findings (Ying et al., 2013; Chen, 2016) have established that, being married has a positive impact on the likelihood of achieving homeownership. Linking these discussions to this model, Married and Employed were created as dummy variables, with 1 indicating 'being married' and 'being employed'; while 0 indicates 'the others'. In this model, the above two demographic factors were employed as a proxy for income, and were expected to have a negative impact on housing affordability, but have a positive impact on the likelihood of achieving homeownership.

Liquidity constraint is the main effect preventing households (and in particular young households) from becoming homeowners, was defined using two approaches: the down-payment constraint, which requires homebuyers to pay a given proportion of the house price as the deposit; and the income constraint, which refers to the mortgage payment affordability (Linneman et al., 1997; Gan and Hill, 2009). Liquidity constraints refer to the ability of meeting the borrowing requirements, i.e. paying for the down-payment requirement. In this model, the LTV ratio was therefore employed as the indicator to examine the impact of the liquidity constraint on the likelihood of becoming homeowners. The effects of the liquidity constraint on the demand for housing have been specified in a number of studies, which has shown that the liquidity constraint or borrowing restrictions are negatively related to the homeownership (Zorn, 1989). In relation to life cycle theory, potential younger homebuyers are likely to experience constraints when it comes to making down payments, as a result of shortages in housing deposits and discretionary income (Linneman et al., 1997; Guest, 2005). In addition, Mayer and Engelhardt (1996) stated that the amount of down payment rises in line with house prices, or if house price rises rapidly or unexpectedly, it leads to potential homebuyers

postpone entering the homeownership, because they may take longer to save the down payment.

Two housing policy indicators were employed in relation to the research questions, in order to examine whether housing policies are effective at mitigating housing affordability difficulties, as well as facilitating homeownership. As specified in Chapter 2, HPF forms the main housing policy in China, focussing on mitigating housing difficulties by providing low-rates of housing debt. It has been evidenced that housing assistance from HPF has improved the affordability of homeownership for the lower-middle class in China (Ying et al., 2013). In this model, the variable 'having an HPF' and the HPF borrowing rate were employed as housing policy indicators, and were expected to have a negative impact on housing affordability. Alternatively, HPF is expected to have a positive impact on the likelihood of achieving homeownership.

Considering the regional imbalances that result from differences in economic development and the transmission of monetary policies (Ying et al., 2013; Wang and Otsuki, 2015; Chen, 2016), three regional dummies were involved in the model, to examine regional differences in terms of housing affordability and tenure choice. As noted in Chapter 2, Beijing, Shanghai and Guangdong are the three most expensive regions in China; economic conditions and average house prices differ considerably from other regions. In this regard, it was expected that this model would capture significant differences in terms of housing affordability and tenure choice among Beijing, Shanghai and Guangdong. Guangdong was expected to have fewer housing affordability difficulties in comparison with the other two regions, along with a high likelihood of achieving homeownership. This is because housing expenditure in Guangdong is lower than that in Beijing and Shanghai.

7.5   Data Limitations

As discussed in Chapter 5, the data used for this research were organised based on the CHFS 2011 dataset, which forms the representative microeconomic household survey in China. However, using the dataset in an empirical investigation has a number of limitations that may

potentially influence the estimations. Therefore, this current section discusses these data limitations and introduces methods that could be applied to minimise them. Firstly, information about housing policy is crucial to establish the empirical findings and answer the research questions in this thesis. However, the CHFS 2011 dataset does not collect information concerning housing policy, and in particular information concerning the HPF borrowing rate. In order to obtain an intensive and meaningful finding regarding the impact of the HPF borrowing rate on housing affordability and the likelihood of achieving homeownership, the annual HPF borrowing rate issued by the PBOC was attached to the research dataset, corresponding to the year in which each household undertook their borrowing. The research data sample in relation to renters incorporates the attached HPF borrowing rate during the year of the survey. The attached HPF borrowing rate contributes information concerning the activities of the housing policy environment, providing empirical evidence on whether housing policy acts to reduce difficulties relating to housing affordability, and thus promotes homeownership in China.

Secondly, although the CHFS dataset provides data concerning borrowing rates, corresponding to the type of debt created by each household, there are a number of missing values in the variable, resulting from typing errors and the presence of erroneous data. In short, misreporting is a common problem present in most survey data, and sorting out the missing and erroneous data is a time-consuming process.

In addition, the CHFS 2011 dataset fails to capture information concerning housing affordability, in particular data relating to the housing affordability ratio. In order to generate a dependent variable for the housing affordability equation, the housing expenditure to income ratio was therefore computed, in relation to housing expenditure by both homeowners and renters. The methods employed to undertake the variable transformations are specified in Chapter 5.

In addition, with regard to the discussions concerning background to market performance, macroeconomic factors are found to have a key role in a households' demand for housing, as well as the issue of housing affordability (Goodhart and Hofmann, 2008; Deng et al., 2011;

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Yang and Chen, 2014). However, the dataset does not contain information concerning macroeconomic environment and the dynamics of the housing market. Consequently, macroeconomic factors, supply side factors and average house prices related to the discussion in Chapter 2 were attached to the research data sample, following similar principles of attaching data to housing policy variables. The descriptive statistics presented in the following section outline a brief understanding of the empirical variables employed in the model, thus enabling the interpretation of the empirical findings discussed in Section 7.7.

7.6 Descriptive Statistics and Data Explanations

As noted in Chapter 5, this thesis employs household level data obtained from the CHFS (2011) household survey. This is the first survey to collect information concerning the financial and demographic status of households, along with assets and housing expenditure (Gan et al., 2013). The CHFS 2011 is a cross-sectional survey, with the dataset comprised of a household-level dataset of 8438 households; and an individual-level data set of 29438 individuals. In order to associate the data sample with the research objectives, and obtain intensive information concerning housing affordability and tenure choice at the household level, the datasets were merged by attaching the individual dataset to the household dataset. In addition, some of the irrelevant data from the sample were removed (as discussed in Chapter 5), and the research data sample employed in this current thesis includes 675 households. This section primarily interprets the descriptive statistics of the variables employed in the household level model, assisting the understanding and interpretation of the results obtained from the empirical investigations. The table below presents the values of mean and standard deviations, comprising the data sample of all observations and four disaggregation groups.

Table 7-1 Descriptive Statistics of Key Empirical Variables

Variable	All Sample		Age >40		Age <=40		Rural		Urban		Income >= Ave. income		Income < Ave. income		Basic educational Level[1]		High Educational Level[2]	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Housing Expenditure to Income Ratio (%)	26.42	18.19	23.78	17.37	28.31	18.55	26.55	19.17	26.37	17.84	21.21	14.76	28.88	19.13	25.28	18.45	27.04	18.04
Mortgaged Homeowners	0.45	0.50	0.39	0.49	0.48	0.50	0.24	0.43	0.52	0.50	0.64	0.48	0.36	0.48	0.54	0.49	0.27	0.44
Having a Provident Fund	0.33	0.47	0.24	0.43	0.39	0.49	0.07	0.25	0.42	0.49	0.50	0.50	0.24	0.43	0.46	0.50	0.08	0.28
HPF Borrowing Rate (%)	4.37	0.30	4.39	0.29	4.35	0.30	4.36	0.29	4.37	0.30	4.37	0.30	4.37	0.29	4.39	0.31	4.36	0.29
LTV (%)	68.34	12.15	68.22	11.38	68.43	12.68	72.16	8.74	66.98	12.88	67.78	12.61	68.61	11.93	71.19	8.43	66.78	13.52
Employed	0.76	0.43	0.57	0.50	0.89	0.32	0.85	0.36	0.72	0.45	0.88	0.33	0.70	0.46	0.83	0.38	0.62	0.49
Married	0.81	0.40	0.83	0.38	0.79	0.41	0.80	0.40	0.81	0.39	0.88	0.33	0.77	0.42	0.79	0.41	0.83	0.37
Household Size	2.97	1.22	3.05	1.25	2.92	1.20	3.25	1.46	2.87	1.11	3.02	1.17	2.95	1.25	3.27	1.33	2.81	1.13

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[1] Households with A-levels education or below

[2] Households with college education or above

Urbanisation Rate (%)	43.98	6.41	41.14	7.92	46.02	3.98	46.47	3.86	43.10	6.89	44.62	5.04	43.68	6.95	43.00	7.56	44.52	5.62
Inflation Changes year-on-year (%)	3.07	3.85	3.49	5.18	2.76	2.46	3.06	2.30	3.07	4.27	2.94	3.71	3.12	3.92	3.59	4.50	2.78	3.42
House Price (10,000 yuan)	25.28	32.77	20.28	19.33	28.86	39.35	20.22	29.49	27.07	33.71	42.66	51.39	17.04	11.15	15.99	11.24	30.37	39.01

(Source: CHFS 2011)

Table 7-1 presents the descriptive statistics for both the numeric variables and nominal variables, comprising the values of the mean and standard deviations. The average housing expenditure to income ratio is 26.42%, which is within the theoretical threshold limit of no more than 30% (Maclennan et al., 1990; Hulchanski, 1995; Thalmann, 2003). With regard to the descriptive statistics related to the proportion of owner-occupation, the data reveal that 45% of households in the research data sample are mortgaged homeowners. Table 7-1 shows that 33% of households participated in the HPF, revealing that the proportion of participating in the HPF remains very low, in comparison with the proportion of mortgaged homeowners. Married households comprise approximately 81% of the research data sample, and employed households comprise 76%. The average LTV ratio is 68.34%, while the mean value of the HPF borrowing rate is 4.37%, thus indicating that the Chinese government operates a moderate borrowing environment by regulating a restrained borrowing requirement, compared with countries that have high LTV. The mean value of the house price is 25.28 (10,000 yuan), and shows the significant differences in the comparisons of this value between disaggregation groups.

In addition, in relation to the research hypotheses specified in Section 7.2, the variation in terms of housing affordability and tenure choice among different social groups was examined. A number of existing studies have applied similar considerations. Wang and Li (2004), Deng et al. (2005), and Tang and Coulson (2017) investigated variations in homeownership between different age cohort by splitting the data sample for two groups: age under 40 and above 40. In addition, Chen (2016) examined the heterogeneity of tenure choice by focusing on different social groups among the urban population in China. Chen and Yang (2017) captured the likelihood of achieving homeownership by introducing different levels of educational attainment in their model. Accordingly, based on these approaches, this current model examines differences in housing affordability and tenure choice by introducing different social groups, including: (1) Age groups (households aged under or over 40); (2) 'Hukou' location (households have urban or rural 'hukou'); (3) Income groups (income less or greater than the average annual household income); and (4) Education groups, including households with high educational achievement (i.e. college or above) or basic educational achievement (i.e. A levels or below).

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The mean values of the housing expenditure to income ratio reveal that households under the age of 40 have a relatively higher value compared to those aged over 40. Lifecycle theory identifies the reason for this as younger households' lower levels of finance capacities, while those aged over 40 have accumulated sufficient family wealth to afford the housing expenditure. In relation to the differing proportions of married households between age groups, Table 7-1 shows that 83% of households aged above 40 are married, while 79% of household aged under 40 is married.

The average house price for all samples is 25.28 (10,000 yuan). However, there remain considerable differences between the two income groups. The mean value of house prices for the low-income group is 17.04 (10,000 yuan), while the value for high income groups (i.e. income greater than the average household income) is 42.66 (10,000 yuan), 2.5 times higher than that of the low-income group. This reveals a number of the significant differences in terms of housing inequality and housing affordability, i.e. the richer the group, the more expensive the property they owned. Similarly, a comparison of the mean value of house prices between two education levels reveals that the house price of the higher educated households was double the value of the households at the basic educational level. This confirms that improved levels of educational achievement result in a high likelihood of gaining a high level of income, thus helping households to obtain a good standard of living. This has been demonstrated in previous research, which found that the attainment of homeownership is highly correlated with a high level of educational achievement (Chen, 2016).

In the research data sample, the variable 'owner-occupation' refers to mortgaged homeowners, because the majority of housing purchases were financed by mortgages. For the mean value of owner-occupation, Table 7-1 shows that, for households aged under 40, the proportion of mortgaged homeowners is 48%; while for those aged over 40, the proportion is 39%. This comparison, it does not reveal that the homeownership rate among households aged above 40 is low. Conversely, the figure implies that young households need more debt to finance homeownership due to a lack of family wealth. With regards to the lifecycle theory, the level of family wealth and financial capacity increases with age, and therefore older households have lower level of debt compared to younger households.

Moreover, there are a number of significant differences in the proportion of mortgaged homeowners between different income levels, i.e. the proportion of mortgaged homeowners for low-income households (income less than the average household income) is 36%, while at the high-income level (income over average household income) is 64%. This shows that high-income groups have a comparatively high accessibility to the mortgage market.

The proportion of participation in the HPF among different groups is revealed by the descriptive statistics in Table 7-1, which helps to understand the empirical findings. A comparison of the mean values of households participating in the HPF reveals a significant difference between the proportions of younger and older households (households aged under or over 40), showing mean values of 39% (age under 40) and 24% (age over 40) respectively. This reveals that the HPF is more attractive to younger age groups, as they need more financial assistance in achieving homeownership.

There is a clear difference in the proportion of urban and rural households participating in HPF, showing a distinctive difference by 24% and 0.7% respectively. The discussions in Chapter 2 revealed that the implementation of HPF is associated with the 'hukou' system, and therefore households with an urban 'hukou' experience a high rate of accessibility to the HPF scheme. This figure thus provides evidence of the limitations of the HPF, as discussed in Chapter 2, as rural households have limited accessibility to the HPF. In addition to the differences between locations, as shown in Table 7-1, there are a number of distinctive differences between the two income groups in terms of obtaining the HPF. The proportion of low-income groups in possession of the HPF is 24%, as some low-income jobs do not provide access to the HPF. In contrast, the proportion for high income groups is 50%. This figure is in line with the findings of Wang et al. (2000) and Burell (2006), revealing inequalities in terms of accessing the HPF and showing that low-income groups participate less than high-income groups.

The following section interprets the empirical results, answering the research hypotheses specified in Section 7.2, and discussing the differences in terms of the efficiencies of the HPF between different disaggregation groups.

7.7 Empirical Results

This section discusses the empirical results of the simultaneous model, with regard to the housing affordability equation and house price equation. The interpretations of the empirical findings are based on the previous discussions concerning empirical specifications and the interpretation of variables, in order to answer the research questions and provide evidence for the hypotheses. The model is also estimated by introducing four different social groups, in order to test the hypothesis stated in the previous section and to examine whether the factors influencing housing affordability and tenure choice have a different impact in different social groups. In addition, three regional dummies are employed in the equation in order to capture regional variations in terms of housing affordability, offering valuable findings for this equation.

As previously stated, the OLS estimators suffering simultaneous bias in this model, leading to the OLS estimation inconsistent and biased. As a result, the estimation technique 2SLS was employed to estimate the housing affordability equation. The tenure choice equation was modelled as a probit, thus the MLE estimation technique was used to estimate the tenure choice equation, and marginal effects were employed to interpret the impacts of each variable on the likelihood of choosing owner-occupation. All estimation procedures were performed in the statistical package Stata 14.0, requesting heteroskedasticity-robust standard errors for the regression. Empirical results for the housing affordability equation and tenure choice equation are presented in the subsequent sections, including estimated coefficients, robust t-statistic, R-squared, first-stage F-statistic, and marginal effects for the probit equation. The 5% significance level is employed in this current thesis. In addition, the identification checks for the instrumental variables in housing affordability equation were performed, by employing the Cragg-Donald Wald F statistic and Wooldridge's robust score.

A robustness check was carried out to examine whether the estimators were robust, which involved different kind of estimation techniques. This was followed by theoretical theory of Cameron and Trivedi (2010) and the implications of robustness checks in existing studies (Yang et al., 2017). Based on the theoretical discussions of Cameron and Trivedi (2010, p. 199),

a number of alternative estimation techniques might be asymptotically equivalent to 2SLS, but would contain better properties in the finite-sample when compared with that of 2SLS. Accordingly, the LIML estimation technique preceded 2SLS because it generates a smaller bias that that of 2SLS and GMM, and involves some good finite-sample properties, especially when instruments are not as strong (Cameron and Trivedi, 2010). In addition, as the differences between logit and probit has been specified in Chapter 4, the logit technique was used to perform the robustness check for the tenure choice equation. The results of the robustness check for this household level model are shown in Appendix 3 (Tables 3 and 4), by employing the estimation technique of LIML and the GMM for housing the affordability equation, and the logit technique for the tenure choice equation.

The results of robustness check are presented in Appendix 3 (see Appendix 3, Tables 3 and 4). When comparing Table 7-2, 7-3 with the results of the robustness check, it can be seen that the estimators are robust with the signs for the core variables unchanged, and the parameters for the core variables do not show a significant change. In addition, the validity of the instruments was also checked in the robustness test. The result shows that F-statistic is greater than 10, implying all instruments are effective. The weak instruments test and over-identification test were carried out, confirming the validity of the instruments employed in the robustness check.

7.7.1   Empirical Results: based on all samples

This section illustrates the empirical findings for the housing affordability and tenure choice equation. It presents factors influencing housing affordability and the likelihood of achieving homeownership, incorporating data for all research samples at the household level.

Table 7-2: Estimation results of the housing affordability equation: based on all samples

VARIABLES	Coefficients	(t-statistic)
Tenure Choice	12.135***	(4.99)
Employed	-4.213***	(-2.45)
Married	-3.361**	(-1.86)
Having a Provident Fund	-6.293***	(-4.03)
HPF Borrowing Rate	-3.988**	(-1.91)
Urbanisation Rate	0.541***	(5.27)
House Price	0.096***	(4.07)
Beijing	4.364***	(2.04)
Shanghai	4.880***	(2.80)
Guangdong	-0.664	(-0.26)
Constant	19.030**	(1.82)
Observations	675	
F-statistic	17.90	
R-squared	0.174	
Weak instruments test H0: instruments are weak	Cragg-Donald Wald F statistic: 38.900 > (11.460[a])	
Over-identification test H0: all instruments are valid	Wooldridge's robust score = 14.396 p = 0.072	
Instruments	LTV Ratio; Age; Net Increase in National Household Savings; HPF Net Lending Amount; M2 Supply; Housing Investment; The Number of People in Urban Working Population; Logarithms of HPF Borrowing Rate; House Price; Inflation Changes	

Robust t-statistics in parentheses

*** $p<0.05$, ** $p<0.1$

[a] Critical value at 10% 2SLS relative bias

Table 7-2 shows the empirical results based on the Equation 7-8. The dependent variable is calculated as the ratio of housing expenditure to income for the sample households, where housing expenditure incorporates data concerning both mortgaged homeowners and renters. Examinations for the identification and the validity of the instrumental variables were carried out. The F-statistic in the first stage regression is 17.90, indicating that all instruments are effective. The weak instruments test reveals that the instrumental variables are not weak,

because the Cragg-Donald Wald F-statistic of 38.90 exceeds the critical value of 11.460 at a 10% relative bias. The Wooldridge's robust score test for the over-identification test reveals that the model is correctly specified, accepting the null hypothesis that the instrumental variables are valid.

Table 7-2 reveals that the housing affordability ratio at the household level is influenced by the tenure choice (households choosing owner-occupation), demographic factors (being employed and married), urbanisation rate, house price, and the housing policies (having HPF and the HPF borrowing rate). The results reveal that the choice of a housing tenure is positively related to the level of the housing affordability ratio, demonstrating a high significance at the 5% level, thus providing empirical evidence of the simultaneity between tenure choice and housing affordability. The demographic factors 'employed' and 'married' have a negative impact on the housing affordability ratio, thus showing that being employed and being married contribute mitigating housing affordability difficulties, *ceteris paribus*. In particular, the coefficients reveal that being employed decreases the housing affordability ratio by 4.213, while being married is less significant at the 5% level. Being married leads to the housing affordability ratio decreases by 3.361. In relation to the lifecycle theory, these two demographic factors involved in the housing affordability equation are employed as proxies for income (Ying et al., 2013; Chen, 2016), suggesting that being employed and married have additional income resources, which contribute to reducing the housing affordability ratio.

The urbanisation rate is a policy indicator attached to the research data sample, which is found to have a positive impact on the housing affordability ratio. The estimation parameter reveals that an increase in urbanisation rate results in a housing affordability ratio rise of 0.541. This result corresponds to the results obtained from the aggregate level model, revealing that the urbanisation rate has a positive impact on the housing affordability ratio, because it stimulates the demand for housing. In addition, with regard to the discussion in Chapter 2, the implementation of the 'hukou' system is regarded as a policy concern in China, alongside various industrialisation strategies. The process of urbanisation drives economic development and industrialisation and creates job opportunities in urban China (Chan, 2010;

Peng et al., 2011), therefore encouraging a growing demand for housing. Accordingly, the process of urbanisation leads to an aggravation in housing affordability in urban areas, due to the continuous growth in house prices. In addition, Table 7-2 reveals that house prices have a positive influence on housing affordability, indicating that an increase in house prices would lead to an increase in the housing affordability ratio of 0.096. The theoretical discussions in Chapter 3 revealed that house prices dominate both housing costs and mortgage borrowing costs (Goodhart and Hofmann, 2008), specifying that an increase in house prices leads to a rise in total housing costs, thereby resulting in households increasing both their deposits and borrowing to afford a housing purchase. This leads to difficulties in housing affordability for particular income groups, especially those who lack sufficient income and financial capacities.

The effectiveness of housing policy indicators in significant to this model. Table 7-2 shows that both the HPF and HPF borrowing rate have a negative impact on the housing affordability ratio, thus answering the research question and the previously specified hypothesis. More precisely, the estimation results reveal that participating in the HPF contributes to a decrease in the housing affordability ratio of 6.293, while an increase in HPF borrowing rate by 1% leads to a decrease of 3.988 in the housing affordability ratio. This result supports the theoretical discussions undertaken by Wang et al. (2000), Burell (2006), and Ying et al. (2013), confirming that housing policies, especially the implications of the HPF, play a significant and effective role in improving the housing affordability.

In relation to the hypothesis, regional differences as a result of economic development and the transmission of monetary policy have the potential to influence housing affordability across regions. Chapter 2 discussed this aspect by illustrating regional differences in Beijing, Shanghai and Guangdong. Thus, the econometric model in this current chapter examines the regional differences in housing affordability by involving three regional dummies in the equation. The estimation results answer the research question and hypothesis, demonstrating the existence of regional differences in housing affordability. The results reveal that two of the three regional dummies, Beijing and Shanghai, are statistically significant at the 5% level and have positive signs. Guangdong is not statistically significant, but reveals an interesting finding that households residing in Guangdong have a negative

impact on housing affordability. Table 7-2 shows that not all regional variables are statistically significant, but that the results provide empirical evidence of the existence of regional differences.

Detailed examination of this aspect reveals that households residing in Beijing and Shanghai are less affordable, increasing the housing affordability ratio by 4.364 and 4.88 respectively. This is consistent with the house price figure presented in Chapter 2, demonstrating that house prices are relatively high in Beijing and Shanghai. However, households residing in Guangdong are found to have a negative impact on housing affordability, decreasing the housing affordability ratio by 0.664. The findings reveal that it is less affordable to reside in Beijing and Shanghai, leading to households experiencing more severe issues related to housing affordability. On the other hand, residing in Guangdong is identified as being relatively moderately affordable because of the comparatively cheaper housing costs.

When regional differences are linked to the discussions outlined in Chapter 2, it can be seen that housing affordability is associated with the level of economic development, house prices, and the transmission of monetary policy. Beijing and Shanghai have a number of economic and political advantages, which attract a high volume of investment and labour to the housing market. This results in the housing markets in Beijing and Shanghai being relatively more developed than in Guangdong, leading to a comparatively high level of housing costs. In addition, the transmission of monetary policies expands regional variations in the mortgage market (Campbell and Cocco, 2007; Barth et al., 2012). This leads to the lending environment in each of these three regions behaving in a different manner. Shanghai (as the financial centre of China) has a high level of accessibility to mortgage funds and relatively lower lending costs than the other two regions, thus generating a growing increase in house price appreciation (Hui and Yue, 2006; Chen and Yang, 2017). In addition, Beijing has experienced the implications of monetary policy and strong fiscal power as a political advantage in implementing housing policy (Li, 2004).

The contribution of this current thesis is thus providing empirical evidence confirming the effectiveness of housing policies to mitigate housing affordability difficulties. However, the

HPF is a saving scheme related to household's income, and therefore leads to inequality, since low-income households obtain fewer benefits from the HPF scheme, while still contributing the same proportion of HPF deposits as high-income households (Burell, 2006; Wang et al., 2015). This arises interests concerning the variation in the effects of the HPF among different social and demographic groups, leading to further empirical investigations through the group-based estimation, which is discussed in Section 7.7.2. The next section discusses the findings of the tenure choice equation.

Table 7-3: Estimation results of the tenure choice equation: based on all samples

VARIABLES	Coefficients	(t-statistic)	Marginal Effects	(t-statistic)
Housing Expenditure to Income Ratio	0.018***	(4.48)	0.003***	(4.70)
Household Size	0.130***	(2.10)	0.025***	(2.13)
Employed	0.731***	(4.00)	0.139***	(4.14)
Married	0.689***	(3.16)	0.131***	(3.22)
Loan to Value Ratio	-0.123***	(-9.96)	-0.023***	(-13.58)
Having a Provident Fund	1.026***	(6.47)	0.195***	(7.22)
HPF Borrowing Rate	0.743***	(2.86)	0.141***	(2.92)
Inflation Changes	-0.163***	(-5.34)	-0.031***	(-5.74)
Beijing	-1.388***	(-5.25)	-0.264***	(-5.59)
Shanghai	-0.028	(-0.13)	-0.005	(-0.13)
Guangdong	0.411**	(1.87)	0.078**	(1.89)
Constant	3.551***	(2.41)	-	-
Observations	675		675	

Robust t-statistics in parentheses

*** $p<0.05$, ** $p<0.1$

Table 7-3 shows the estimation results for the tenure choice equation, answering the research question concerning factors influencing the likelihood of choosing owner-occupation. The results in this table are comprised of coefficients and marginal effects, along with the corresponding t-statistic. The marginal effects are employed to interpret the estimation results, measuring the effect of a one-unit change in the explanatory variable on the conditional mean of the dependent variable (Cameron and Trivedi, 2010). The likelihood of choosing owner-occupation in this equation is a function of the housing affordability ratio,

demographic factors, liquidity constraints (LTV), macroeconomic changes, and housing policy indicators.

The housing expenditure to income ratio is thus found to have a positive impact on the likelihood of achieving homeownership, providing empirical evidence of the simultaneity between housing affordability and tenure choice. Boehm and Schlottmann (2014) noted that housing affordability has a positive impact on the tenure choice in transiting from renting to homeownership. The estimation results related to demographic factors are found to have a positive impact on the likelihood of choosing owner-occupation, and are statistically significant at the 5% level, pertaining to household size, and being employed and married. This reveals that households being employed and married are more likely to choose owner-occupation, increasing the probability of becoming homeowners by 0.139 and 0.131, respectively. The results are consistent with the findings of Ying et al. (2013), Bourassa et al. (2015) and Chen (2016), thus establishing that households who are employed and are married are more likely to own a house, since this increases the potential sources of income, with married and employed being proxies for the level of income. Additional income and family wealth ease the down-payment constraint, thus contributing to an increase in affordability, and raising the likelihood of accessing homeownership (Haurin, 1991; Haurin et al., 1996; Huang, 2004; Hendershott et al., 2009).

In addition, in relation to lifecycle theory, marriage is a predominant factor in the demand for housing. Households are more likely to choose owner-occupation following a change to their demographic status, including getting married (Huang, 2004; Bohem and Schlottmann, 2014; Drew, 2015). Studies of tenure choice in China have revealed that the positive effect of marriage on the choice of homeownership is associated with a "marriage-dominated housing demand" (Wei et al., 2012). This is accordance with the life cycle theory, showing that young households and their parents to regard owner-occupation as indicating wealth, which can increase family wealth and the competitiveness in the marriage market (Li and Chand, 2013; Chen, 2016, Deng et al., 2016). Being married thus stimulates the demand for owner-occupation. In addition, the impact of household size is also found as positive and significant, indicating that an increase in household size by a single individual could lead to an increase

in the probability of choosing owner-occupation of 0.025. Similar findings have been obtained from research, stating that households that increase in size, in particular through having a child, are more likely to own a house with the aim of stabilising and improving living conditions (Aarland and Nordvik, 2009; Blaauboer, 2010; Lee et al., 2016).

The impact of LTV on the likelihood of choosing homeownership is found to be negative in this current model, implying that an increase in LTV resulting in homeownership proves less attractive. The evidence reveals that an increase in LTV decreases the probability of choosing homeownership by 0.123. This finding contrasts with some studies concerning the impact of LTV on tenure choice, showing that an increase in LTV encourages more renters switch to owners (Linneman et al., 1997). However, for those who are liquidity constrained, a loosening LTV would not increase the probability of buying a house if the house prices increase rapidly or unexpectedly. Because the level of down payment increases substantially alongside the house price (Mayer and Engelhardt, 1996). If the house prices rise faster than LTV, this therefore leads a number of potential first-time buyers to change their plan for purchasing a house: either by postponing entering homeownership market (they may take longer to save for the down payment), or buying a smaller home. For liquidity constrained first-time buyers, if they are unable to seek financial from parents or parents to assist them with the down payment, they would be more likely to be excluded from the homeownership market. This has happened in China: the level of the LTV ratio remains constantly compared with the growth of house price, thus preventing a growing number of potential households from entering the homeownership market.

When this is further linked with housing affordability, the choice of achieving homeownership for first time buyers can be associated with the affordability of mortgage payments (McCord et al., 2011). An increase in LTV leads to a higher likelihood that default risks may arise from the increased size of the loan and the mortgage payments (Deng et al., 2005; Goodhart and Hofmann, 2008), especially for specific income groups. Consequently, low income households are more likely to experience difficulties in relation to mortgage payment, if their income remains unchanged, and are therefore excluded from the homeownership market.

Table 7-3 shows that housing policy indicators have a positive impact on the likelihood of choosing owner-occupation. In particular, household participating in the HPF increases the probability of achieving homeownership by 0.195, whereas an increase in the HPF borrowing rate increases the probability of achieving homeownership by 0.141. This result is in line with recent findings by Ying et al. (2013), Wang et al. (2015), Xu (2016), and Tang and Coulson (2017), confirming that participation in the HPF improves the ability of paying for housing, thereby increasing the probability of achieving homeownership. This aspect is of interest to this current thesis, as the empirical results reveal the HPF scheme mitigates the housing affordability difficulties, thus encouraging the likelihood of achieving homeownership rate in China. This forms the contribution of this current research, answering the research question and confirming the hypothesis that HPF effectively reduces housing affordability difficulties and facilitates homeownership, as households who participated in the HPF are able to obtain financial support from the HPF scheme. Accordingly, it is therefore suggested to continue with the implementation of this housing policy, while at the same time, further expanding its accessibility.

The results of regional dummies also contribute a number of significant findings for this thesis. The parameters for Beijing and Shanghai show a lower probability of achieving homeownership, which is seen to have a negative sign, while residing in Guangdong is found to be positively influence the likelihood of becoming a homeowner, although it is not statistically significant. More specifically, residing in Beijing and Shanghai incurs a greater number of issues relating to housing affordability, resulting from relatively high housing costs (Li, 2004; Chen and Yang, 2017), thereby leading to a lower likelihood of achieving homeownership. By contrast, residing in Guangdong leads to fewer affordability issues, and thus increases the likelihood of owning a house. Households undertake tenure decisions based on the level of housing costs and their housing affordability. Accordingly, the findings regarding regional differences are consistent with those obtained from the housing affordability equation. In conjunction with the discussion presented in Chapter 2, it is concluded that regions with high house prices experience more severe housing affordability issues, and people therefore have a relatively lower likelihood of achieving homeownership.

The following section discusses the empirical results, incorporating four disaggregated groups within the model, establishing their differing potential for housing affordability and tenure choice.

7.7.2   Empirical Results: group-based regression

In relation to the lifecycle theory, this current model examines variations in housing affordability and tenure choice by introducing four different social groups in the model. The specifications for disaggregating the subgroups were interpreted in Chapter 5 and Section 7.6. The group-based regressions are based on the following four groups: Age groups (age <= 40 or > 40); income groups (income under or above the average household income); 'hukou' locations (households have an urban or rural 'hukou'); and education groups (households have a high or a basic level of education). The empirical results for both the housing affordability equation and tenure choice equation are presented below:

Table 7-4: Estimation results of housing affordability equation: group-based regression

VARIABLES	(Urban)	(Rural)	(Age > 40)	(Age <=40)	(High Income)	(Low Income)	(Basic Educational Level)	(High Educational Level)
	Coefficients (t-statistic)	Coefficients (t-statistic)	Coefficients (t-statistic)	Coefficients (t-statistic)	Coefficients (t-statistic)	Coefficients (t-statistic)	Coefficients (t-statistic)	Coefficients (t-statistic)
Tenure Choice	11.029***	11.551***	12.862***	13.678***	8.083***	5.812***	15.849***	11.840***
	(4.02)	(2.28)	(2.87)	(3.26)	(2.69)	(1.99)	(3.53)	(4.02)
Employed	-3.937***	-3.023	-4.634***	-4.864**	-4.892***	-1.147	-2.393	-5.768***
	(-2.04)	(-0.75)	(-2.20)	(-1.66)	(-2.02)	(-0.59)	(-0.96)	(-2.40)
Married	-5.628***	2.957	-1.862	-4.844**	-2.664	-0.404	0.196	-4.726***
	(-2.67)	(0.85)	(-0.75)	(-1.95)	(-1.12)	(-0.19)	(0.07)	(-2.08)
Urbanisation Rate	0.543***	0.323	0.396***	0.913***	0.330***	0.266***	0.337***	0.760***
	(5.03)	(0.88)	(3.24)	(3.00)	(2.44)	(2.19)	(1.99)	(6.15)
Having a Provident Fund	-5.493***	-7.459**	-6.846***	-5.764***	-1.980	-2.966	-3.051	-5.927***
	(-3.19)	(-1.74)	(-2.92)	(-2.60)	(-1.21)	(-1.48)	(-0.74)	(-3.23)
HPF Borrowing Rate	-2.233	-9.955***	-2.706	-4.988**	-0.641	-4.369	-3.103	-3.677
	(-0.97)	(-2.10)	(-0.82)	(-1.78)	(-0.29)	(-1.57)	(-0.79)	(-1.49)
House Price	0.118***	0.059**	0.086	0.085***	0.150***	0.691***	0.104	0.094***
	(4.36)	(1.74)	(0.94)	(2.98)	(6.48)	(6.99)	(0.69)	(4.02)
Bei Jing	3.308	7.022	10.139***	0.011	6.448***	7.661***	7.869	3.393
	(1.42)	(1.10)	(2.55)	(0.00)	(3.01)	(2.08)	(1.52)	(1.38)
Shang Hai	5.416***	3.877	6.663***	3.763	7.465***	2.404	0.269	7.674***
	(2.55)	(1.19)	(2.50)	(1.56)	(3.26)	(1.13)	(0.08)	(3.67)

Guang Dong	-3.578	7.543	2.402	-2.233	2.976	6.403	1.304	-0.848
	(-1.42)	(1.25)	(0.57)	(-0.69)	(1.25)	(1.27)	(0.24)	(-0.30)
Constant	12.739	49.737**	16.238	9.160	2.956	23.744**	19.370	9.785
	(1.10)	(1.85)	(1.03)	(0.49)	(0.25)	(1.76)	(1.02)	(0.80)
Observations	498	177	282	393	243	432	239	436
F-statistic	16.24	5.42	9.05	8.78	18.32	20.25	3.78	20.82
R-squared	0.225	0.125	0.210	0.152	0.471	0.260	0.117	0.227

Robust t-statistics in parentheses

*** p<0.05, ** p<0.1

The group-based estimation results are presented in Table 7-4. Firstly, in relation to the 'hukou' system, the data sample was disaggregated into households with an urban or rural 'hukou'. For urban households, tenure choice is found to be positively related to the housing affordability ratio, and is statistically significant, confirming the simultaneity between housing affordability and tenure choice. As shown in Table 7-4, being employed is found to have a negative impact on the housing affordability ratio for urban households, indicating that being employed decreases the housing expenditure to income ratio by 3.937. Similarly, being married is evidenced as having a negative impact on the housing affordability ratio for urban households, leading to a decrease of 5.628. The demographic factors, employed and married, are employed as the proxy for income resources. Being employed and married brings additional income resources to a household, thus improving the financial capacity for housing affordability. However, for the rural households group, the demographic factors are not statistically significant. The parameter of 'married' for the rural group differs in comparison to urban households, the impact of marriage on housing affordability for rural households is 2.957, while that for urban households is -5.628. These results reveal variations in housing affordability arising from different types of 'hukou' registration. As females in rural households are not normally employed in paid employment, rural married households have fewer income resources and less family wealth than married urban households.

In relation to the hypothesis stated in this Chapter, particular attentions are paid to whether the effects of housing policy on housing affordability differ between urban and rural households. Table 7-4 indicates that housing policy indicators (including both having HPF and HPF borrowing rate) are found to have a negative impact on the housing affordability ratio for both urban and rural households, however, the coefficient of the HPF borrowing rate is not statistically significant for the urban group. As the coefficients showed, participating in the HPF contributes to a decrease in housing affordability ratio of 5.493 for urban households, and to a decrease in the housing affordability ratio of 7.549 for rural households.

The estimation results show that house prices positively influence housing affordability for both urban and rural households, but the effects have a different explanatory power. An increase in house prices in an urban area raises the housing affordability ratio by 0.118,

whereas an increase in house prices in a rural area increases the housing affordability by 0.059. This establishes that housing affordability is more sensitive to changes in house prices in urban areas, showing that an increase in house prices leads to severe housing affordability difficulties in urban areas when compared with that for rural areas. In relation to the 'hukou' system and the Chinese policy of urbanisation, the differences between urban and rural can be easily interpreted. As shown in Table 7-4, the urbanisation rate is found to be positively related to the housing affordability ratio in urban areas, and is statistically significant, showing that an increase in the urbanisation rate leads to an increase in the housing affordability ratio by 0.543. However, for rural households, it is found to be insignificant. Urbanisation takes place alongside economic development and industrialisation, attracting increasing numbers of migrants to urban areas, thus increasing both housing demand and house prices (Chan, 2010; Chen et al., 2011). As a result, housing affordability is more sensitive to changes in urbanisation rate and house prices in urban areas than in rural areas, thus leading to a severe housing affordability difficulty in urban areas alongside the increase in house prices.

When comparing the differences between urban and rural amongst three regions, it is shown that households residing in urban area of Beijing and Shanghai are more severely affected by housing affordability difficulties, increasing the housing affordability ratio by 3.308 (which is found insignificant) and 5.416 respectively. This result is found to be consistent with the results based on the all sample (see Table 7-2), showing that Beijing and Shanghai are comparatively less affordable. For rural households, the results for Beijing and Shanghai remain consistent with the results presented in Table 7-2, while those for Guangdong are positive, showing that households residing in rural areas Guangdong is less affordable. The results capture the variation between rural and urban for specific regions, establishing an interesting finding that households residing in urban Guangdong would have less affordability difficulties. However, those residing in rural Guangdong have severe housing affordability issues, as the level of economic prosperity in rural areas Guangdong is lower than in urban areas.

When comparing the differences between the two age groups, the results remain consistent with the findings obtained based on all samples (see Table 7-2). The introduction of two age

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groups is in accordance with lifecycle theory, and has been applied in a number of previous studies (Wang and Li, 2004; Deng et al., 2005; Tang and Coulson, 2017). It is stated that young households tend to experience more liquidity constraints due to their relatively insufficient family wealth and lower incomes (Leece, 2004; Li and Li, 2006; Iacoviello and Pavan, 2013). With regard to the effect of marriage on housing affordability for both age groups, the signs are found to be negative for both the younger group (age <= 40) and the older group (age > 40), although the results are not statistically significant. This affirms the discussions in Section 7.7.1, implying that being married leads to an increase in additional income resources, thus improving the ability of paying for housing expenditure. When comparing the effects of being married between two age cohorts, the results show a greater impact on the younger age group, but are not statistically significant. The results reveal that being married contributes to a decrease in the housing affordability ratio by 4.844 for the group age <= 40, implying that the level of housing affordability is more sensitive to changes in marriage for younger households. Because the majority of younger households experience liquidity constraints in supporting their housing expenditure due to a lack of income, savings and family wealth (Ying et al., 2013; Drew, 2015), while being married brings additional income resources for younger households, therefore enabling their affordability for housing expenditure.

Table 7-4 shows that housing policy indicators work effectively on housing affordability for both younger and older age groups, while the explanatory power of HPF is somewhat stronger in older groups. The results show that HPF decreases the housing affordability ratio by 6.846 for the older group, with a decrease of 5.764 for young households. Linking the viewpoints proposed by Deng et al. (2011) and Wang et al. (2015), the older group tend to have relatively higher incomes and greater financial capacity than the younger group, and therefore they obtain more benefit from the HPF since they have a higher proportion of HPF savings. Similarly, HPF also acts to reduce housing affordability difficulties for both the higher and basic levels of education group. The results show that HPF has a greater impact for the group attained high educational level (households with college education or above) than those attained basic educational level (households with A-level education or below). This could be attributed the reason that educational background is closely linked to the level of lifetime earnings, with high educational achievement acting to increase expected levels of income

(Gyourko and Linneman 1997; Li et al., 2017). Table 7-4 shows that having HPF decreases the housing affordability ratio by 5.927 for the highly educated group, and by 3.051 for the group with basic educational level. As the HPF is a savings-based housing assistance scheme, it inevitably raises inequality due to inequality of income (Deng et al., 2011; Wang, 2000). Therefore, households that do not have advantages in obtaining a high level of income, such as younger households and those with a low level of education, only gain a small amount of benefit from the HPF in comparison to the older and highly educated groups, as the contribution of the HPF is related to the participant's income.

Furthermore, this raises an interesting finding for this current thesis in relation to the differences between the two education groups. Firstly, the effect of employment is found to be stronger for those who are highly educated, decreasing the housing expenditure to income ratio by 5.786, demonstrating that households with a high level of education have fewer difficulties in relation to housing affordability. The effect of employment on households with a basic level of education decreases the housing affordability ratio by 2.393. This corresponds with the lifecycle theory that high educational achievement can be used a proxy for improved job prospects and a high level of expected income (Drew, 2015; Li et al., 2017). Secondly, as presented in Table 7-4, the effects of marriage on housing affordability vary between different levels of educational achievement. Marriage is noted as being negatively related to housing affordability for those with higher levels of education, while it has a positive impact on housing affordability for those with a basic level of education. Those with a higher level of education are more likely to have a spouse who has been educated to an equally high level, and thus their joint income contributes to reducing issues related to their housing affordability.

A comparison of the two education groups in terms of the impact of house prices on housing affordability showed that house prices have a positive impact on housing affordability for both groups. However, the results for the basic education group are fond to be insignificant. Table 7-4 shows that an increase in house prices leads to an increase in housing affordability of 0.094 for those with higher levels of education.

The difference between the education groups among the regional dummies reveals that those with a higher level of education experienced fewer issues with housing affordability in Guangdong, although this variable is not significant. The results reveal that the highly educated group experienced relatively less housing affordability issues in Guangdong, decreasing the housing affordability ratio by 0.848. In contrast, households with basic education level residing in Guangdong experienced more issues. Similarly, for households in Beijing, the highly educated group experienced fewer issues relating to housing affordability than the basic education group. Table 7-4 reveals that for highly educated households residing in Beijing leads to a moderate increase in the housing affordability ratio of 3.393, while households with low education level residing in Beijing would have a severe housing affordability problem, alongside an increase in the housing affordability ratio of 7.869. This confirms that an improved educational background contributes to positive career prospects, increasing the expected level of income, and subsequently raising lifetime wealth while at the same time reducing liquidity constraints (Ying et al., 2013; Boehm and Schlottmann, 2014; Drew, 2015; Li et al., 2017).

Table 7-5: Estimation results of tenure choice equation: group-based regressions

VARIABLES	(Urban)	(Rural)	(Age>40)	(Age<=40)	(High Income)	(Low Income)	(Basic Educational Level)	(High Educational Level)
	Coefficients (t-statistic)	Coefficients (t-statistic)	Coefficients (t-statistic)	Coefficients (t-statistic)	Coefficients (t-statistic)	Coefficients (t-statistic)	Coefficients (t-statistic)	Coefficients (t-statistic)
Housing Expenditure to Income Ratio	0.022***	0.012	0.025***	0.012***	0.072***	0.025***	0.017***	0.017***
	(4.44)	(1.55)	(3.68)	(2.34)	(4.62)	(4.92)	(2.77)	(3.08)
Household Size	0.247***	0.014	0.268***	-0.008	0.192	0.132	0.209***	0.140
	(3.00)	(0.11)	(2.91)	(-0.09)	(1.48)	(1.54)	(2.17)	(1.51)
Employed	0.901***	0.551	0.946***	0.346	1.420***	0.489***	0.552***	1.012***
	(4.16)	(1.33)	(3.73)	(1.10)	(2.87)	(2.16)	(2.10)	(3.36)
Married	0.504***	1.486***	-0.010	1.304***	1.492***	0.379	0.395	0.927***
	(2.02)	(2.12)	(-0.03)	(3.78)	(2.80)	(1.37)	(1.01)	(3.27)
Loan to Value Ratio	-0.106***	-0.165***	-0.101***	-0.147***	-0.169***	-0.132***	-0.129***	-0.132***
	(-7.61)	(-5.57)	(-5.95)	(-7.29)	(-4.45)	(-8.60)	(-6.14)	(-7.63)
Having a Provident Fund	0.832***	0.831	0.851***	1.152***	1.081***	0.949***	0.109	0.948***
	(4.54)	(1.49)	(3.43)	(5.30)	(3.46)	(4.29)	(0.25)	(4.93)
HPF Borrowing	0.780***	0.428	0.236	1.462***	0.938	0.769***	0.611	0.839***
	(2.58)	(0.73)	(0.61)	(3.58)	(1.64)	(2.21)	(1.35)	(2.42)
Inflation Changes	-0.167***	-0.089	-0.161***	-0.220***	-0.189***	-0.189***	-0.184***	-0.156***
	(-4.79)	(-1.09)	(-3.48)	(-4.40)	(-2.77)	(-4.70)	(-3.46)	(-3.89)
Beijing	-1.371***	-	-1.115***	-1.640***	-2.692***	-2.307***	-	-1.255***

	(-5.06)	-	(-2.88)	(-3.88)	(-5.26)	(-3.21)	-	(-4.30)
Shanghai	0.183	-0.952	0.123	-0.143	-1.022***	-0.081	-0.545	0.341
	(0.69)	(-1.56)	(0.37)	(-0.48)	(-2.14)	(-0.28)	(-1.35)	(1.18)
Guangdong	0.535***	0.189	0.109	0.665***	-0.208	-0.737	-0.497	0.667***
	(1.99)	(0.40)	(0.29)	(2.19)	(-0.53)	(-1.55)	(-1.04)	(2.39)
Constant	1.891	7.513***	3.998**	2.739	4.774	4.013***	4.664**	3.407**
	(1.09)	(2.31)	(1.88)	(1.19)	(1.34)	(2.12)	(1.80)	(1.75)
Observations	498	164	282	393	243	432	224	436

Robust t-statistics in parentheses

*** p<0.05, ** p<0.1

Table 7-6: Marginal effects for tenure choice equation: group-based regressions

VARIABLES	(Urban)	(Rural)	(Age>40)	(Age<=40)	(High Income)	(Low Income)	(Basic Educational Level)	(High Educational Level)
	Marginal Effects (t-statistic)	Marginal Effects (t-statistic)	Marginal Effects (t-statistic)	Marginal Effects (t-statistic)	Marginal Effects (t-statistic)	Marginal Effects (t-statistic)	Marginal Effects (t-statistic)	Marginal Effects (t-statistic)
Housing Expenditure to Income Ratio	0.004***	0.002	0.005***	0.002***	0.010***	0.004***	0.003***	0.003***
	(4.74)	(1.57)	(3.99)	(2.40)	(5.88)	(5.33)	(2.91)	(3.22)
Household Size	0.046***	0.002	0.053***	-0.001	0.027	0.021	0.040***	0.025
	(3.10)	(0.11)	(3.06)	(-0.09)	(1.52)	(1.55)	(2.22)	(1.53)
Employed	0.167***	0.092	0.188***	0.057	0.198***	0.077***	0.106***	0.179***
	(4.41)	(1.34)	(4.04)	(1.10)	(3.12)	(2.19)	(2.14)	(3.53)
Married	0.094***	0.248***	-0.002	0.215***	0.208***	0.060	0.076	0.164***
	(2.04)	(2.17)	(-0.03)	(4.01)	(3.00)	(1.37)	(1.02)	(3.39)
Loan to Value Ratio	-0.020***	-0.028***	-0.020***	-0.024***	-0.024***	-0.021***	-0.025***	-0.023***
	(-9.62)	(-8.10)	(-7.64)	(-9.76)	(-5.52)	(-12.66)	(-8.43)	(-10.27)
Having a Provident Fund	0.154***	0.139	0.169***	0.190***	0.151***	0.150***	0.021	0.168***
	(4.89)	(1.51)	(3.69)	(6.15)	(3.96)	(4.53)	(0.25)	(5.53)
HPF Borrowing Rate	0.145***	0.071	0.047	0.241***	0.131**	0.122***	0.117	0.148***
	(2.63)	(0.73)	(0.62)	(3.81)	(1.69)	(2.25)	(1.37)	(2.47)
Inflation Changes	-0.031***	-0.015	-0.032***	-0.036***	-0.026***	-0.030***	-0.035***	-0.028***
	(-5.19)	(-1.10)	(-3.72)	(-4.77)	(-3.00)	(-5.11)	(-3.72)	(-4.15)

Beijing	-0.255***	-	-0.222***	-0.270***	-0.376***	-0.365***	-	-0.222***
	(-5.51)	-	(-3.02)	(-4.15)	(-7.50)	(-3.32)	-	(-4.66)
Shanghai	0.034	-0.159	0.024	-0.024	-0.143***	-0.013	-0.105	0.060
	(0.70)	(-1.58)	(0.37)	(-0.48)	(-2.24)	(-0.28)	(-1.36)	(1.19)
Guangdong	0.099***	0.032	0.022	0.110***	-0.029	-0.117	-0.095	0.118***
	(2.02)	(0.40)	(0.29)	(2.25)	(-0.54)	(-1.56)	(-1.05)	(2.46)
Observations	498	164	282	393	243	432	224	436

Robust t-statistics in parentheses

*** p<0.05, ** p<0.1

Table 7-5 presents the group-based estimation results for the tenure choice equation, and Table 7-6 presents the marginal effects of each parameter. This section discusses the estimation results based on the marginal effect presented in Table 7-6. Theoretically, in relation to lifecycle theory, demographic factors are closely related to tenure choice (Li and Li, 2006; Halkey and Vasudev, 2014; Gabriel and Rosenthal, 2015; Wang and Otsuki, 2015). As shown in Table 7-6, an increase in the household size has a stronger positive impact on the likelihood of achieving homeownership in urban areas, increasing the likelihood by 0.046. This is consistent with studies undertaken by Yi et al. (2016). Whilst for rural households, the impact of household size on the choice of homeownership shows insignificant. Households residing in rural areas are more likely to consist of a multi-generation family, with younger married couples generally residing with their parents and grandparents, therefore leading to less demand for owner-occupation.

In relation to the results for urban and rural locations, as shown in Table 7-6, having a HPF increases the likelihood of owning a house by 0.154 for urban households. The positive parameters for having a HPF and the HPF borrowing rate imply that housing policies have a pronounced impact on the likelihood of achieving homeownership, which is consistent with Deng et al. (2016). However, the coefficients for rural households are found being insignificant. This reveals that the 'hukou' system contributes more to the effect of the HPF, because an urban 'hukou' provides a high level of accessibility to jobs and the HPF, enabling urban households to enter the homeownership market.

A comparison of the results for urban and rural areas in these three regions showed that, households located in Beijing are less likely to become homeowners, which is consistent with the results presented in Table 7-3. Meanwhile, households in urban Shanghai are comparatively more likely to own a house, in comparison with those in rural Shanghai. This is because urban areas in Shanghai have a good jobs market, providing high accessibility of employment opportunities and a high level of income. In addition, the mortgage market and the HPF system in urban Shanghai are more developed than that in rural areas, thus a greater degree of assistance for housing purchases for households residing in urban Shanghai. Unfortunately, this result is insignificant.

The variations in the impacts of demographic characteristics on tenure choice between two age groups are also captured. As Table 7-6 shows, the effect of household size on the choice of homeownership towards positive and strongly significant for the group of aged over 40 (age > 40). This establishes an interesting finding for this current model, revealing that an increase in household size increases the likelihood of achieving homeownership by 0.053 for the group of age above 40. This is consistent with some existing studies. Huang and Clark (2004) empirically captured the positive impact of household size on the likelihood of achieving homeownership. In addition, the results also demonstrate a contradictory result to that captured by Deng et al. (2016). Deng et al. (2016) stated that younger Chinese households are more likely to become homeowners when they have a child. However, the findings presented in Table 7-6 show that an increase in household size decreases the likelihood of achieving homeownership for younger households. This is because younger households are liquidity constrained, lacking sufficient savings to meet the down payment requirement. Consequently, if they are unable to obtain external financial support, such as housing assistance policy or parental funding, they will be in a position of weakness in terms of achieving homeownership, as house prices have far exceeded their financial capacity.

For the age differential in the three regions, it was found that residing in Guangdong has a positive impact on the probability of achieving homeownership for both younger and older groups. In particular, for younger households in Guangdong, the probability of owning a house increases by 0.110. By contrast, residing in Beijing is less affordable, thus having a negative impact on the choice of homeownership for both older and younger households, decreasing the likelihood of achieving homeownership by 0.222 and 0.270 respectively. The choice of homeownership is closely related to financial capacity and housing costs, as well as the level of housing affordability. The high level of housing costs in Beijing leads to the down payment and mortgage payments being comparatively high, thus decreasing the likelihood of achieving homeownership, when compared with the two other regions.

A comparison of the results between the two educations groups show that the housing policy indicators outline an expected positive sign for both of groups, indicating that the HPF scheme effectively works effectively, thus increasing the probability of achieving homeownership. In

addition, the marginal effect of having HPF is an interesting finding of this thesis. The PF has a stronger influence on the higher education group, leading to an increase in the probability of owning a house by 0.168, while increasing the probability for the groups with basic education level by 0.021. This is consistent with the findings captured from the housing affordability equation, revealing that the high education group gains a greater degree of benefit from the HPF due to a good prosperity of income and greater financial capacity. In relation to the discussions of Burell (2006) and Xu (2016), the mechanism in the mandatory saving scheme is of more benefits for households with a higher level of social status, such as a higher level of education and income. This therefore arise discussions concerning the equality of the HPF, which will be discussed in the subsequent sections.

A comparison of the educational difference in tenure choice in regions reveals that higher educated households in Shanghai are more likely to own a house. In contrast, households with a lower level of educational achievement in Shanghai have less possibility of buying a house. This reveals an interesting finding that educational achievement makes a difference in terms of tenure choice in the same region, even though the results are not statistically significant. As with households residing in Guangdong, highly educated households have more likelihood to achieve homeownership, showing an increase in the probability of achieving homeownership by 0.118. However, the less educated group in Guangdong is less likely to own a house, with a decrease in the probability of owning a house of 0.095. The results affirm the findings from previous studies, showing that a high level of educational achievement is considered as a proxy for improved job opportunities and higher levels of expected lifetime income (Bohem and Schlottmann, 2014; Chen and Yang, 2017), thus increasing the probability of owning a house. In addition, the results are consistent with existing research concerning tenure choice in China (Wang et al., 2015; Chen, 2016; Li et al., 2017), implying that highly educated households are better able to afford the down payments and thus more likely to enter the homeownership market.

7.8 Discussion

This chapter has explored a two-reduced form simultaneous equations model, examining factors influencing housing affordability and households' tenure choice. Specific attention has been paid to whether housing policies improve housing affordability and increase the probability of achieving homeownership. Two relevant indicators were employed in the model, including having a HPF and the HPF borrowing rate. The estimation results relating to the housing affordability and tenure choice equations revealed that housing policies significantly reduced housing affordability difficulties, thus increasing the probability of achieving homeownership. The HPF is a housing policy targeted to assist with the housing demands through a compulsory saving and the low-rate housing debt. The empirical results confirmed that this housing policy assisted households with housing affordability difficulties to a great extent, and increased the likelihood of achieving homeownership. The empirical findings were consistent with the results obtained by Ying et al. (2013), Yi et al. (2016), and Tang and Coulson (2017), affirming that the HPF was utilised in an effective way to assist with housing demand and stimulating homeownership in China. For group-based estimation, the results showed that the HPF has a greater impact on households with a high level of education. As the HPF is an income-related assistance project, the level of benefits obtained from it is depend on the level of household's income, as well as the amount of deposits in their HPF account. This is in line with previous discussions regarding the inequality of the HPF, stating that households with a better income prosperity, such as with higher education background, or having more family wealth, would gain a greater degree of housing assistance from this HPF project (Chen and Deng, 2014; Xu, 2016). Consequently, this therefore arising considerations concerning to reduce the inequality in the HPF.

However, care needs to be taken when interpreting this housing policy. A number of researchers have argued that HPF constitutes a subsidy in the form of unpaid income, and acts to increase the gross capacity of the HPF holders (Yeung and Howes, 2006). As discussed in Chapter 2, there is limited accessibility to the HPF, as it is an employment-based scheme, available only for those with a full-time job under a formal employment contract, and it is also subject to the working units joined in the HPF scheme. A number of groups are therefore

being excluded from participating in the system, including those who have been laid-off, rural migrant workers, along with individuals who are in temporary employment or who are self-employed (Yeung and Howes, 2006; Burell, 2006). The previous result reveals a level of inequality arising from the implications of HPF as a result of the education gap, implying that the higher educated groups gain additional benefits from the HPF, compared with the basic education group. Therefore, the HPF generates inequality as a result of being an employment-based saving scheme, households with a high educational background are more likely to have good job prospect and a better income prosperity, therefore would be benefited more from the HPF. This leads to the need for government to pay particular attention to the management of the HPF, including expanding accessibility to those currently prevented from participating in the HPF, such as those who are self-employed and laid-off workers. Inequality in the HPF caused by the income gap, resulting in a need to raise the proportion of savings available from employers for the benefit of low-income households, or to provide discounted HPF borrowing rates.

The above discussion leads to the conclusion that the efficiency of HPF differs between different groups. In terms of policy implications, consideration could be given to expanding the accessibility of the HPF, thus involving those disadvantaged households in the HPF system.

7.9   Conclusion

This chapter investigated factors influencing housing affordability and the choice of owner-occupation. Particular attention has been paid to the effectiveness of housing policies in reducing housing affordability difficulties and improving the likelihood of achieving homeownership. In addition, with regard to regional differences in terms of the micro economic environment, specific attention has been paid to capture whether regional differences exist in housing affordability and tenure choice decisions within the Chinese housing system. In order to answer the research questions, this current thesis developed a simultaneous equations model, and performed the empirical investigations by employing cross-sectional data from the CHFS 2011. The dataset is of particular significance, since it details the most representative micro-level survey in China, containing detailed information

related to households' financial status, household composition, property assets, and policy indicators. The working dataset for this current model employed a multilevel data file, merging the data file at the individual level with that at the household level by employing the key identification number. Through the inclusion of the macroeconomic variables in the research data, this household survey dataset provided a valuable contribution to the empirical investigation, and generated significant findings for this research.

The main contribution of this chapter consisted of employing a mixture of the household level and aggregate data for the first time. This aimed investigate housing affordability issues and tenure choice decisions in China by applying a simultaneous equations model. The results provided empirical evidence of the simultaneity between housing affordability and the tenure choice decisions. Results showed that the choice to enter homeownership was linked to issues related to housing affordability, whilst the level of affordability for owning or renting determined the actual housing tenure choice. A considerable contribution of this thesis consisted of the conclusions of two housing policy indicators. As previously noted, participating in the HPF helped to reduce housing affordability difficulties, and thus contributed to increasing the probability of achieving homeownership. This is of interest to this current thesis, affirming the effectiveness of housing policies in alleviating difficulties relating to housing affordability, and encouraging the homeownership attainment by means of HPF. The findings were consistent with existing studies concerning the impact of HPF on household's tenure choice (Ying et al., 2013; Xu, 2016; Tang and Coulson, 2017).

Furthermore, regional differences were empirically detected in relation to housing affordability and tenure choice, revealing that households residing in Beijing and Shanghai experience severe housing affordability difficulties. In contrast, households residing in Guangdong have relatively less affordability issues. Consequently, the estimation results of the tenure choice equation provided evidence that households residing in Beijing and Shanghai were less likely to achieve homeownership, while those in Guangdong were more likely to become homeowners. This formed a valuable contribution to this thesis, answering the research question relating to the potential existence of regional differences in terms of housing affordability and tenure choice, and confirming a variation in housing affordability

and tenure choice among regions, in response to variations in economic conditions and the housing market. The results from the housing market in both Beijing and Shanghai revealed that they are less affordable, leading to a need to expand the accessibility of the HPF to all groups within these regions, providing priority access for those in need of assistance. Furthermore, it is suggested to increase the supply of affordable housing and cheap rental housing in the market, thus encouraging those liquidity constrained households to access low-cost public housing, to enable them to save more and gain a greater financial capacity for homeownership.

The implications of this current research suggested the need to continue the implementation of and expansion of accessibility to the HPF, also expanding the access to various groups such needing housing assistance. In addition, the need to increase awareness of the impact of education on housing affordability has been identified. Actions may need to be taken to improve the level of educational achievement, and to enable individuals to become more competitive in the labour market, thus leading to an improved lifetime income and an increased housing affordability.

The findings in this chapter provided a number of suggestions for future research. Firstly, there is potential to study housing affordability in relation to different social groups. In relation to the 'hukou' system, particular attentions need to be paid to housing affordability for people migrating from rural to urban areas. Secondly, further research is required to examine the impact of parental financial support in the context of housing affordability and tenure choice.

Chapter 8 Conclusion

8.1 Main Empirical Findings and Contributions

Issues concerning housing affordability are increasingly being raised in a number of countries, as high housing costs combined with sluggish income growth. This preventing a growing number of households from achieving homeownership, due to lack of sufficient financial capacity to meet down payment requirements. In relation to these considerations, this current thesis focused on examining the factors influencing housing affordability in China, developing two econometric models by incorporating data at the aggregate level and the household level.

Chapter 2 detailed the background to the Chinese housing market, this led to a discussion about the housing reform, the development of the market-based housing system, and the foundation of the housing finance market. The chapter discusses the development of the housing policy, illustrating its targets and imperfections in relation to overcoming housing difficulties. This provides a theoretical foundation to understand the effectiveness of HPF. Furthermore, this chapter illustrates an overview of market performance of the Chinese housing market, presenting figures concerning macroeconomics, housing finance and regional markets.

Chapter 3 reviewed existing studies in relation to housing affordability and tenure choice, detailing current theoretical understanding of factors influencing housing affordability, defining housing affordability, and explicating the measurements of housing affordability and their limitations. By including discussions concerning house price and housing affordability from a macroeconomic perspective, the chapter provided a discussion in relation to empirical studies of housing affordability, in accordance with the different types of data employed in the research. As this current thesis focused on housing affordability issues in China, the chapter reviewed existing studies on housing affordability based on Chinese data, establishing a theoretical basis for empirical investigations.

Chapters 4 and 5 specified the methods and data sample employed in this thesis. A quantitative approach was employed in this current thesis, developing two econometric models. Two types of data were employed in this thesis, comprising data at the aggregate level and the household level. This is the significance of the current thesis, which states that the estimations of factors influencing housing affordability and tenure choice in China were performed in combination with two types of data, covering information concerning the national level over the past 15 years, and the micro level in China. This current thesis merged two separate datasets from the CHFS 2011, to attain individual and household level data, and to capture extensive and detailed household information. In addition, considering the heterogeneity of the households in the dataset, some additional information obtained at the macroeconomic level was attached to the household level dataset, contributing to capture the impact of market dynamics on housing affordability and tenure choice.

Chapter 6 captured that housing supply and demand side factors were found to have a significant impact on the housing affordability ratio. Similarly, it was found that factors influencing housing affordability include macroeconomic dynamics, housing finance, and demographic data. In addition, the housing policy indicator was found to assist in mitigating housing affordability difficulties. Chapter 6 presented an aggregate level model and its results, in combination with national level data spanning 2000: Q1 and 2015: Q1. The model presented in Chapter 6 consisted of two econometric equations, which was the house price equation and the housing affordability equation, and was estimated using the 2SLS technique. Validity checks of the instruments were performed, showing that all instruments employed in the model were both valid and effective. Periodic changes were captured by splitting the sample into two groups, which were pre- and post- 2007. The results revealed that liquidity constraints and the long-term HPF borrowing rate have acted to mitigate housing affordability difficulties since 2007. This is consistent with the discussions in Chapter 2, which illustrate that, following the financial crisis, the central government enacted a number of measures to regulate lending conditions, and to alleviate the impact of the financial crisis, cool down house price inflation and reduce housing affordability difficulties.

Chapter 7 employed household level data to conduct an empirical investigation, in order to obtain intensive answers concerning factors influencing housing affordability at the household level. A two reduced form simultaneous equations model was discussed in Chapter 7, suggesting that housing affordability and tenure choice are simultaneously determined. This model was performed by employing a cross-sectional micro level data from a household survey, including a number of macroeconomic factors and the house prices.

The main contribution of this research is its use of a two reduced form simultaneous equations model based upon Chinese household level data, to empirically validate the existence of simultaneity between housing affordability and tenure. Chapter 7 captured the negative relationship between the demographic factors and the housing affordability ratio, showing that being married and being employed were strongly negatively impacted on the housing affordability ratio. Therefore, it is implied that employment and marriage reduce housing affordability difficulties, as a result of higher levels of income. Consequently, demographic factors increase the probability of achieving homeownership. The factors of HPF and HPF borrowing rate were employed in the model as the focus of this thesis was a specific interest in the effectiveness of housing policies. The results revealed that having a HPF and HPF borrowing rate contributed to mitigating housing affordability, leading to a decrease in the housing affordability ratio. Correspondingly, the likelihood of achieving homeownership in the model was increased with the assistance of HPF, demonstrating that households participating in HPF are more likely to own a house. The results offered an important contribution to this research, including evidence that housing policy is utilised effectively as a means to mitigate housing affordability difficulties, and encouraging HPF participants to achieve homeownership. Thus, HPF can be viewed as a beneficial scheme, which has achieved its original intention of assisting with housing demand and improving the affordability of housing purchases, thereby encouraging the homeownership rate in China.

An effect from LTV on tenure choice was also observed, resulting in homeownership proving less attractive for households. This can be explained relative to mortgage affordability. For households with insufficient family wealth or a shortage in income, having a higher LTV resulting in a higher likelihood of default risk. This is because an increase in LTV increases the

size of the loan, and also the level of mortgage payments (Mayer and Engelhardt, 1996; Deng et al., 2005; Goodhart and Hofmann, 2008). Consequently, an increase in LTV to some extent leads to housing affordability issues by being unable to afford the mortgage payments for liquidity constrained households (Gabriel and Rosenthal, 2015).

It was established that, in relation to findings concerning regional affordability, the choice of tenure tended to vary by region, in accordance with corresponding differences in housing affordability. The high level of down payments and mortgage costs reduced the probability of achieving homeownership, in particular among those experiencing liquidity problems. The results revealed that, due to the high levels of housing costs, those residing in Beijing and Shanghai experience greater housing affordability difficulties when compared to households residing in Guangdong. Such groups are therefore less likely to own a house. Residing in Guangdong, however, was found to be relatively more affordable, having fewer housing affordability difficulties, thereby increasing the probability of owning a house.

The household level model was examined in further detail, focussing on four different social groups. The results evidenced the existence of variations in housing affordability and tenure choice between different social groups. It was established that the impact of marriage on housing affordability varied between urban and rural households. For those residing in urban areas, greater employment opportunities along with a higher level of income contributed to decrease the housing affordability ratios. The effect of the HPF was greater for rural than urban households, implying that, when it comes to housing purchases, rural households need additional housing assistance. The education groups generated a number of different factors influencing housing affordability difficulties and the choice of homeownership. It was found that households with a higher educational achievement gained a greater degree of benefit from the housing policy, encouraging to achieve homeownership, as education levels can be used as a proxy for a career and an expected lifetime income. Therefore, it was established that, for households residing in Shanghai and Guangdong, the probability of homeownership increased for those with a high level of education.

8.2 Policy Implications

The Chinese government has, since the national housing reform, issued a number of housing and monetary policies to regulate the overheated housing market, providing policy engines to facilitate the challenges in housing affordability, targeting those on low incomes in particular. The research questions ensured that this thesis investigated whether current housing policy has proved effective in mitigating housing affordability difficulties and encouraging households to become homeowners. By the use of aggregate level data and household level data, this current research captured the effectiveness of the HPF, revealing that HPF works effectively to mitigate housing affordability difficulties, and increases the likelihood of achieving homeownership. In accordance with discussions and empirical findings in this thesis, this section discussed the implications of housing policies, proposing suggestions to alleviate HPF inequality, in order to improve the effectiveness of the HPF; and suggesting that the HPF scheme can be applied to any of transition economies.

Issues of HPF inequality were evidenced in the current thesis when considering the empirical findings of the household level model, showing that households with a higher level of education gain a greater degree of benefit from the housing policy, thereby encouraging homeownership, as education levels to be used as a proxy for a career and an expected lifetime income. In addition, when it comes to the decision of tenure choice, urban households acquire a higher degree of benefit from the HPF, resulting in a higher likelihood of achieving homeownership. As has been discussed in Chapter 2, the inequality related to HPF was primarily arising from the income gap; however, there were other potential causes which may lead to HPF inequality, including: (1) Limited access to or exclusion from the HPF, affecting migrants, seasonal-workers, cheap labour, and self-employed households; (2) Regional imbalances in terms of economic performance and the development of the HPF system; (3) Different HPF contributory rates pertaining to the regions, types of employers, and professional status; (4) Imbalances in terms of benefiting from the HPF.

Accordingly, it is a necessary for governments to direct particular attention towards mitigating HPF inequality. The following actions need to be implemented: (1) To reduce HPF

inequality by reducing the income gap; (2) To improve the access to the HPF, by permitting all those in need to benefit from the HPF scheme. More precisely, there is a need to expand the coverage of the HPF to involve disadvantaged households, such as migrants, seasonal-workers, self-employed households, and low-paid workers; (3) To raise the HPF contributory rate for low-paid households from their employer side, to expand the aggregate savings to the HPF; (4) To provide floating points of the HPF borrowing rate for low-paid households, and to improve disadvantaged households' accessibility to cheaper mortgages (HPF housing debts).

Furthermore, the results based on the empirical investigations revealed that employment contributed to reducing housing affordability. More specifically, in relation to the aggregate level model, it has been evidenced that an increase in urban employment assists in reducing the housing affordability ratio, alleviating housing affordability difficulties (see Table 6-3). Similarly, when observing the findings from the household level model, it is noticed that being employed reduced the housing affordability ratio, increasing the likelihood of achieving homeownership (see Table 7-2 and 7-3). This is due to employment status can be used as a proxy for the level of income, thus contributing to mitigating housing affordability difficulties due to the increased income level. Accordingly, this leads to the suggestion that there is a need to improve employment rates by developing the economy and increasing job opportunities, to encourage the population to improve their level of education, or to engage in life-long learning, thereby improving their level of income.

Thirdly, empirical results regarding the household level model captured regional differences in terms of housing affordability and tenure choice, lending considerations to the importance of regional deviations in response to housing policy measures. There is a need to decentralise the management of the HPF, awarding local government and authorities with greater powers to draw together each region's policy to regulate the housing market. When considering the regional differences in terms of the transmission of monetary policy, there is a need to issue mortgage policies towards a number of specific regions, allowing local banks to devise applicable lending criteria in view of their own lending conditions. In addition, in relation to the level of mortgage borrowing rate and the LTV ratio, it is suggested that it is necessary to

loosen centralised control. More precisely, it is suggested to allow local banks and mortgage providers to undertake evaluations of location conditions, setting the LTV ratio and interest rates according to their own lending conditions.

Moreover, when considering the features of the Chinese economy and the functions of the HPF, implications may arise that the HPF could be transferable. In particular, it is applicable to any of transition economy case, such as post-Soviet Asian countries. This is because, the HPF in China draws on the successful experience of the Singapore Central Provident Fund system, it has now been developed as a key housing assistance policy in accordance with the transitioning Chinese economy, functioning as the main policy tool for resolving housing difficulties and stimulating homeownership. Housing market under a transitioning economy, is changing from a centrally planned economy to a market economy, and so the scheme of the HPF is applicable to help resolving the housing difficulties in the transition economies, and can be developed according to its own economic conditions. In addition, this thesis employed both aggregate level data and household level data to examine the effectiveness of housing policies, and both the estimation technique and the type of data employed in this current thesis can be applied to any housing policy research in China.

8.3 Limitations

This current research comprised a number of limitations, pertaining to the accessibility of the dataset. There are described here, and suggestions given to improve upon them in future research in the following section.

Firstly, the time span of the time series dataset is relatively short for an aggregate level model. Due to the transition that has been taking place in the Chinese housing market, data prior to 1998 was not and applicable, and so had to be excluded.

Secondly, some key information in the household level dataset was missing, limiting the degree of information included the HPF in the model, such as number of years participating

in the HPF, monthly savings contributed to the HPF, and the occupation of household participants benefiting from the HPF.

Thirdly, the household level model estimated group-based regressions, but failed include all groups due to the data availability; e.g. there was no data identifying rural to urban migrations, or pertaining to the large number of cheap labour forces. Also relating to data availability, it limited the investigation on regional differences. Due to the limited sample size in the working data file, it was a challenge to involve more regions in the model.

8.4   Future Research

This current thesis established a number of significant findings in relation to factors impacting housing affordability and tenure choice. Linking the empirical findings captured in corporation with aggregate level data and household level data, the current thesis has contributed a number of implications in relation to improve the effectiveness of housing policies, as well as to mitigate HPF inequality. However, there is potential for the current research to be improved upon and applied in combination with different types of data and estimation techniques.

Firstly, in relation to the data sample at the aggregate level, the model employs national level data spanning 2000 and 2015, this leads to a need for future research to access more recent data and thus expand the dataset at the aggregate level. Similarly, there is a need to extend the data concerning other regions in China.

Secondly, future research could be developed to deliver a deep insight into the effects of housing policy, in association with extensive housing policies factors. More specifically, the characteristics and heterogeneity of each HPF participant could be integrated into in the model, by including factors such as the level of monthly HPF deposits, and the duration of households participated in the HPF, etc. This therefore suggests future research employs a new dataset at the household level.

Following on from this, in terms of group-based investigations at the household level, it is suggested that this model could be applied concentrating on specifically targeted groups in the future. As specified in Chapter 2, rural migrant workers and temporary workers in China numbering around 277 million as of 2015, yet are excluded from the HPF system (NBS, 2015). Those people in excluded groups suffer from greater housing difficulties than those with access to the HPF, and this inequitable access links the HPF system to certain social dilemmas. Consequently, in future research, the household model could be applied to examine the efficiency of housing policy as a mechanism to help resolve housing affordability difficulties for migrants moving from rural to urban areas in China. Similarly, considering the huge volume of cheap labour, especially rural migrant workers, there is a need to concern their housing affordability in the context of house price appreciation and the shortage of housing assistants. Accordingly, the household level model could be applied to investigations of housing affordability for specific groups in China. Furthermore, regional differentials for the three key regions in China were captured at the household level. This might lead to future works to undertaking an empirical investigation by employing different regional groups, with the regions grouped according to differences in economic development, or political divisions.

Furthermore, as discussed in section 7.7.2, younger households are found to be less likely to achieve homeownership, even they are being married. This could be attributed to house price appreciations, which are now far beyond the younger households' family financial capacity. This therefore arises in future research concerning the impact of parental financial support on housing affordability for younger households in China.

Finally, in terms of the econometric model, further research could be employ different models and estimations, such as the Heckman two step model, or the multivariable fractional polynomials method (MFP).

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Appendix 1 Interest Rate Changes Announced by the Central Bank

Interest Rates Changes Announced by the Central Bank (1999 – 2006)

Adjust Date	Mortgage Interest Rate					HPF Borrowing Rate	
	6 Months	1 Year	1-3 Years	3-5 Years	Above 5 Years	5 Years and Below	Above 5 Years
01.05.1996	9.72%		13.14%	14.94%	15.12%		
23.08.1996	9.18%	10.08%	10.98%	11.70%	12.42%		
23.10.1997	7.65%	8.64%	9.36%	9.90%	10.53%		
25.03.1998	7.02%	7.92%	9.00%	9.72%	10.35%		
01.07.1998	6.57%	6.93%	7.11%	7.65%	8.01%		
07.12.1998	6.12%	6.39%	6.66%	7.20%	7.56%		
10.06.1999	5.58	5.85	5.94	6.03	6.21	4.14	4.59
21.02.2002	5.04	5.31	5.49	5.58	5.76	3.60	4.05
29.10.2004	5.22	5.58	5.76	5.85	6.12	3.78	4.23
28.04.2006	5.4	5.85	6.03	6.12	6.39	4.14	4.59
19.08.2006	5.58	6.12	6.3	6.48	6.84	4.32	4.77

Appendix 1 Continued

Interest Rates Changes Announced by the Central Bank (2007-2015)

Adjust Date	Mortgage Interest Rate					HPF Borrowing Rate	
	6 Months	1 Year	1-3 Years	3-5 Years	Above 5 Years	5 Years and Below	Above 5 Years
18.03.2007	5.67	6.39	6.57	6.75	7.11	4.32	4.77
19.05.2007	5.85	6.57	6.75	6.93	7.2	4.41	4.86
21.07.2007	6.03	6.84	7.02	7.2	7.38	4.50	4.95
22.08.2007	6.21	7.02	7.2	7.38	7.56	4.59	5.04
15.09.2007	6.48	7.29	7.47	7.65	7.83	4.77	5.22
21.12.2007	6.57	7.47	7.56	7.74	7.83	4.77	5.22
15.09.2008	6.21	7.2	7.29	7.56	7.74	4.59	5.13
09.10.2008	6.12	6.93	7.02	7.29	7.47	3.42	4.86
30.10.2008	6.03	6.66	6.75	7.02	7.2	4.05	4.59
27.11.2008	5.04	5.58	5.67	5.94	6.12	3.51	4.05
23.12.2008	4.86	5.31	5.4	5.76	5.94	3.33	3.87
20.10.2010	5.1	5.56	5.6	5.96	6.14	3.50	4.05
26.12.2010	5.35	5.81	5.85	6.22	6.4	3.75	4.30
09.02.2011	5.6	6.06	6.1	6.45	6.6	4.00	4.50
06.04.2011	5.85	6.31	6.4	6.65	6.8	4.20	4.70
07.07.2011	6.1	6.56	6.65	6.9	7.05	4.00	4.50
08.06.2012	5.85	6.31	6.4	6.65	6.8	4.20	4.70
06.07.2012	5.6	6	6.15	6.4	6.55	4.00	4.50
22.11.2014	5.6	5.6	6	6	6.15	3.75	4.25
01.03.2015	5.35	5.35	5.75	5.75	5.9	3.50	4.00
11.05.2015	5.1	5.1	5.5	5.5	5.65	3.25	3.75

Source: PBOC

Appendix 2 Robustness Check for Aggregate Level Model

Table 1: Robustness check for house price equation

	(All)	(Year >=2007)	(Year <2007)
VARIABLES	House Price	House Price	House Price
Estimation Technique	2SLS	2SLS	2SLS
Housing Investment Volumes	-13.946***	21.421**	-26.206***
	(-3.32)	(1.82)	(-3.19)
Floor Spaces Completed for Sale	-1.858***	3.628**	-1.741***
	(-3.94)	(1.86)	(-4.26)
Urbanisation Rate	0.552***	6.590***	-0.250
	(2.66)	(3.32)	(-1.38)
Marriage Rate	10.784**	-1.031	-11.089
	(1.92)	(-0.08)	(-1.64)
GDP	3.509***	-7.065***	7.348***
	(4.36)	(-2.07)	(6.32)
Constant	-16.038***	-235.536***	18.624***
	(-2.19)	(-3.43)	(2.55)
F-statistic	671.10	115.71	50.21
Observations	61	33	28
R-squared	0.977	0.915	0.957
Weak instruments test	Cragg-Donald Wald F statistic: 10.203 > (9.08[a])		
H0: instruments are week			
Over-identification test	Wooldridge's robust score = 1.978		
	$p = 0.3720$		
Instruments	GDP; M2 Supply; Long-term Borrowing Rate; Natural Logarithm Inflation; Floor Spaces Completed for sale		

*** $p<0.05$, ** $p<0.1$

Robust t-Statistics in parentheses

[a] Critical value at 10% 2SLS relative bias

Table 2: Robustness check for housing affordability equation

VARIABLES	(All) House Price to Income Ratio	(Year >= 2007) House Price to Income Ratio	(Year < 2007) House Price to Income Ratio
Estimation Technique	2SLS	2SLS	2SLS
M2 Supply	0.074***	0.046	0.050
	(3.19)	(1.54)	(1.07)
Urbanisation Rate	-0.365***	-0.641***	-0.266***
	(-6.92)	(-2.14)	(-3.82)
Net Increase in National Household Saving	-0.851***	-0.343***	-0.020
	(-4.27)	(-3.41)	(-0.13)
Marriage Rate	4.954***	4.186***	-3.345***
	(4.99)	(2.87)	(-2.51)
LTV	0.057***	-0.090***	0.029***
	(2.56)	(-2.28)	(3.26)
Housing Investment Volumes	-3.910***	-1.550***	-1.657
	(-3.96)	(-3.24)	(-1.33)
Long-term HPFs Borrowing Rate	0.179	-0.942***	2.099***
	(0.80)	(-4.20)	(17.27)
Constant	18.711***	48.422***	13.665***
	(12.11)	(3.36)	(4.94)
F-statistic	92.50	249.66	146.54
Observations	61	33	28
R-squared	0.888	0.905	0.953
Weak Instrument Test H0: instruments are weak	Cragg-Donald Wald F statistic = 11.183 > (10.83b)		
Over-identification test H0: all instruments are valid	Wooldridge's robust score = 4.841 $p = 0.3040$		
Instruments	Instruments= GDP; LTV; Net Increase in National Household Savings; Housing Investment; Unemployment Rate; Inflation Rate; Long-Term Borrowing Rate; House Price;		

*** p<0.05, ** p<0.1

Robust t-Statistics in parentheses

[b] Critical value at 10% 2SLS relative bias

Appendix 3: Robustness Check for Household Level Model

Table 3: Robustness check for housing affordability equation

VARIABLES	Housing Expenditure to Income Ratio	Housing Expenditure to Income Ratio	Housing Expenditure to Income Ratio
Estimation Technique	(2SLS)	(GMM)	(LIML)
Tenure Choice	12.135***	11.855***	12.354***
	(4.99)	(4.95)	(4.90)
Employed	-4.213***	-4.440***	-4.238***
	(-2.45)	(-2.59)	(-2.46)
Married	-3.361***	-3.449***	-3.406***
	(-1.86)	(-1.95)	(-1.88)
Having Provident Fund	-6.293***	-5.917***	-6.347***
	(-4.03)	(-3.83)	(-4.05)
HPF borrowing rate	-3.988***	-3.927***	-3.995***
	(-1.91)	(-1.92)	(-1.91)
Urbanisation ate	0.541***	0.490***	0.542***
	(5.27)	(5.22)	(5.27)
House price	0.096***	0.102***	0.094***
	(4.07)	(4.44)	(3.96)
BeiJing	4.364***	4.007***	4.438***
	(2.04)	(1.97)	(2.06)
ShangHai	4.880***	4.840***	4.883***
	(2.80)	(2.79)	(2.80)
GuangDong	-0.664	-1.695	-0.661
	(-0.26)	(-0.67)	(-0.26)
Constant	19.030**	21.078***	19.003**
	(1.82)	(2.09)	(1.82)
Observations	675	675	675
R-squared	0.174	0.175	0.173

*** $p<0.05$, ** $p<0.1$

Robust t-Statistics in parentheses

Table 4: Robustness check for tenure choice equation

VARIABLES	Tenure Choice	Tenure Choice
Estimation Technique	(probit)	(logit)
Housing Expenditure to Income Ratio	0.018***	0.031***
	(4.48)	(4.44)
Household Size	0.130***	0.217***
	(2.10)	(2.03)
employed	0.731***	1.290***
	(4.00)	(3.88)
Married	0.689***	1.290***
	(3.16)	(3.21)
Loan to Value Ratio	-0.123***	-0.214***
	(-9.96)	(-9.49)
Having Provident Fund	1.026***	1.809***
	(6.47)	(6.46)
HPF borrowing rate	0.743***	1.283***
	(2.86)	(2.82)
Inflation Changes	-0.163***	-0.284***
	(-5.34)	(-5.26)
BeiJing	-1.388***	-2.459***
	(-5.25)	(-4.99)
ShangHai	-0.028	-0.036
	(-0.13)	(-0.10)
GuangDong	0.411**	0.675**
	(1.87)	(1.80)
Constant	3.551***	6.118***
	(2.41)	(2.39)
Observations	675	675

*** p<0.05, ** p<0.1

Robust t-Statistics in parentheses