

**THE IMPACT OF DEMOGRAPHIC TRANSITION ON CHINA'S  
REALESTATE MARKET PRICES**

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## ABSTRACT

The real estate industry is not only the pillar industry of China's economy, but also the development of the real estate market has an important impact on the life of Chinese people and the stability of the financial market. Since the housing market reform in 1998, China's urban real estate market has developed rapidly. However, in the process of the rapid development of China's urban real estate market, the price of China's urban real estate has also experienced a huge rise, which is far more than the rise of the per capita income level of Chinese residents, thus exerting an important impact on the housing demand of Chinese residents. At the same time, China's population structure has changed dramatically in terms of age, urban and rural residence, and employment. Population is the main support for the demand of the urban real estate market. The drastic change of population structure undoubtedly plays an important role in the rapid rise of the price of the urban real estate market in China. To clarify the influence of population structure change on China's urban real estate market price, this dissertation explores the influence of population structure on China's urban real estate market price from three aspects of population age, population urban-rural location and population employment by using econometric methods on the basis of constructing a local equilibrium model to analyze the influence of population structure on urban real estate market price.

Based on the realistic background of the development of China's real estate market and the change of population structure, this dissertation first constructs a partial equilibrium model of the real estate market after combing the existing relevant literature, and theoretically analyzes the impact of the change of population structure on the real estate market price from the three aspects of population urban-rural, population age and population employment. Second, this paper deeply combs the historical process of the development of China's real estate market and analyzes data on the changes in the urban-rural location, age and employment of China's population in the past decades. The

correlation between China's population structure and real estate market price is preliminarily analyzed by drawing scatter plot. Finally, on the basis of the above theoretical analysis and preliminary data analysis, this paper uses the econometric regression analysis method to further analyze the impact of demographic structure change on the price of China's real estate market from the three aspects of population urban-rural location, population age and population employment. The following three main conclusions are obtained: First, in terms of the urban-rural population structure, the increases of the proportion and number of urban residents have a positive impact on the price of China's urban real estate, and vice versa means that the increases of the proportion and number of rural residents have a negative impact on the price of China's real estate. Second, in terms of population age structure, the increases in the proportion and quantity of the population aged 0-14 have a negative impact on the price of China's real estate market, while the increases in the proportion and quantity of the population aged 15-64 and the increases in the proportion and quantity of the population aged 65 and above have a positive impact on the price of China's real estate. Thirdly, in terms of population employment structure, the increases of the proportion and number of employed population in primary industries has a negative impact on the price of China's real estate market, while the increase of the proportion and number of employed population in the secondary and tertiary industries has a positive impact on the price of China's real estate.

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## CHAPTER 1. INTRODUCTION

### 1.1 Background and Issues

#### 1.1.1 Background

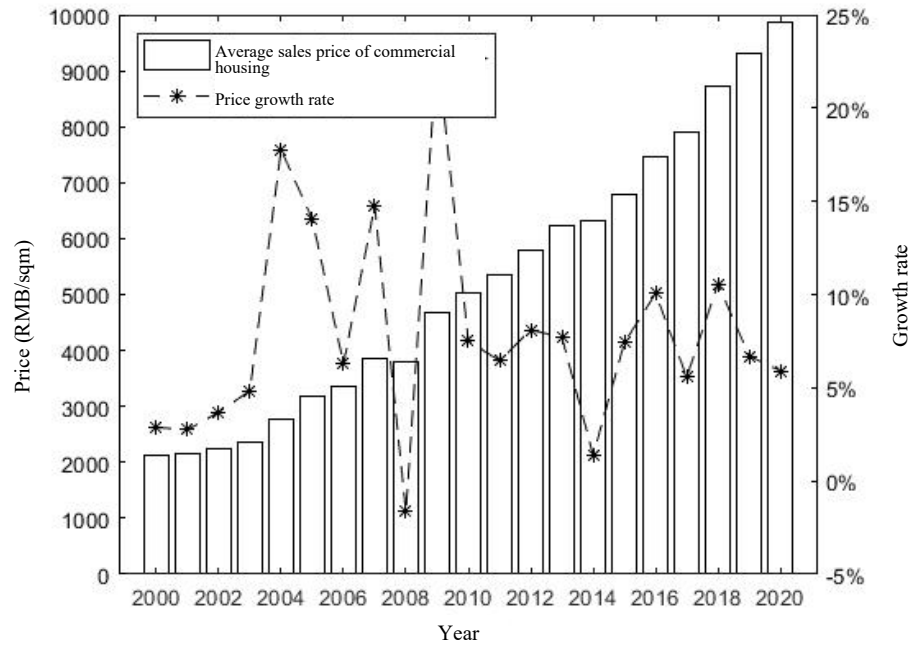
China's economy entered a fast track after China started reform and opening in 1978. This is evidenced by the official data released by the National Bureau of Statistics of China, showing that China's nominal gross domestic product (GDP) increased from RMB 410 billion in 1979 to RMB 101,599 billion in 2020. China's real GDP increased by 235.71 times, with an average annual growth rate of 14.03%, during the 42 years from 1979 to 2020. China's real estate market has also boomed together with fast economic development. The urban real estate market formed as the result of the housing marketization reform in 1998, which ushered in a new era for China's real estate industry. After two years of reconditioning following 1998, the market regained momentum in 2000 after a complete range of policies and rules were released. According to the official data released by the National Bureau of Statistics, the added value of China's real estate industry, the added value of the construction industry, which is closely related to real estate, and the national gross domestic product (GDP) were RMB 414 billion, RMB 553 billion, and RMB 10,028 billion respectively in 2000. The contribution rate of the real estate industry to GDP was 4.13%, and that of the real estate industry together with the construction industry was 9.65% in the year. In 2020, the added value of China's real estate industry, the added value of the construction industry, and the national gross domestic product (GDP) were RMB 7,455 billion, RMB 7,300 billion, and RMB 101,599 billion respectively. The contribution rate of the real estate industry to GDP was 7.34%, and that of the real estate industry together with the construction industry was 14.5% in

the year. China's economic structure has undergone tremendous changes from 2000 to 2020 with momentous growth in the tertiary sector and related science and technology industries. The contribution rate of the real estate industry to GDP kept growing from 4.13% in 2000 to 7.34% in 2020, an increase of 3.21 percentage points during the 20 years. Statistically, China's real estate industry and construction industry recorded an average annual growth rate of the added value of 15.55% and 13.77% respectively from 2001 to 2020, while the average annual growth rate of the national GDP was 12.28% during the same period. Both the real estate industry and the construction industry grew faster than the national GDP. Therefore, the real estate industry's development has played an important role in driving China's economic growth in recent decades whether in terms of the industry's contribution rate to the national GDP or from the comparison between the industry's average annual growth rate and that of the national GDP. In fact, the real estate industry is a pillar of the Chinese economy, and its development plays a key role in maintaining the stability of people's lives and the financial market in China. Housing takes up a dominant part in the portfolios of assets owned by Chinese families as data show that real estate assets account for 70% of the total assets of Chinese residents.

The effect of rising housing prices has been considered in the above data about the growth of the real estate market and its contribution to China's economy. The average price of commercial housing was RMB 2,112.00 per square meter in China in 2000, while China's consumer price index, which took 1978 as the base year, was 434.0 in that year. In 2020, the average price of commercial housing rose to RMB 9,860.00, 4.67 times higher than that in 2000. With 1978 as the base year, the consumer price index in 2020 was 686.5, 1.58 times higher than that in 2000. That is, the rise of housing prices in China

has notably outrun the pace of rising prices of other consumer goods. To be more specific, the times of increase in the average price of commercial housing in China was 3.09 higher than the times of increase in the consumer price index from 2000 to 2020. It can be said that the rising housing prices have also played a tremendous part in the whole real estate market's contribution to China's economic growth.

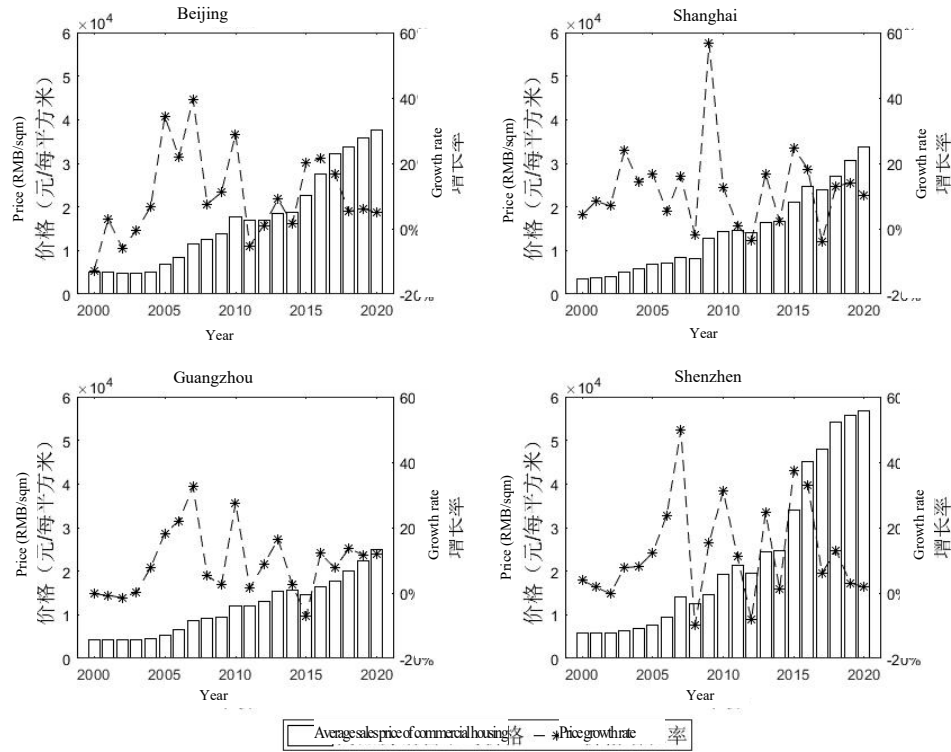
Figure 1 shows the average prices and growth rates of commercial housing in China from 2000 to 2020. From the figure, China's housing prices experienced sharp fluctuations over the 20 years, with the most shocking price changes observed from 2003 to 2010. The prices of commercial housing increased by about 3% – 5% per year from 2000 to 2003. The housing prices surged by 17.76% in 2004 and took a breather by rising 14.02% and 6.29% in 2005 and 2006 respectively. The housing prices resumed a two-digit increase in 2007. China's real estate market witnessed the fastest rise in prices of 23.18% in 2009. After that, China's housing prices entered a steadily fast growth stage in 2010. The average housing price nearly doubled, increasing from RMB 5,032 in 2010 to RMB 9,860 in 2020, with an average annual growth rate of 7.74% during the ten years.



**Figure 1. Average Prices and Growth Rates of Commercial Housing in China**

Below are data of Beijing, Shanghai, Guangzhou, and Shenzhen, the four most developed first-tier cities in China. From Figure 2, the average price of commercial housing in Beijing, Shanghai, Guangzhou, and Shenzhen was RMB 4,919, RMB 3,565, RMB 4,294, and RMB 5,718 per square meter respectively in 2000. The average price of commercial housing in Beijing, Shanghai, Guangzhou, and Shenzhen rose to RMB 37,665, RMB 33,798, RMB 25,056 RMB, and RMB 56,829 per square meter respectively in 2020. The housing prices of Beijing, Shanghai, Guangzhou, and Shenzhen increased by 7.66, 9.48, 5.84, and 9.94 times respectively, with average annual growth rates of 10.22%, 12.19%, 9.18%, and 12.71% respectively during the 20 years from 2000 to 2020. The four cities also shared similar patterns of housing price growth during the 20 years. The housing prices in all four cities rose modestly between 2000 and 2004. The housing price growth rates in Beijing, Guangzhou, and Shenzhen all peaked in 2007, being 39.53%, 32.45%, and 49.71% respectively. The housing price growth rate in

Shanghai peaked in 2009, being 56.68%. Like the general situation in other cities across China, the housing prices in Beijing, Shanghai, Guangzhou, and Shenzhen entered a steadily fast growth stage after 2010.



**Figure 2. Housing Prices and Growth Rates in Beijing, Shanghai, Guangzhou, and Shenzhen**

From the figure above, China's housing prices entered a steady fast growth stage in 2010 after undergoing sharp fluctuations marked by soaring prices whether from the perspective of individual typical cities or the real estate market of China as a whole. The fast-rising housing prices have been a strong driver of China's economic growth. The current housing price level, however, has outrun the incomes of residents after more than 20 years of development of China's real estate market. Chinese residents face serious housing issues because of the fast-rising housing prices, which could also aggravate the uncertainty in the financial market, leading to additional financial risks. To address these

issues, the Central Economic Work Conference in 2016 insisted that "housing is for living, not for speculation" to promote the stable and healthy development of the real estate market. This means that the national decision-makers have further clarified the positioning of China's real estate market, emphasizing that the primary goal of real estate development is to "meet the housing demand" rather than driving economic growth and to resume its residential use as the primary purpose. The Chinese government has released policies in finance, administration, land, taxation, and other fields to curb the excessive rise of housing prices and prevent speculative bubbles from forming in the real estate market. For example, relevant Chinese authorities have released financial policies to cool down residents' housing demand by increasing the percentage of down payment, raising loan interest rates, and tightening housing credit. Despite the government's efforts to reverse the trend of the real estate market through measures of finance, administration, land, and taxation, they have not fundamentally solved the severe socioeconomic problems posed by high housing prices in Chinese cities. Therefore, studying the drivers behind the rising housing prices in China in this context will not only help us further understand the law of the real estate market but also provide theoretical references for the government in regulating the real estate market and for real estate developers in formulating business strategies.

Among the variety of factors affecting housing prices, the population is the main support of the demand in the real estate market. Changes in the population's age structure (Ermisch, 1996; Lindh and Malmberg, 2008; Levin et al., 2009; Hiller and Lerbs, 2016), urban-rural structure (Gabriel et al., 1999; Wang et al., 2017), and employment structure (Green and Hendershott, 1996) have played an important role in the fast-rising housing

prices in China. Statistics show that tremendous changes have taken place in China's population structure in recent decades from the perspectives of urban-rural residence, age, and employment. From the urban and rural perspective, China's urban population has had a notable increase in terms of absolute number and relative proportion since 1995, while China's rural population has experienced an obviously constant decrease. The urban population continued to expand, and the rural population kept shrinking. Behind this was the rapid advancement of China's industrialization and population urbanization in recent decades. The tremendous changes in the urban-rural structure of land and population have undoubtedly caused a strong impact on urban housing prices given China's unique land systems in rural and urban areas. In China, a homestead system is implemented in rural areas, where the land of homesteads is collectively owned and allowed for use by farmers. Farmers may build houses on the homesteads allocated by the government to meet their housing needs. The government has not established rules on the transfer of rural homesteads, so there is no real estate market in rural areas, and rural homesteads and the houses attached to them cannot be traded in the market. In contrast, state ownership of land is implemented in cities, where the land is owned by the country, and the land use right may be transferred through listing for sale, contracts, bidding, and auction. The government transfers land for residential use to real estate developers chosen through bidding or auction, and then the real estate developers build houses and finally sell them to urban residents in the real estate market. As a result, urban residents have only two options to obtain the right to use houses. One is to buy houses from real estate developers in the market, and the other is to rent houses for short-term use. Therefore, with a large portion of the rural population moving to cities, the changes in

China's population structure have generated huge demand in the urban real estate market, which has led to the fast rise in housing prices.

From the perspective of age, the proportion of the population aged 15 – 64 kept increasing from 1995 to 2010, reaching 74.5% in 2010. However, this figure began to decline slowly after the year and arrived at 68.6% in 2020. From the above statistics, China's population was concentrated in the range between 15 and 64 years old during the 20 years after the housing marketization reform started. The population of this age range accounted for 60% – 70% of the total population. The population of this age range has been not only the main labor force for economic and social development but also the main consumer group in the real estate market. Thus, the age structure of China's population also provides essential support for the demand in China's real estate market. Therefore, the changes in the population's age structure may also play a significant role in the fast-rising housing prices in China.

Following National Bureau of Statistics of China, I define the three broad sectors in the obvious way: Primary sector comprises agriculture, forestry, husbandry and fishery; secondary sector comprises mining, manufacturing, production and supply of electricity, heat, gas and water, construction; Tertiary sector comprises all other industries (i.e., education, government, real estate, trade, transportation, etc.). From the perspective of employment, the number of people employed in the primary sector decreased by 178.15 million from 1995 to 2020. Contrary to the trend in the primary sector, the number of people employed in the tertiary sector was 168.80 million in 1995, and this figure increased to 358.06 million in 2020. The absolute number of people employed in the tertiary sector increased by 189.26 million during the 26 years. The number of people

employed in the secondary sector was 156.55 million in 1995, and this figure was 215.43 million in 2020. The number of people employed in the secondary sector showed two humps by increasing first and then decreasing, then increasing and then decreasing again from 1995 to 2020. Next, the proportions of people employed in the primary, secondary, and tertiary sectors in the total labor force are compared. The proportion of people employed in the primary sector continued to decline, while the proportions of people employed in the secondary and tertiary sectors continued to rise in general from 1995 to 2020. Compared with the proportion in the secondary sector, the proportion of people employed in the tertiary sector increased at a faster pace.

In China, significant disparity is observed in wage levels in the primary, secondary, and tertiary sectors. The wage level of the tertiary sector is higher than that of the secondary sector, which is higher than that of the primary sector. As the labor force moves from the primary sector to the secondary and tertiary sectors, the income level of Chinese residents has kept increasing and laid a foundation for the increasing demand in the real estate market. Therefore, the changes in the population's employment structure may also play a significant role in the fast-rising housing prices in China.

#### 1.1.2 Issues

China has made remarkable achievements in economic growth in the past two decades. Along with the rapid growth of China's economy, China's real estate market has also made dramatic progress since the start of the housing market reform in 1998. This process has been accompanied by a sustained and rapid rise in housing prices. This is especially true in tier-one cities, such as Beijing, Shanghai, Guangzhou, and Shenzhen, where housing prices have outrun the incomes of residents. Housing affordability has

become an important livelihood issue in China's economy and society. Many scholars have studied the phenomenon of fast-rising housing prices in China in this context. The existing literature mainly reviews the reasons for fast-rising housing prices in China from the perspectives of land price, monetary policy, residents' income, and urbanization. As for the effect of land prices and land systems on housing prices, Bao (2004) and Yun (2006) believed that the rules on urban land transfer released by the Chinese government gave birth to land finance, which in turn pushed up land prices and finally led to rising housing prices. As for the effect of monetary policies on housing prices, scholars believe that loose monetary policies mean lower loan costs for home purchases, driving the housing demand and thus the housing prices (Song and Gao, 2007; Zhou and Li, 2011). As for the effect of residents' income on housing prices, scholars believe that the increase in residents' income level has accelerated the accumulation of residents' wealth, driving the housing demand and thus the housing prices (Zhao and Zou, 2012; Guo, 2018). As for the effect of urbanization on housing prices, Shuai (2005) and Zhou (2010) believed that the rapid advancement of urbanization attracted a large number of rural residents into cities, resulting in huge demand for homes and thus driving housing prices.

It is worth noting that the urban-rural structure, age structure, and employment structure of China's population have experienced tremendous changes together with fast-rising housing prices. Therefore, systematic research of the effect of China's population structure on housing prices is of great theoretical significance and provides important references in practice in this context. Focusing on the changes in housing prices mainly from a macro perspective, this dissertation studies the effect of the urban-rural structure,

age structure, and employment structure on housing prices with econometric analysis methods and puts forward policy recommendations based on the findings.

## **1.2 Literature Review**

After review and collation, a wide selection of existing literature related to this dissertation can be divided into two categories. One deals with the influencing factors of housing prices in China and their mechanisms with diversified research methods from different perspectives, while the other pays more attention to demographic changes for explaining the causes and trends of price fluctuations in the real estate market.

### **1.2.1. Research on Influencing Factors of Housing Prices in China**

From the literature on a large number of studies, the price formation mechanisms in China's real estate market are found to be complex, and the price formation is affected by many factors. Common influencing factors include economic development level, inflation rate, per capita disposable income, population size, urban public infrastructure, development cost, land use density, and down payment availability (Kearl et al., 1979; Dougherty et al., 1982; Shen and Liu, 2004; Egert et al., 2007; Liang and Gao, 2007; Tan and Chen, 2012; Wang, 2013). However, these basic economic factors became less useful in explaining China's housing prices after 1998 and are unlikely to account for the strong growth of China's housing prices for many years (Shen and Liu, 2004). Relevant studies by scholars show that China's ratio of housing price to per capita GDP has far exceeded the ratios of developed countries in Europe and the Americas and developing countries, such as Indonesia (Lu et al., 2014). For this reason, scholars have also carried out studies on other factors affecting housing prices in China besides those named above. Generally,

scholars mainly discuss factors affecting housing prices in China from the following perspectives in addition to the basic influencing factors.

The first is monetary policy. The monetary policy can affect housing prices through the money supply and interest rate. Some scholars believe that the excessive money supply due to China's long-time loose monetary policy is the decisive factor pushing up the housing price (Li et al., 2011; Zhang, 2016). For example, Li et al. (2011) were among the first scholars who studied the long-term relationship between housing price and money stock with a co-integrated VAR model. They carried out empirical tests with the data of the United States, Japan, and China during periods of housing bubbles and found that the changes in quasi-money stock were highly correlated with those in housing prices. This was especially true in Japan, where the contribution rate of the money stock to housing price increases was as high as 50%. Therefore, a huge money stock is the most important factor driving housing prices during periods filled with speculative bubbles. Zhang (2016) analyzed the influencing mechanism of money supply on housing prices theoretically by establishing a dynamic stochastic general equilibrium model. The simulation results showed that the housing price would increase by about 0.8% when the monetary authority increases the money supply by 1% due to more money flowing into the real estate market as a result of the financial accelerator effect. Some other scholars try to explain the reasons for housing price fluctuations from the perspective of bank credit and discuss the relationship between interest rates and housing prices (Dai 2009; Gu, 2014; Chen, 2016). For example, Dai (2009) and Kuang (2010) first discussed the influencing mechanism of changes in interest rates on housing prices on the supply side and the demand side and thought that the rise of interest rates would

reduce the desire of residents for consumption and repress the demand. However, the rise of interest rates would also increase the financing cost and credit pressure on real estate developers, who would reduce supply. Finally, they found that the changes in interest rates had a significant negative disturbing effect on housing prices through structural VAR empirical analysis. The reason is that the rise in interest rates leads to decreased demand in the real estate market, resulting in the decline of housing prices, while falling interest rates increase the housing demand, driving up housing prices. Gu and Zhang (2014) compared and analyzed the effect of interest rate and deposit reserve rate, the two main monetary policy tools, on housing prices. They found that interest rates have a less significant regulating effect on housing prices than that exerted by deposit reserve rates though both interest rates and deposit reserve rates are Granger causes of housing prices. Chen (2016) further studied the influencing mechanism of social financing costs on interest rates' role in price pass-through. The study showed that lowering interest rates could generate a more obvious pulling effect on housing prices where social financing costs are relatively high. Some other scholars have studied the heterogeneity of the regional effect of monetary policy on housing prices in depth (such as Tu et al., 2018; Long, 2019; Yin, 2022, etc.).

The second is speculation at the time of economic bubbles. It is worth noting that many scholars analyze the reasons for the rising housing prices from the perspective of demand for speculation at the time of economic bubbles considering the dual attributes of housing as consumer goods and investment products (Zhou, 2005; Sun, 2010, etc.). For example, Zhou (2005) established a real estate speculation test model and used the panel data of 14 cities for regression. He found that the per capita disposable income is not the

decisive factor in housing prices. Instead, the factor of speculation explains the high housing prices in China to a great extent, especially in the real estate markets of Shanghai, Hangzhou, and other cities in the Yangtze River Delta, where speculation existed widely. Similarly, Kuang (2010) believed that the basic economic factors do not change in the short term, so they are not decisive factors pushing up the housing prices in China. He proved that expectation and speculation are strongly explanatory of the housing prices in China and are important factors driving the housing prices by establishing a housing market equilibrium model including expectation and speculation and using the housing price data of 35 Chinese cities from 1996 to 2007 for regression analysis. Tan (2010) further suggested that 2005 was a critical point for the structural mutation of the value attribute and price level of real estate in China. Since 2005, real estate has got a strong attribute of investment and even speculation and experienced dramatic fluctuations of investment with obvious bubbles due to the rigid demand of residents and the deliberate control of developers. Li (2012) believed that the fundamental cause of the demand for speculation lay in the rising inflation rates and the expectations of residents for future inflation due to the extremely loose monetary policy implemented in many countries after a financial crisis broke out in 2008. Real estate was used as hedging assets for investment or speculation. Strong speculative demand led to rising prices in the whole real estate market and resulted in the irrational booming of the real estate market.

The third is land finance. According to China's land systems, urban land is owned by the country, while rural land use rights are owned by collectives except for a few special cases. Such land systems gave rise to the monopoly of land supply by the

government and the unique land finance in China. Land finance means that local governments obtain revenues from land transfer fees paid by real estate developers or real estate taxes and construction taxes to meet their financial needs. Land finance has been proved to be one of the main reasons for the continuously rising housing prices in China (Xu, 2009; Zhang and Li, 2010; Ren, 2017; Xie, 2019; Deng and Ou, 2021). Chinese scholars have carried out detailed analyses of the influencing mechanism of land finance on housing prices. For example, Guo (2013) believed that local governments induced developers to offer high prices in land auctions through the current practices of "bidding, auction, and listing for sale" in land auction transfer, which also allow some space for rent-seeking. Therefore, high land prices driven by land finance are a key factor that causes housing prices to rise too fast. Zhou (2010) constructed a general equilibrium model including residents, local governments, and real estate developers and concluded that land prices and housing prices are in a mutual relationship of Granger causality through empirical research. Moreover, changes in land prices play an important role in housing prices and transactions according to the pass-through mechanism of land prices as land prices are a core component of developers' costs. With panel data from Beijing, Tianjin, Chongqing, and Shanghai, Du (2011) studied the dynamic relationship between land prices and housing prices in the past two decades. The results show that land prices are indeed the Granger cause of the real estate market, but the reverse relationship is not established. On the contrary, Joseph et al. (2006) found that housing prices are the Granger cause of land prices, but the reverse relationship is not established in the real estate market of Singapore. This finding is opposite to that of empirical research in China, so the reasons behind it are worth pondering. Interestingly, Wang and Wen (2012)

gave explanations different from the mechanism of "land prices driving house prices" summarized by the three scholars above. From the results of theoretical models and empirical analyses, they found the monopoly of land by the government does not drive housing prices by pushing up land prices as traditionally believed. Instead, local governments are motivated to reduce the speculative risks of real estate by various means (such as consultation with developers and bailout policies). By giving a signal that "house prices will rise forever", they boost the speculative demand of residents, thus indirectly fueling the rising housing prices and the continuous increase in government revenues. Therefore, reform of the financial system and local government performance appraisal should be addressed first to fundamentally curb the high housing prices in the domestic market. No matter how land finance affects housing prices, the housing prices of countries with high reliance on land finance are obviously higher than those of countries not relying on land finance, as evidenced through comparative analyses of empirical studies of different countries.

#### 1.2.2 Study of Mechanisms of Population Structure Affecting Housing Prices

The studies mentioned above show that housing prices in China are affected by many factors, such as basic macroeconomic level, land finance, loose monetary policy, expectation, and speculative psychology. Population, however, has been rarely considered in the main research framework though it is the most important carrier of the actual demand in real estate transactions. More and more scholars turn their attention to the effect of demographic changes on housing prices and transactions along with the progress of urbanization and aging (Lee et al., 2003; Liu et al., 2013). The relevant literature is summarized below from the perspective of population structure.

Theoretically, the population structure can be categorized from multiple perspectives. For example, Ye (2012) divided the characteristics of population structure into natural characteristics (such as gender structure and age structure), economic characteristics (such as industrial structure and housing consumption structure), social characteristics (such as marriage status structure and educational background structure) and distribution and migration (such as urbanization level and migration of urban and rural population) in analyses of the sixth census of Hubei Province. At present, many studies focus on the urbanization level, which represents changes in the spatial structure, and the aging level, which represents changes in time-migration, as key variables and deals with their correlation with housing prices and mechanisms of their effect on housing prices.

(1) Study of mechanisms of urban-rural structure affecting housing prices

China has made remarkable achievements in urbanization along with rapid economic development since China started reform and opening up. The rapid advancement of urbanization has been accompanied by dramatic changes in the urban-rural structure of China's population. The proportion of the rural population in the total population has continued to decline, while that of the urban population has kept increasing, as a large number of rural residents have come to live in cities. China's urbanization level increased from 33.35% in 1998 to 64.72% at the end of 2021 according to the Statistical Communiqués of the People's Republic of China on the National Economic and Social Development. Many scholars believe that the demand for commercial housing has risen significantly in cities due to urbanization in the past two decades. Consequently, the inflow of migrant farmers, college graduates, and local residents with compensation for demolished homes has also played a large part in driving

the price level in the real estate market (Xie, 2013; Lu et al., 2014; Wu, 2015; Gong et al., 2019). For example, Xie (2013) studied the relationship between the changes in the urban-rural structure and the supply and demand in the real estate market based on fixed-effect models with the panel data of 31 provinces and autonomous regions in China from 2005 to 2011. The empirical test results show that the increase in the urban population and the decrease of the rural population drive both the demand and supply in the real estate market. Wu (2018) further distinguished the heterogeneity of residents' housing demand while considering the urban-rural structure of the population. Wu (2018) categorized the demand in the real estate market into rigid consumption demand of immigrants, speculative demand of local residents, and demand of local farmers with compensation for demolished homes. With data from the Pearl River Delta economic zone from 2005 to 2016, Wu analyzed the effect of residents' heterogeneous housing demand on housing prices with a fixed-effect model while considering changes in the urban-rural structure of the population. Luo (2011) observed characteristics of typical bimodal distribution in the relationship between changes in the urban-rural structure and housing prices in addition to the use of basic regression with panel data. On this basis, Luo (2011) explored the nonlinear effect of changes in the urban-rural structure of the population on housing prices in detail. The empirical results show that the increase in the proportion of the urban population has not only a positive impact on housing prices but also an obvious threshold effect and spatial spillover effect as indicated by regression analyses with panel data. That is, the impact of changes in the urban-rural structure of the population on housing prices is subject to a threshold effect of economic development level and human capital level, and housing prices are also affected by the housing prices

in neighboring provinces. To make up for the insufficiency of theoretical models on urbanization and population mobility, Meng et al. (2017) pondered on the effect of urbanization and inter-regional population mobility factors on the changes in housing prices. By depicting the heterogeneity of buyers' demand, they established a general equilibrium model between buyers and real estate developers and carried out relevant empirical tests. Finally, both theoretical models and empirical data prove that per capita income level, urbanization rate, and population mobility have a significant positive impact on housing prices in the inflow areas.

## (2) Study of mechanisms of age structure affecting housing prices

From many empirical studies, Chinese and foreign scholars find that the age structure of the population has a significant impact on housing prices. Some scholars note that the age structure is more explanatory of fluctuations in housing prices compared with macro-economic factors and have even successfully predicted the trend of housing prices based on the trend of ages (Mankiw and Weil, 1989; Bakshi and Chen, 1994; Bergantino, 1998; Dent, 2004).

At present, there are two theories supporting the relationship between the changes in the age structure of the population and the changes in housing prices. One is the life cycle theory represented by Mankiw and Weil (1989). According to this theory, rational individuals make economic decisions from the perspective of long-life cycles and maximize the utility of the whole life cycle by balancing savings and consumption at different ages. The life cycle theory implies that the changes in the age structure have an impact on the fluctuation of housing prices. Savings exceed consumption, and excessive demand appears for fixed assets such as commercial housing when the proportion of

young people rises. In this case, housing prices rise accordingly. Consumption exceeds savings, and excessive supply of fixed assets exists with housing prices declining accordingly when the proportion of old people rises. The other is the overlapping generations model (OLG) represented by Abel (2001). According to this theory, individuals of different ages have obviously different demands for real estate. For example, young people would spend savings to buy real estate to meet the rigid housing demand or other speculative demand, while old people are more likely to sell real estate and other fixed assets in exchange for funds to meet their needs for care due to limited income. As a result, the differences in age structure led to changes in the housing demand and thus have a significant impact on housing prices.

Population aging was not an issue in China until recent decades, so domestic scholars were late in studying the influencing mechanism and change trend of population structure on housing prices. As a result, the literature on this topic is insufficient and centered on qualitative analysis (Chen, 2012; Xu, 2012; Zou, 2014; Guo, 2015; Hu; 2017). For example, Guo (2015) measured the degree of aging in China with the old-age-dependency ratio, i.e., the ratio of elderly dependents 64 years and older to the number of people of working age and measured the urbanization level with the proportion of the urban population. Guo (2015) constructed a panel smooth transition model to empirically study the nonlinear effect of population growth on housing prices through two transition variables: aging degree and urbanization level. The study found that there is a significant positive correlation between China's population growth rate and housing prices, but this positive effect of the population gradually weakens as the aging degree becomes severer. Comparing the relative size of the conversion coefficients, it is found that the aging

degree has a faster impact on housing prices than the urbanization level. Therefore, China's real estate market will face pressure for recession when the demographic dividend gradually disappears, and the aging becomes severer. A few scholars have studied the effect of changes in age structure on housing prices with the overlapping generations model. For example, Chen (2013) constructed an overlapping generations model for three stages of the lifecycle, i.e., juvenile, young and middle age, and old age by taking into account the dual demand for real estate in consumption and investment. The results of equilibrium behavior show that housing prices drop with the increase in the old-age-dependency ratio and rise with the decrease in the child-dependency ratio. The reason is that the expenses for education and consumption related to raising children decrease and the ability to afford homes increases where the child-dependency ratio decreases. Population aging increases supply in the real estate market and brings possible declining housing prices. This finding is enlightening in predicting housing price fluctuations and trends in the real estate market considering China's aging population and the unconditional two-child policy. The unconditional two-child policy refers to the policy that all couples, regardless of urban or rural, regional or ethnic group, can have two children. The implementation of the unconditional two-child policy is a further adjustment of the fertility policy after the conditional two-child policy. On December 27, 2015, the Standing Committee of the National People's Congress passed “the Amendment to the Population and Family Planning Law”, which including the unconditional two-child policy, and this unconditional two-child policy was officially implemented on January 1, 2016.

After comparing the changes in population and trends in housing prices in China, the United States, Japan, and South Korea, Shao (2021) concluded rising housing prices happen concurrently with the demographic dividend, which is closely related to the producer-consumer ratio. That is, the increase in the ratio means an increase in social investment and savings, thus supporting the prices of real estate and other fixed assets.

### (3) Study of mechanisms of employment structure affecting housing prices

At present, only a limited number of studies have covered the correlation effect between the employment structure of the population and housing prices, and most of them focus on the one-way effect of housing prices on changes in the employment structure and the industrial structure. For example, Gao (2012) noted that a complex internal correlation mechanism possibly exists among housing price changes, labor mobility, and industrial structure changes. The research results show that some workers are forced to move out of areas with high housing prices based on the new economic geography model proposed by Krugman (1991, 1992) and the inclusion of housing price factors. This produces a crowding-out effect in industries with low added value, while high-end industries and emerging industries get more development opportunities. Li (2012) and Zhou and Cheng (2013) studied the effect of the employment structure on housing prices in Guangzhou and Beijing as examples. With sample data from Guangzhou from 1990 to 2009, Li (2012) found that the increase in non-agricultural workers has a notable impact on housing prices in Guangzhou in the short term. On this basis, Zhou and Cheng (2013) examined the impact of the employment structure on housing prices in Beijing and further considered the impact of the proportion of the working population with the sample data of Beijing from 1990 to 2011. The study found

that the employment proportions in all the primary, secondary and tertiary sectors had a significant impact on housing prices in Beijing. The increase in employment proportion of the tertiary sector significantly contributed to the rise of housing prices in Beijing. With the sample data from Shanghai from 1994 to 2012, Sun (2017) reached a finding similar to that of Zhou and Cheng (2013). That is, the increase in employment in the tertiary sector drove the rise of housing prices in Shanghai. Wang et al. (2017) carried out a study with a broadened sample range including 70 large and medium-sized cities and found that population factors affect the industrial structure and thus housing prices.

### 1.2.3. Summary of Literature

As for the studies on the influencing factors of housing prices in China, most of the existing literature deals with the impact of changes or shocks on housing prices from the perspective of macroeconomic policies and local financial systems and verifies the correlation and mechanisms between core variables and housing prices with theoretical models and empirical analysis. Scholars generally believe that the continuously rising housing prices have been mainly driven by demand factors considering the rigidity of supply in China's real estate market. However, most of such factors cause only short-term impacts or accidental shocks, which cannot fully account for the long-time continuous rise and fluctuations of housing prices in China. Some other scholars studied the correlation effect with housing prices in China from the perspective of real estate tax (Su et al., 2012; Kuang 2012), income distribution (Pan, 2013; Zhou, 2019), and population structure (Zhou et al., 2013; Wang et al., 2013).

As for mechanisms of population structure affecting housing prices, some studies have found changes in the population structure have a significant impact on housing

prices in China. Changes in the urban-rural structure, age structure, and employment structure of the population have supported and even drove the formation of housing prices. The urban-rural structure, age structure, and employment structure are key factors that cannot be ignored in studying the formation of housing prices in China and predicting its trend of changes. Though some studies dealt with the impact of the urban-rural structure, age structure, and employment structure on housing prices in China, little literature covers the effect of changes in the population structure on housing prices from the combined perspective of age, urban-rural residence, and employment. In fact, it is impossible to systematically and comprehensively understand the mechanisms of changes in population structure affecting housing prices in China, if the effect of changes in the urban-rural structure, age structure, and employment structure on housing prices are discussed separately as they interact with and influence each other. Therefore, this dissertation deals with the effect of changes in urban-rural structure, age structure, and employment structure on housing prices in China simultaneously on the basis of existing related literature. This dissertation is intended to enrich the existing literature and provide new insights for explaining the history of fast-rising housing prices in China in the past 20 years.

## **CHAPTER 2. THEORETICAL ANALYSIS OF EFFECT OF CHANGES IN POPULATION STRUCTURE ON HOUSING PRICES**

### **2.1 TERMS AND DEFINITIONS**

#### **2.1.1 Population Structure**

Population structure, also known as population composition, refers to a portrayal obtained by dividing the population according to various criteria. The population structure reflects various qualitative and prescriptive quantitative and proportional relations within a population in a certain region at a certain time point. Li et al. (2008) divided the population structure from five aspects: nature, economy, society, quality, and geographical location. Some other scholars divide the population structure into four categories by gender and age, geographical location, society, and economy (Hu, 2002). At present, the research community generally categorizes the population structure into natural structure, regional structure, and social structure.

The natural structure of the population consists of population gender structure and population age structure. The gender structure represents the proportions of men and women in the total population. The age structure represents the proportion of each age range in the total population according to various age classification criteria. Compared with gender structure, the age structure reflects the natural characteristics of the population in a region or a country and presents important economic attributes. Societies composed of different population age structures may differ in economic development. Different age structures also have an important impact on the development of various industries in the economy and society. Therefore, the age structure, which is a type of

natural structure, is chosen to study its effect on housing prices in China in this dissertation.

Geographical structure of population refers to a population structure obtained by dividing the population by geographical location where the people live. The types of geographical structure include urban-rural structure, jurisdiction structure, mobility structure, and natural geographical structure. Changes in the urban-rural structure are of tremendous economic significance given China's unique dual land systems in rural and urban areas. China's dual land systems directly affect the supply in the real estate market, while the urban-rural structure has an important impact on the demand. Therefore, the urban-rural structure from the geographical structures is chosen to study its effect on housing prices in China in this dissertation.

Social structure of population refers to a population structure obtained by dividing the population according to the social and economic characteristics of the population, such as education, employment, marriage and family status, social class, and ethnicity. Accordingly, the types of social structure may be defined by employment, marriage and family status, social class, ethnicity, and so on. Considering that the marriage and family status structure, social class structure, and ethnic structure change slowly over time, this dissertation chooses the employment structure, which is a type of social structure, to study its effect on housing prices in China. Generally, the employment structure is further divided by the primary, secondary industry, and tertiary sectors, and the changes in the proportion of employed people in each sector in the total employed population reflect the changes in the employment structure.

### 2.1.2 Housing Prices

Housing price refers to the price of buildings together with the land on which they stand. Specifically, the housing price consists of land price and building price. Housing prices are the most important mechanism for regulating economic operation and resource allocation in the real estate market.

As a commodity, real estate has use value and exchange value like other commodities. According to the labor value theory and price theory in Marxist economics, housing prices are based on the value in general and essentially the monetary expression of real estate's value. However real estate is a special commodity. The word "essentially" is added when describing the formation of housing prices to suggest the difference from that of other common commodities. As a complex economic category, housing prices include both land prices and building prices. Housing prices reflect the value of the combination of buildings and land, which are inseparable from each other. Buildings are the results of human labor and have value, as common commodities do. As a special commodity, real estate is not completely a product of labor. The price of land represents the capitalization of land rent due to land monopoly as the original land is a creation of nature without human labor.

The so-called land rent is essentially the cost paid by land users to landowners for the use of land, which reflects the value of land as a natural resource. Therefore, the price of the original land is not a monetary expression of labor value from this point of view. However, the land in real life has been treated with a large amount of human labor. To make the land suitable for economic use, human beings have transformed land through a lot of materialized labor and living labor in exploration and exploitation. Particularly, the

cost of infrastructure and other investments in land are high, and more and more labor are accumulated in the process. Such input of labor has the same labor value as that of common commodities. Most of the land price is the monetary expression of labor value, and its value is measured by the labor input from this point of view.

Therefore, the value of real estate is a combination of the value of buildings, land as a natural resource, and labor input in the land. The housing price is the monetary expression of this special combination of value. Because the value of houses and buildings and the value formed by labor input in land account for the main part, it can be said that the housing price is essentially the monetary expression of real estate value. Housing prices are essentially the monetary expression of real estate's value because the value of buildings and labor input in land account for the majority of real estate's value, which is similar to the relation of price to labor input for all other commodities.

## **2.2 Partial Equilibrium Model of Real Estate Market**

Like other commodities in a market economy, the basic law of market supply and demand determines housing prices because real estate is traded in the market (Zhang et al., 2011). For this dissertation, housing price refers to the combined price of buildings and land meeting the people's residential needs. Housing prices fluctuate around their value according to the law of supply and demand, which guides the housing market to form an equilibrium price. This is the pricing theory of the housing market. To better illustrate the subsequent analysis, the changes in supply and demand in the housing market and the determination of equilibrium price are briefly summarized below.

The equilibrium price is formed with the quantity of supply of goods matches the demand for goods according to basic economic theories. Assume the demand equation of the real estate market is:

$$Q_d = \alpha_1 + \beta_1 P \quad (1)$$

Variables  $Q_d$  and  $P$  represent the demand and the price in the real estate market respectively. Parameter  $\alpha_1$  is a constant; parameter  $\beta_1 < 0$  indicates that the housing demand decreases with the rise of the housing price.

Assume the supply equation of the real estate market is:

$$Q_s = \alpha_2 + \beta_2 P \quad (2)$$

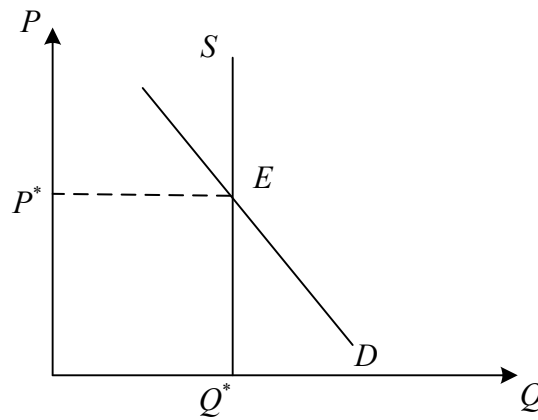
Variables  $Q_s$  and  $P$  represent the supply and the price in the real estate market respectively. Parameter  $\alpha_2$  is a constant; parameter  $\beta_2 > 0$  indicates that the supply in the real estate market increases with the rise of the housing price.

Considering the demand and supply in the real estate market, the market equilibrium is determined by the following equation:

$$Q_d = Q_s \quad (3)$$

On the demand side, like other types of products, the price elasticity of demand in the real estate market is negative, meaning the demand decreases with the rise of the housing price. The demand curve of the real estate market is represented by a downward slope toward the right. On the supply side, the price elasticity of supply in the real estate market is weak because real estate is characterized by a long time for construction and delayed supply. The supply in the real estate market remains almost unchanged in the short term. To reflect this in the supply equation (2) of the real estate market, parameter

$\beta_2$  is close to zero or even equal to zero. As result, the supply is hardly affected by the housing price, and the supply is unlikely to increase with the rise of the housing price in the short term. The short-term equilibrium of the real estate market can be represented as shown in Figure 3 below:

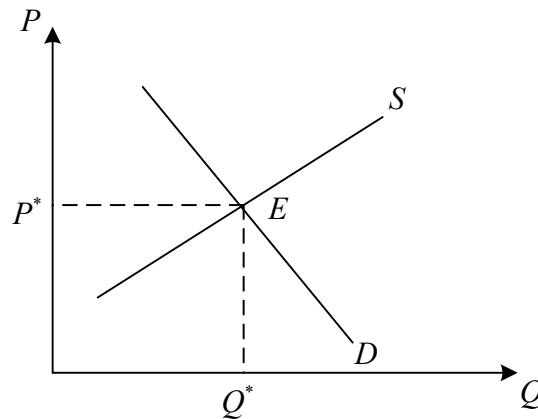


**Figure 3. Short-term Equilibrium of Real Estate Market**

In Figure 3, the horizontal axis represents the equilibrium output of the real estate market, and the vertical axis represents the equilibrium price of the real estate market. The curve  $D$  sloping downward to the right represents the demand curve of the real estate market, and the vertical line  $S$  represents the short-term supply curve. The intersection  $E$  of the demand curve  $D$  and short-term supply curve  $S$  of the real estate market represents the market equilibrium point. The price  $P^*$  corresponding to the equilibrium point is the market equilibrium price, and the price  $Q^*$  corresponding to the equilibrium point is the market equilibrium output.

The supply in the real estate market increases with the rise of the housing price, and the price elasticity of the supply in the real estate market is positive in the long term. To reflect this in the supply equation (2) of the real estate market, parameter  $\beta_2$  is greater

than zero. In this case, the supply curve of the real estate market inclines upwards to the right, and the long-term equilibrium of the real estate market can be represented as shown in Figure 2.2 below:



**Figure 4. Long-term Equilibrium of Real Estate Market**

Similar to Figure 3, the horizontal axis represents the equilibrium output of the real estate market, and the vertical axis represents the equilibrium price of the real estate market in Figure 4. The curve  $D$  sloping downward to the right represents the demand curve of the real estate market, and the curve  $S$  inclining upward to the right represents the short-term supply curve. The intersection  $E$  of the demand curve  $D$  and short-term supply curve  $S$  of the real estate market represents the market equilibrium point. The price  $P^*$  corresponding to the equilibrium point is the market equilibrium price, and the price  $Q^*$  corresponding to the equilibrium point is the market equilibrium output.

It is worth noting that the supply curve and demand curve of real estate market are unobservable in reality in the partial equilibrium model of real estate market. From the data, we can observe only the equilibrium point determined by the demand curve and the supply curve of real estate market together. That is the equilibrium price and equilibrium

output of real estate market. This is also the case when the demand curve or the supply curve of real estate market changes. In this case, we can only observe changes in the equilibrium price and equilibrium output of the real estate market and cannot observe changes in the demand curve or the supply curve. However, we can still use the equilibrium model of real estate market as a theoretical tool to explain the mechanism by which the population structure affects the housing price on the abstract level even if we cannot get the real estate market supply-demand and demand curve. Next, this dissertation is to analyze the theoretical mechanism by which the population's age structure, urban-rural structure, and employment structure affect the housing price with the aforementioned equilibrium model of real estate market as an analysis tool.

## **2.3 Analysis of Mechanisms of Population Structure Affecting Housing Prices**

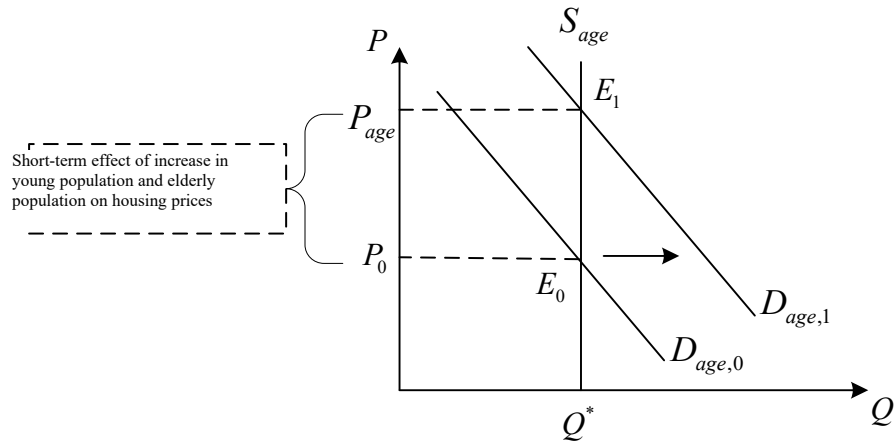
### **2.3.1 Age Structure and Housing Prices**

The effect of the age structure on housing prices can be explained with the life cycle theory and the intergenerational transfer theory. People at different ages differ significantly in terms of economic variables such as consumption and income according to the life cycle theory. They also have different physiological and psychological characteristics. As housing is a kind of consumer goods with relatively high value, the housing demand of people of different ages naturally has different characteristics, which affect the housing price. Specifically, the same individual may also have different housing demands at different ages according to the life cycle theory. When individuals are young, they may have strong demand for homes when getting married and having babies. The demand for homes decreases due to physiological and psychological changes when individuals get old. Therefore, the overall housing demand increases with the

increase in the number or proportion of young people in an economy, and the overall housing demand decreases with the increase in the number or proportion of the elderly population.

From the above analysis with the life cycle theory, the demand in the real estate market increases with an increase in the young population and decreases with an increase in the elderly population. However, this is not the entire case in China, where the elderly family members usually help their descendants buy homes in the Chinese traditional culture. That is, intergenerational transfer exists between the elderly population and the young population. In fact, intergenerational transfer is an apparent phenomenon in home purchases in China due to the Chinese traditional culture and the dividend brought about by China's real estate reform at the end of the last century.

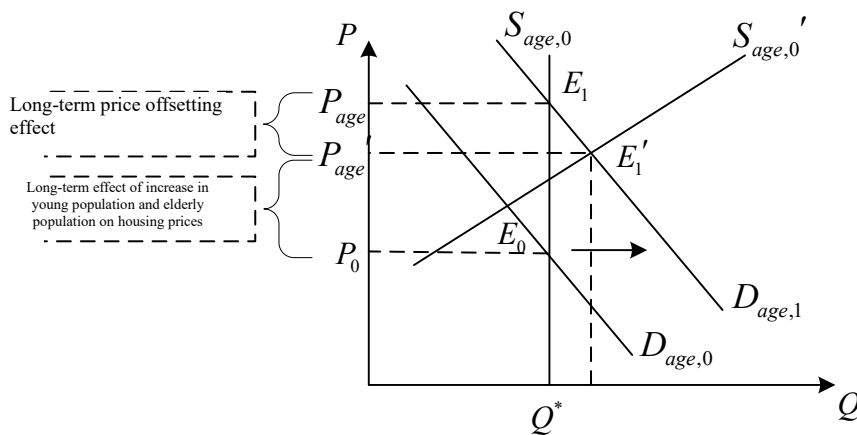
The demand in China's real estate market may be driven by both the increase in the youth population and the elderly population due to the combined effect of life cycle and intergenerational transfer. In the short term, housing prices would rise due to the increase in demand in the real estate market caused by the changes in the age structure of the population as the supply in the real estate market lack elasticity. Specifically, the effect of the increase in the youth population and the elderly population in the age structure on China's housing prices in the short term is represented as shown in Figure 4:



**Figure 5. Short-term Effect of Increase in Young Population and Elderly Population on Housing Prices**

Figure 5 measures the short-term effect of the increase in the youth population and the elderly population on housing prices. Specifically, the initial demand curve of the real estate market is  $D_{age,0}$ , and the short-term supply curve is  $S$  in Figure 2.3. The initial equilibrium point of the real estate market is  $E_0$ , the corresponding initial equilibrium price is  $P_0$ , and the initial equilibrium output is  $Q^*$ . The demand in the real estate market increases with the increase in the youth population and the elderly population, and the demand curve of the real estate market moves from the initial  $D_{age,0}$  toward the upper right to be  $D_{age,1}$ . The corresponding equilibrium point of the real estate market becomes  $E_1$ , and the equilibrium price becomes  $P_{age}$ . As the supply in the real estate market remains unchanged in the short term, the equilibrium output after the increase in the demand remains unchanged and is still  $Q^*$ .  $P_{age} - P_0$  reflects the increase in the youth population and the elderly population leads to an increase in demand in the real estate market and then affects the housing price in the short term.

The increase in the youth population and the elderly population drives the demand in the real estate market and then the housing price. In the long term, because the price elasticity of supply in the real estate market is positive, the rise in housing prices would lead to an increase in supply in the real estate market, thus offsetting the effect of rising housing prices brought by the increase in the youth population and the elderly population. Specifically, the effect of the increase in the youth population and the elderly population in the age structure on China's housing prices in the long term is represented as shown in Figure 2.4:

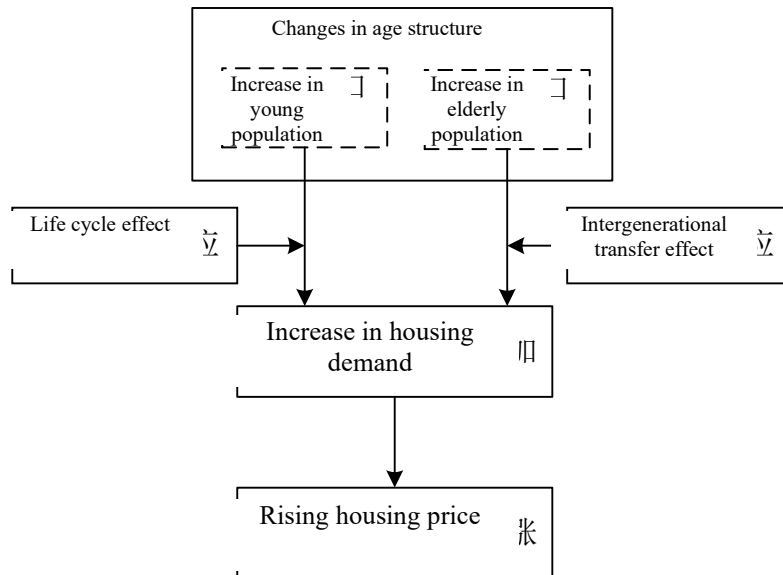


**Figure 6. Long-term Effect of Increase in Young Population and Elderly Population on Housing Prices**

Figure 6 measures the long-term effect of the increase in the youth population and the elderly population on housing prices. Specifically, the initial demand curve of the real estate market is  $D_{age,0}$ , and the short-term supply curve is  $S_{age,0}$  in Figure 2.4. The initial equilibrium point of the real estate market is  $E_0$ , the corresponding initial equilibrium price is  $P_0$ , and the initial equilibrium output is  $Q^*$ . On the demand side, the demand in

the real estate market increases with the increase in the youth population and the elderly population, and the demand curve of the real estate market moves from the initial  $D_{age,0}$  toward the upper right to be  $D_{age,1}$ . On the supply side, the supply in the real estate market increases with the rise of housing prices in the long term, which is different from the behavior of the supply in the real estate market in the short term. Therefore, the long-term supply curve of the housing market inclines toward the upper right, as shown by the curve  $S_{age,0}$  in Figure 5. In this case, the right-shifting demand curve  $D_1$  of the real estate market caused by the increase in the youth population and the elderly population intersects with the long-term supply curve  $S_{age,0}$  of the real estate market at point  $E_1$ , which is the new equilibrium point of the real estate market. At this time, the equilibrium price of the real estate market is  $P_{age}'$ , and the equilibrium output of the real estate market is  $Q^*$ .  $P_{age}' - P_{age}$  reflects that the short-term price effect of the increase in the young population and old population is partially offset by the increase in the supply in the real estate market in the long term.  $P_{age}' - P_0$  reflects the long-term effect of the increase in the youth population and the elderly population on housing prices.

Generally, the changes in the age structure of the population have a combined effect of life cycle and intergenerational transfer on the demand in the real estate market and then affect the housing price. The theoretical mechanism of the age structure affecting housing prices can be summarized as shown in Figure 2.5 below:



**Figure 7. Theoretical Mechanism of Age Structure Affecting Housing Prices**

Based on the above analyses, the following assumptions are proposed:

H1.1: The increase in young and middle-aged population has a positive impact on housing prices in China.

H1.2: The increase in the elderly population has a positive impact on housing prices in China.

### 2.3.2 Urban-Rural Structure and Housing Prices

The real estate market virtually involves cities only as housing trading barely exists in rural areas due to China's unique dual land systems in rural and urban areas. This is because China has established relevant systems for urban land transactions only and has no trading system for rural land transactions at all. The missing of a rural land trading market means the missing of the rural real estate market because the land is a necessary input factor for the production of real estate products.

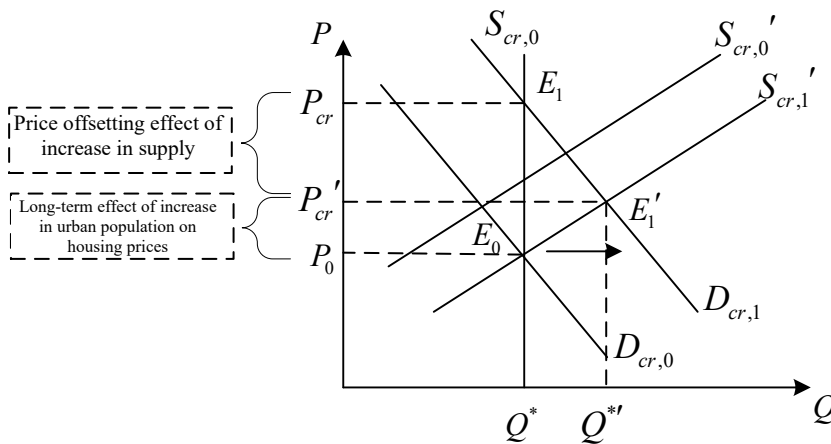
On the demand side, the changes in the urban-rural structure affect housing demand through direct and indirect channels and thus affect the housing price. The

changes in the urban-rural structure affect the housing price directly via residents' purchase behavior and affect the housing price indirectly via residents' rental behavior. As an example, the analysis below addresses the case where the urban population increases, and the rural population decreases. When moving from rural areas into cities, people purchase or rent properties, which is a rigid demand for working and living in cities. If they choose to purchase properties, their behavior directly increases the housing demand in their cities, and then possibly drives the housing price; if they choose to rent property, their behavior indirectly increases the demand, and then also possibly drives the housing price. The reason is that the increase in demand in the urban rental market would lead to demand for investment in the real estate market, thus increasing the total demand in the real estate market.

On the supply side, changes in the urban-rural structure may also affect the housing supply in the long term. As an example, the analysis below addresses the case where the urban population increases, and the rural population decreases. Generally, the increase in the urban population means an increase in the urban labor supply. A large number of laborers moving from rural areas into cities have entered the real estate construction industry in China. The increase in labor supply in the real estate construction industry would lead to an increase in housing supply to some extent in the long term, while the increase in housing supply has a negative effect on the housing price. However, it is worth noting that only a fraction of the labor force enters the real estate construction industry when people move from rural areas into cities. As a result, the increase in demand in the real estate market brought by the population moving from rural areas into cities may outweigh the increase in housing supply brought by them, so the net effect of

the population moving from rural areas into cities may lead to the rise of housing prices. Moreover, the price elasticity of housing supply is generally weaker than that of housing demand. As a result, the price increase brought by the increase in housing demand outweighs the price decrease brought by the increase in housing supply, which further supports the finding that the net effect of the population moving from rural areas into cities may lead to the rise of housing prices.

The mechanism of changes in urban-rural structure affecting housing prices analyzed above can be summarized as shown in Figure 7. The graphical interpretation of the short-term mechanism of changes in urban-rural structure affecting housing prices is not discussed in this dissertation as it is similar to that of the age structure on housing prices. The figure below is used to analyze the long-term mechanism of changes in urban-rural structure affecting housing prices only.

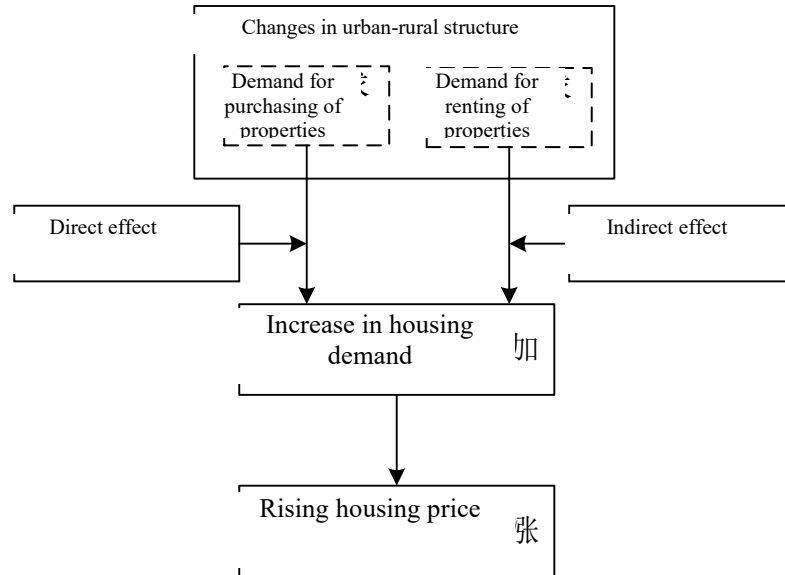


**Figure 8. Long-term Effect of Increase in Urban Population on Housing Prices**

Figure 8 measures the long-term impact of the increase in the urban population on housing prices. Specifically, the initial demand curve of the real estate market is  $D_{cr,0}$ , and the short-term supply curve is  $S_{cr,0}$  in Figure 5. The initial equilibrium point of the

real estate market is  $E_0$ , the corresponding initial equilibrium price is  $P_0$ , and the initial equilibrium output is  $Q^*$ . On the demand side, the demand in the real estate market increases with the increase in the urban population, and the demand curve of the real estate market moves from the initial  $D_{cr,0}$  toward the upper right to be  $D_{cr,1}$ . On the supply side, the supply in the real estate market increases not only with the rise of housing prices in the long term but also with the increase in labor force in the real estate construction industry brought by the increase in the urban population, which is different from the behavior of the supply in the real estate market in the short term. Therefore, the long-term supply curve of the real estate market moves from  $S_{cr,0}$  toward lower right to be  $S_{cr,1}$ . In this case, the right-shifting demand curve  $D_{cr,1}$  of the real estate market caused by the increase in the urban population intersects with the long-term supply curve  $S_{cr,1}$  of the real estate market at point  $E_1$ , which is the new equilibrium point of the real estate market. At this time, the equilibrium price of the real estate market is  $P_{cr,1}$ , and the equilibrium output of the real estate market is  $Q^*$ .  $P_{cr} - P_{cr}$  reflects that the short-term price effect of the increase in the urban population is partially offset by the increase in the supply in the real estate market in the long term.  $P_1 - P_0$  reflects the long-term effect of the increase in the urban population on housing prices.

Generally, the urban-rural structure has a combined effect of direct demand from purchasing properties and indirect demand from renting of properties on the demand in the real estate market and then affects the housing price. The theoretical mechanism of the urban-rural structure affecting housing prices can be summarized as shown in Figure 9 below:



**Figure 9. Theoretical Mechanism of Urban-Rural Structure Affecting Housing Prices**

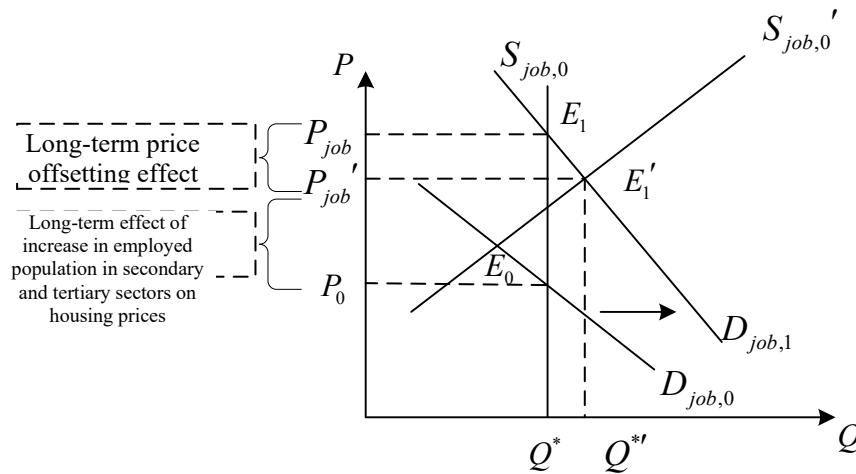
Based on the above analyses, the following assumptions are proposed:

H2: The change of rural population into urban population has a positive impact on urban housing prices in China.

### 2.3.3 Employment Structure and Housing Prices

The changes in the employment structure with the labor force moving from the primary sector to the secondary sector and then to the tertiary sector is the inherent embodiment of the economic development process (Kuznets, 1971). As for the changes in the employment structure, what has happened in countries around the world suggests that the labor force moves from the primary sector to the secondary and tertiary sectors together with the increase in the income level when the level of economic and social development keeps rising. In fact, the process of labor force flowing from the primary sector to the secondary and tertiary sectors is also called the process of industrial structure transformation and upgrading by scholars. The industrial structure in a

jurisdiction is often more advanced with higher per capita income levels where the secondary and tertiary sectors account for a high proportion of employment. The general increase in per capita income drives the housing demand and changes the price elasticity of housing demand. The price elasticity of housing demand is often weaker where the income level is higher. Changes in price elasticity of housing demand would affect the housing demand and thus affect the housing price. The figure below depicts the long-term mechanism of changes in the employment structure with the employed population moving from the primary sector to the second and tertiary sectors affecting housing prices. The short-term mechanism of changes in the employment structure affecting housing prices is not discussed in this dissertation as it is similar to that of the urban-rural structure affecting housing prices. The figure below is used to analyze the long-term mechanism of changes in the employment structure affecting housing prices only.



**Figure 10. Long-term Effect of Increase in Employed Population in Secondary and Tertiary Sectors on Housing Prices**

The initial demand curve of the real estate market is  $D_{job,0}$ , and the short-term supply curve is  $S_{job,0}$  in Figure 10. The initial equilibrium point of the real estate market

is  $E_0$ , the corresponding initial equilibrium price is  $P_0$ , and the initial equilibrium output is  $Q^*$ . As the population moves from the primary sector to the secondary and tertiary sectors, the income level keeps increasing and directly leads to an increase in housing demand. This is reflected by the housing demand translating from the  $D_{job,0}$  toward upper right to dotted line  $D_{job,1}$  in Figure 10. The rising income level brought about by changes in the industrial structure also weakens the price elasticity of housing demand. This is reflected by the demand curve of the real estate market rotating counterclockwise from  $D_{job,1}$  to  $D_{job,1}'$  in Figure 10. In this case, the right-shifting demand curve  $D_{job,1}'$  of the real estate market caused by the changes in the population structure moving from the primary sector to the secondary and tertiary sectors intersects with the long-term supply curve  $S_{job,0}'$  of the real estate market at point  $E_1'$ , which is the new equilibrium point of the real estate market. At this time, the equilibrium price of the real estate market is  $P_{job}'$ , and the equilibrium output of the real estate market is  $Q^*$ .  $P_{job} - P_{job}'$  reflects that the short-term price effect of the increase in the urban population is partially offset by the increase in the supply in the real estate market in the long term.  $P_{job}' - P_0$  reflects the long-term effect of the changes in the population structure with the employed population moving from the primary sector to the second and tertiary sectors on housing prices.

Generally, the changes in the employment structure with the employed population moving from the primary sector to the second and tertiary sectors on housing prices directly increase the housing demand by increasing the per capita income level of the jurisdiction; such changes also affect the price elasticity of demand in the real estate

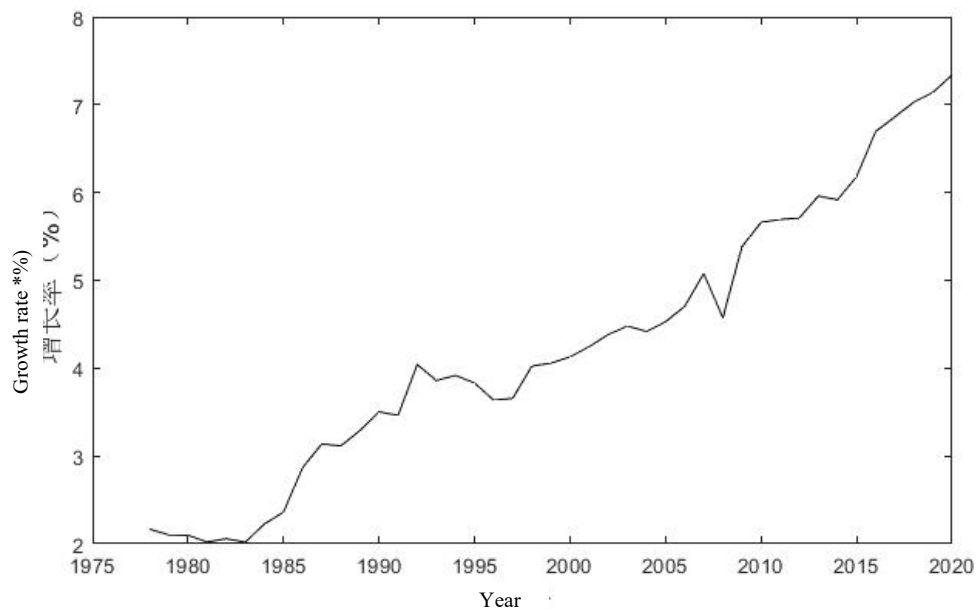
market, and thus affect the demand in the real estate market and ultimately affect the housing price. Based on the above analyses, the following assumptions are proposed:

H3: The changes in the employment structure with the employed population moving from the primary sector to the second and tertiary sectors have a positive impact on housing prices in China.

## CHAPTER 3. STATUS QUO OF CHINA'S POPULATION STRUCTURE AND REAL ESTATE INDUSTRY, AND ANALYSIS OF THEIR CORRELATION

### 3.1 Development Of China's Real Estate Market

China's economy embarked on a fast track when the Third Plenary Session of the Eleventh Central Committee of the Communist Party of China made the great decision to reform and open up in 1978. China's real estate market began to develop gradually while getting rid of the constraints of the planned economic system. The proportion of the added value of China's real estate industry to China's GDP continued to increase from 1978 to 2020. The added value of China's real estate industry accounted for 2.17% of China's GDP in 1978, as shown in Figure 11 below. The proportion kept increasing in the following decades and reached 7.34% of China's GDP in 2020, which marked that the real estate industry became a pillar industry driving China's economic growth.



**Figure 11. Proportion of Added Value of Real Estate Industry of China's GDP from 1978 to 2020**

The development of China's real estate market since 1978 can be roughly divided into six stages: initial development, rapid development, adjustment, prosperity, continued development, and stable development. The initial development extended from 1979 to 1991; the rapid development extended from 1992 to 1993; the adjustment extended from 1994 to 1997; the prosperity extended from 1998 to 2003; the continued development extended from 2004–2015; the stable development has extended from 2016 to the present.

### 3.1.1 Initial Development (1979–1991)

The initial development stage of China's real estate market began after the Third Plenary Session of the Eleventh Central Committee of the Communist Party of China in 1978. After this meeting, China launched economic system reforms in various fields, including the housing system reform. In September 1978, Deng Xiaoping noted: "Can we solve the housing problem with a wider mindset by, for example, allowing private housing, providing public assistance for private housing, and paying by installments to leverage the money of individuals, while the government solves the supply materials? The potential would be huge in this respect." In *Deng Xiaoping Talking about Construction Industry and Housing* published in April 1980, he noted that "urban residents may buy or build houses, sell new or old houses, and pay housing prices in a lump sum or in installments". The real estate industry was gradually recognized as an important part of the economic growth, and the commercialization of housing opened the curtain of China's housing system reform. In June 1980, the State Council approved the *Outline of Report at the National Capital Construction Work Conference*, which formally put forward the housing commercialization system. Shenzhen was the first city to collect

land use fees and allow the use of state-owned land on a paid basis in the year. The policy of selling urban real estate at full price was implemented all over the country in 1981. The effect was unsatisfactory though more than 60 cities in 23 provinces, autonomous regions, and municipalities directly under the Central Government started to sell new housing. A "three-thirds subsidizing policy" was implemented in cities in 1982. Under the policy, the government, employers, and individuals bear 1/3 of the house price. However, this policy was stopped because the subsidized house sales system encountered resistance. As part of the housing system reform, "rent subsidization" was launched from 1985 to 1986, and Yantai, Bengbu, and other places were the first cities to implement "rent subsidization." China kicked off the land use system reform in November 1987, when the State Land Administration designated Shenzhen, Shanghai, Zhuhai, Guangzhou, Tianjin, Xiamen, Fuzhou, and other places as pilot cities for the land use system reform. At this stage, the investment in real estate development in China rose steadily, and the proportion of real estate investment in fixed assets remained at about 5%.

### 3.1.2 Rapid Development (1992–1993)

China's real estate market started rapid development after Deng Xiaoping's south tour talks in 1992. Deng Xiaoping visited Wuchang, Shenzhen, Zhuhai, Shanghai, and other places in southern China and conducted a series of important talks from January 18 to February 21, 1992. The tide of socialist market economic system reform swept across the country rapidly after Deng Xiaoping's south tour talks. The investment in real estate development began to increase rapidly during this time. China's investment in real estate development was RMB 33.6 billion in 1991 and increased to RMB 193.7 billion in 1993,

an increase of 476%, as shown in Figure 12 China's investment in real estate development accounted for 15% of fixed assets investment in 1993. The development of China's real estate market appeared to overheat during this period. For example, Hainan Province was then a popular province for real estate investment. The average price of the real estate market in Hainan Province was just RMB 1,400 per square meter in 1991 and soared rapidly to RMB 5,000 per square meter in 1992. The rapid rise in prices in the real estate market attracted a lot of investment. The number of enterprises in China's real estate market surged from more than 3,000 in 1988 to more than 30,000 in 1993. The rapid increase in investment led to a surge in the supply of the real estate market. However, China still provided welfare housing at this stage, which led to insufficient demand in the real estate market. The supply of China's real estate market became far greater than the market demand, resulting in a huge stock of commercial housing, and developers began to abandon uncompleted construction projects in many cities. The financial market also began to suffer from a large number of non-performing assets caused by the supply-demand imbalance in the real estate market.

The State Council released the *Opinions on Current Economic Situation and Strengthening Macro-regulation* in 1993 to address the problems in the development of the real estate market and mitigate the financial risks posed by these problems. The document clearly requires strengthening the macro-regulation of real estate, resolutely resists real estate speculation for excessive profits, and decides to strictly control the scale of credit, and crack down on illegal lending, fraudulent fund-raising, and other violations in the financial sector. The sixteen regulatory measures worked with immediate effect in

cooling down the real estate investment in the past two years, and the policy intervention dramatically slowed down the development of China's real estate.

### 3.1.3 Adjustment (1994–1997)

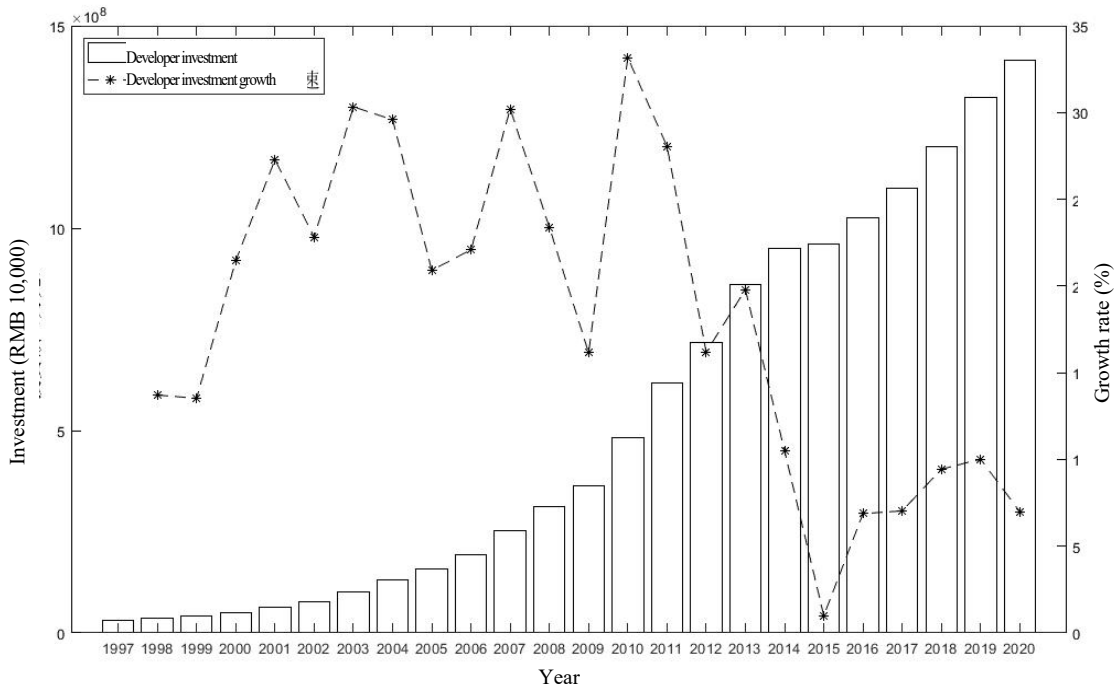
The policy intervention in 1993 led to a rapid decline in the growth of development investment in China's real estate market. As a result, the growth of commercial housing sales area in China's real estate market also decreased from 41.76% in 1992 to 8.11% in 1994. The State Council released the *Decision on Deepening the Reform of Urban Housing System* in July 1994 to deepen the reform of urban housing system and promote the development of housing commercialization and housing construction. The document clearly stated that the fundamental purpose of the urban housing system reform is to establish a new urban housing system adapted to the socialist market economic system and realize the commercialization and privatization of housing, accelerate housing construction, improve living conditions, and meet the growing needs of urban residents for housing. This policy document further deepened the reform of China's housing system. Under the guidance of the central government's policy, local governments adopted preferential policies to encourage residents to buy previously public housing and gradually raise the rent level to the market cost. The rent-to-sales ratio tended to be reasonable. China's real estate market recovered again in 1997 after about three years of adjustment. The growth rate of the commercial housing sales area rose from 8.11% in 1994 to 14.05%.

### 3.1.4 Prosperity (1998–2003)

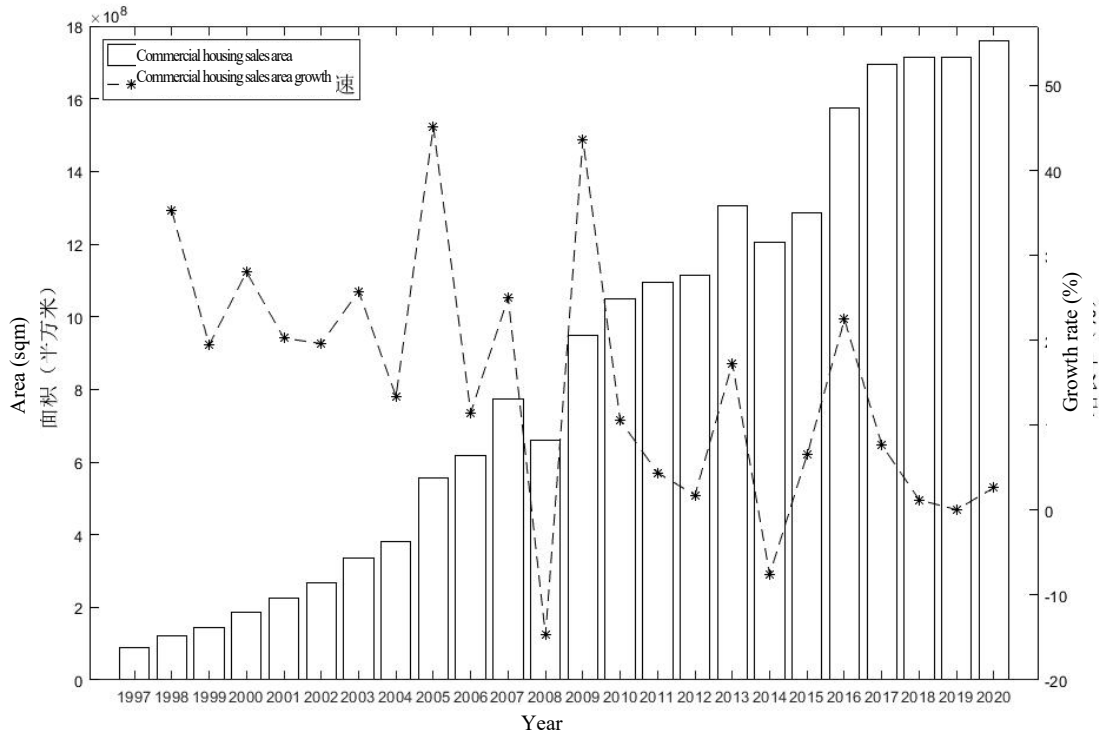
The Chinese government decided to strengthen the urban housing system reform in 1998. The State Council issued the well-known No. 23 policy document -- *Circular on*

*Further Deepening Urban Housing System Reform and Accelerating Housing*

*Construction* in July of the same year. The document formally asked for stopping the distribution of housing in kind, gradually implementing the monetization of housing distribution, and establishing and improving a multi-level urban housing supply system focusing on affordable housing. The No. 23 policy document completely released the effective demand in China's real estate market and directly drove the market into a prosperous stage. As shown in Figure 12, the development investment of Chinese real estate developers was RMB 361.423 billion in 1998, with a growth rate of 13.71%. The development investment of China's real estate developers increased from 1998 to 2013. The growth rates of development investment of Chinese real estate developers were 13.53%, 21.47%, 27.29%, 22.81%, and 30.33% in 1999, 2000, 2001, 2002, and 2003 respectively. The growth rate of development investment of Chinese real estate developers more than doubled in the five years, from 13.71% in 1998 to 30.33% in 2003. The development investment of Chinese real estate developers reached RMB 1,015.38 billion yuan in 2003, exceeding the milestone of RMB one trillion for the first time. The development investment of Chinese real estate developers more than tripled from 2003 to 2015. In terms of commercial housing sales area, the growth rate of commercial housing sales area in China's real estate market was as high as 35.24% in 1998 and maintained a growth rate of more than 20% per year until 2003. This suggested China's real estate market quickly entered a stage of prosperity after China formally implemented monetization of housing distribution.



**Figure 12. Development Investment and Growth Rates of China's Real Estate Developers from 1997 to 2020**



### **Figure 13. Sales Areas and Growth Rates of Commercial Housing in China from 1997 to 2020**

#### 3.1.5 Continued Development (2004-2015)

China launched a system of bidding, auction, and listing for the sale of land uses in 2002. It required that all land for commercial use must be traded through a bidding process. Land has officially become a commodity in real estate market since then. Open land bidding caused high land prices, which directly affected housing prices. The house prices kept rising with the average price of commercial housing sales growing by 15.02% and 16.72% in 2004 and 2005 respectively.

The People's Bank of China released the No. 121 Document in June 2003 to curb the soaring housing price. The document required that real estate developers applying for bank loans should have own funds of no less than 30% of the total investment in development projects, and it required to increase the down payment ratio for buyers if they already have residential units. The government kept releasing subsequent regulations and control policies, including the Eight Measures in 2005 and the Six Measures in 2006 released by the State Council. Affected by the global financial crisis in 2008, the Chinese government temporarily ceased regulating the real estate market and adopted a loose monetary policy. It began to implement a basket of programs to stimulate the economy in November of the year. Benefiting from the changes in macro-regulation, the growth rates of sales area and average sales price of commercial housing in China reached 43.63% and 23.19% respectively in 2009. The central government successively released policies, such as the Eleven Measures, the New Eight Measures, and the New Five Measures of the State Council National, to curb the growth of speculative housing demand and stabilize housing prices from 2010. A new round of housing market adjustment started. The

housing price kept soaring after 2003 though the central government imposed continuous macro-regulation of the real estate market through credit policies, tax policies, purchase restrictions, etc. The average sales price of commercial housing in China increased rapidly from RMB 2,360 in 2003 to RMB 6,793 in 2015, with an average annual growth rate of 9.2%. Among them, 2004, 2005, 2007, and 2009 witnessed the fastest paces at 15.02%, 16.72%, 14.77%, and 23.19% respectively.

During this period, real estate developers enjoyed rising net profit margins over the year as they benefited from the rapid development of the domestic economy, loose monetary policies, local government's financial dependence on land, and other factors. The net profit margin of real estate developers in China maintained at about 10% from 2008, and that of most real estate developers in first-tier cities was far more than 10%. The real estate market saw booming supply and demand, and the privatization and marketization characteristics of the housing market were deepened.

#### 3.1.6 Stable Development (2016–Present)

The central government successively released the March 30 policy and the September 30 policy in 2015, which reduced the down payment ratio of mortgages twice for cities where housing purchases were not restricted. In February 2016, the central government issued policies offering preferential deed tax and business tax exemption, reflecting the government's intention to minimize the stock and unleash the demand of buyers who wanted to buy better properties. Under the guidance of these policies, the real estate market recovered soon after 2016. The growth rate of real estate development investment climbed from 0.99% in 2015 to 6.88% in 2016 and 7.04% in 2017. However, the growing pace of real estate development investment obviously slowed down after

2015 compared with the double-digit annual growth rates after 1998. This suggested that China's housing market entered a new stage of stable development after fast growth in the past more than ten years.

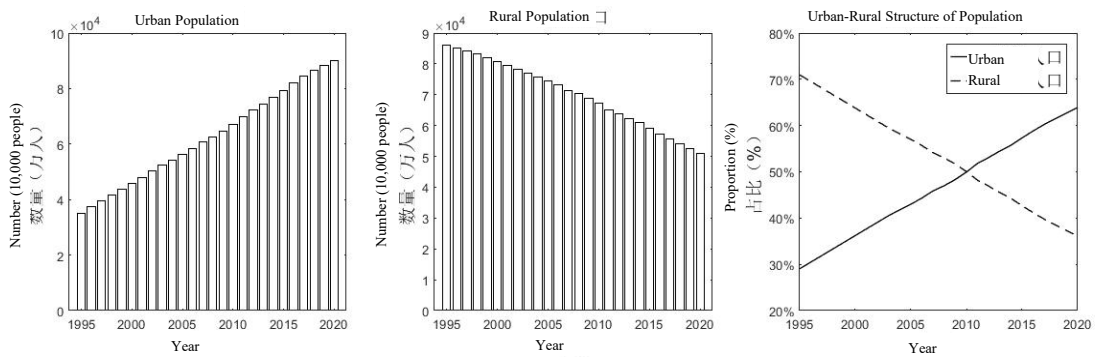
From welfare housing distribution to housing monetization reform, the development of China's real estate market has been a process of continuous adjustment and progress under the self-constraining of the government. The prosperity and development of the real estate market have stimulated the development of the national economy to a great extent. However, it has also exposed a series of problems, such as the imbalance between supply and demand structure, land finance, lack of housing security, etc. Real estate is bound with finance closer and closer. If the real estate market collapsed, it would surely cause a lot of non-performing assets of banks and even lead to a systemic financial crisis. Therefore, it is necessary to closely track the fluctuation of the real estate market and conduct in-depth research.

### **3.2 Analysis of Changes In China's Population Structure**

#### **3.2.1 Changes in Urban-Rural Structure of Population**

The urban-rural structure of population, also known as urban-rural population composition, refers to the numbers and quantitative relationship between urban and rural populations in the total population. The changes in the urban-rural structure of population are not only the result of social and economic changes but also an important factor affecting social and economic development. Figure 14 shows the changes in the numbers and relative proportions of urban and rural populations in China from 1995 to 2020. From Figure 14, the number and proportion of China's urban population maintained an increase from 1995 to 2020, while the number and proportion of China's rural population

experienced a constant decrease in the same period. In 1995, specifically, China's urban population was 351.74 million, accounting for 29.04% of the total population, while the rural population was 859.47 million, accounting for 70.96% of the total population. In the following decades, the urban population and its proportion in the total population continued to expand along with the continuous advancement of China's economic and social development, urbanization, and industrialization. On the other hand, the rural population and its proportion in the total population kept shrinking. China's urban population exceeded the rural population for the first time in 2011. After that, the difference in number between the urban population and the rural population widened steadily. In 2011, specifically, China's urban population was 699.2696 million, accounting for 51.83% of the total population, while the rural population was 649.8904 million, accounting for 48.17% of the total population. In 2020, China's urban population increased to 902.20 million, accounting for 63.89% of the total population, while the rural population dropped to 509.92 million, accounting for 36.11% of the total population.



**Figure 14. Changes in Urban-Rural Structure of China's Population from 1995 to 2020**

The above analysis shows that the number of the urban population in China experienced a continuous increase from 1995 to 2002, and so did the proportion of the urban population in the total population. In contrast, the number of the rural population experienced a continuous decrease, and so did the proportion of the rural population in the total population.

### 3.2.2 Changes in Age Structure of Population

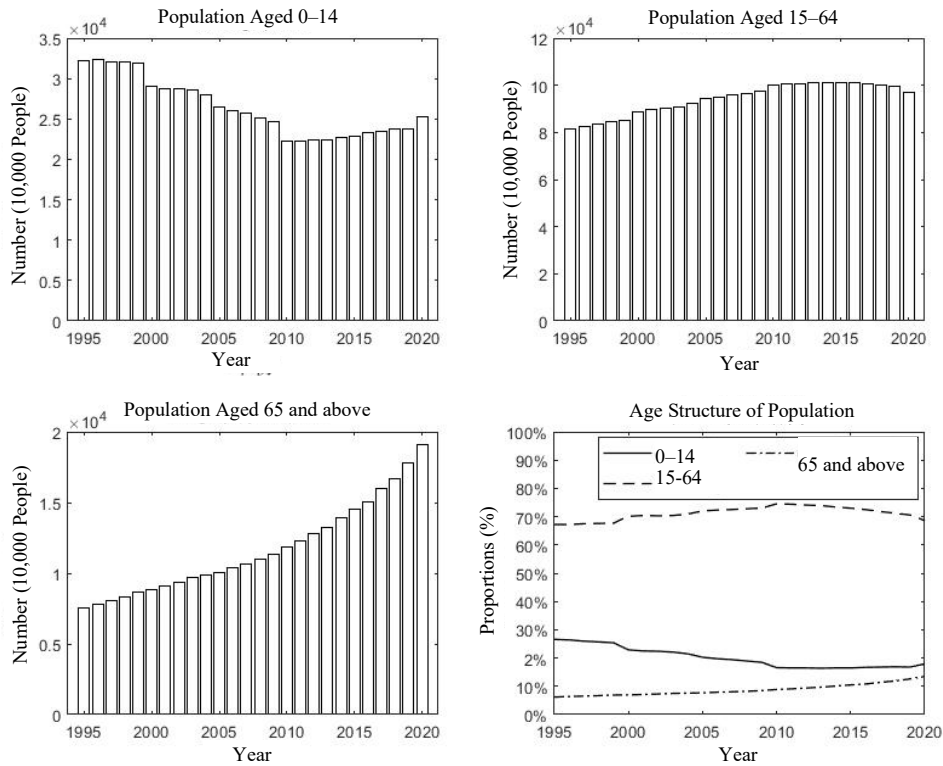
The age structure of population, also known as age composition, refers to the proportions of age groups in the whole population at a certain time and in a certain area and is usually expressed as percentages. The age structure of population is the result of the comprehensive interaction of natural growth and migration in the past decades or even hundreds of years and becomes the basis and starting point of changes in population reproduction in the future. It will not only considerably affect the type, rate, and trend of population development in the future but also have a certain effect on the social and economic development in the future.

Figure 15 shows the changes in the numbers and proportions of China's population by age range from 1995 to 2020. From Figure 15, the absolute number of people aged 0 – 14 was 322.18 million in 1995, and this figure decreased to 252.77 million, a decrease of 69.41 million, in 2020. Consequently, the proportion of people aged 0 – 14 in the total population dropped from 26.6% in 1995 to 17.9% in 2020, a decrease of 8.7 percentage points in the relative proportion. On the contrary, the absolute number and relative proportion of people aged 65 and above increased significantly during the same period. In 1995, the absolute number of people aged 65 and above was 75,095,020, accounting for 6.2% of the total population. In 2020, this figure increased to

190.64 million, an increase of 115,544,980, and their proportion in the total population rose to 13.5%, an increase of 7.3 percentage points. Different from the trend of people aged 0–14 and the people aged 65 and above, the absolute number of people aged 15 – 64 in China experienced a significant increase from 1995 to 2020, but their relative proportion increased first and then decreased during this period. The absolute number of people aged 15 – 64 was 813.93 million in 1995, and this figure increased to 968.71 million, a total increase of 154.78 million in 2020. In terms of relative proportion, the people aged 15 – 64 accounted for 67.2% of the total population in China in 1995 and kept increasing until reaching the highest point of 74.10% in 2012. The proportion of people aged 15 – 64 began to decline after 2012 and arrived at 68.60% in 2020, but it was still slightly higher than the level in 1995.

It is worth noting that the populations of all age groups in China have been notably affected by China's family planning policy. Family planning is a basic national policy of China to ensure that the population increase is kept under control. It was designated as a basic national policy in September 1982 and written into the Constitution in December of the same year. The main content and purpose were to advocate late marriage, late childbearing, fewer births, and eugenics, so the population increases in a controlled way. The basic national policy of family planning has played a positive role in addressing China's population and development problems since its inception. However, it has also brought about the problem of population aging. China's family planning policy was slightly modified at the beginning of the 21st century. As the first batch of children born under the one-child policy in the 1980s reached marriageable age, the family planning policy was relaxed to a certain extent in many areas, especially in economically

developed areas. As a result, the number of people aged 0–14 in China demonstrated a slight growth trend. Specifically, it can be seen from the upper left corner of Figure 15 that the trend of people aged 0–14 in China reversed from a continuous decrease to a slight increase around 2010.



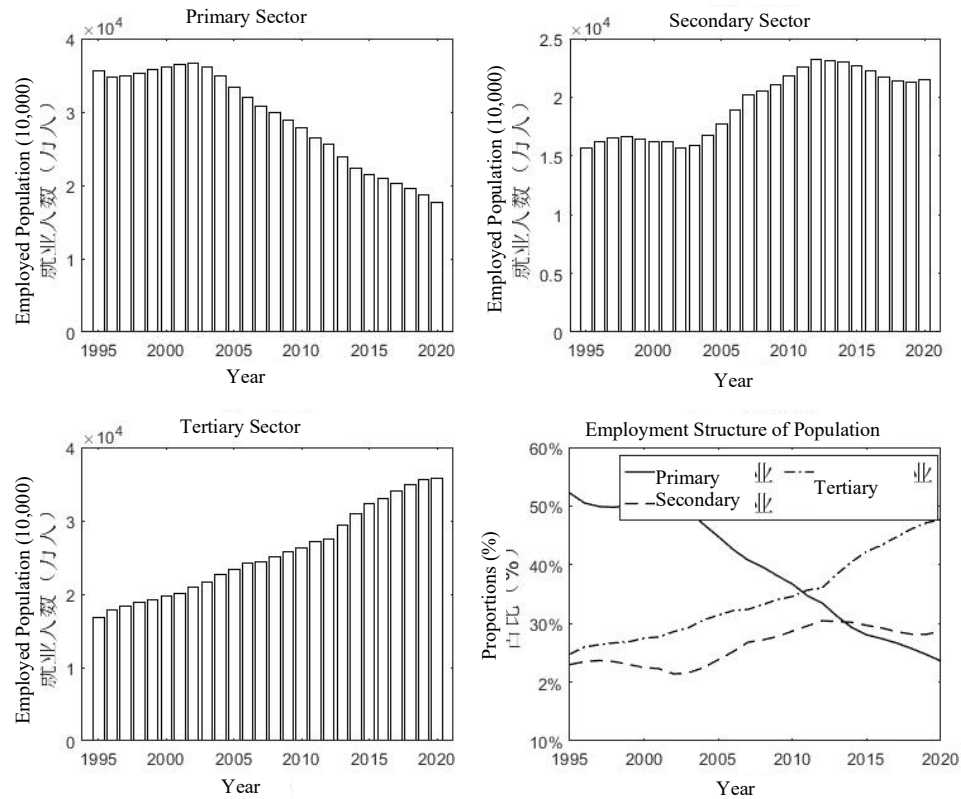
**Figure 15. Changes in Age Structure of China's Population from 1995 to 2020**

From the above analysis, the number of people aged 0–14 and their proportion in the total population in China experienced a decrease from 1995 to 2020, while the number of people aged 15–64 and that aged 65 and above and their proportions in the total population experienced an increase.

### 3.2.3 Changes in Employment Structure of Population

The employment structure of population is an important indicator of the social and economic structure of population and refers to the distribution and proportions of the

working population in various occupations. In this dissertation, the employment structure of population refers to the distribution and relative proportions of people employed in the primary, secondary, and tertiary sectors. Figure 16 shows the changes in the number of people employed and their relative proportions in the primary, secondary, and tertiary sectors in China. From Figure 16, in 1995, the number of people employed in the primary sector was 355.30 million, accounting for 52.20% of the total employed population; that in the secondary sector was 156.55 million, accounting for 23.00%; that in the tertiary sector was 16,880, accounting for 24.80%. From then on, the proportion of people employed in the primary sector continued to decline, while the proportions of people employed in the secondary and tertiary sectors continued to rise. The number and proportion of people employed in the tertiary sector exceeded those in the primary sector in 2011. In that year, the number of people employed in the primary sector was 264.72 million, accounting for 34.74% of the total employed population, while the number of people employed in the tertiary sector was 271.85 million, accounting for 35.68%. The number and proportion of people employed in the secondary sector also exceeded those in the primary sector in 2014. In that year, the number of people employed in the primary sector was 223.72 million, accounting for 29.30% of the total employed population, while the number of people employed in the secondary sector is 230.57 million, accounting for 30.20% of the total employed population. By 2020, the number of people employed in the primary sector decreased to 177.15 million, accounting for 23.60% of the total employed population; that in the secondary sector increased to 215.43 million, accounting for 28.70%; that in the tertiary sector increased to 358.06 million, accounting for 47.70%.



**Figure 16. Changes in Employment Structure of China's Population from 1995 to 2020**

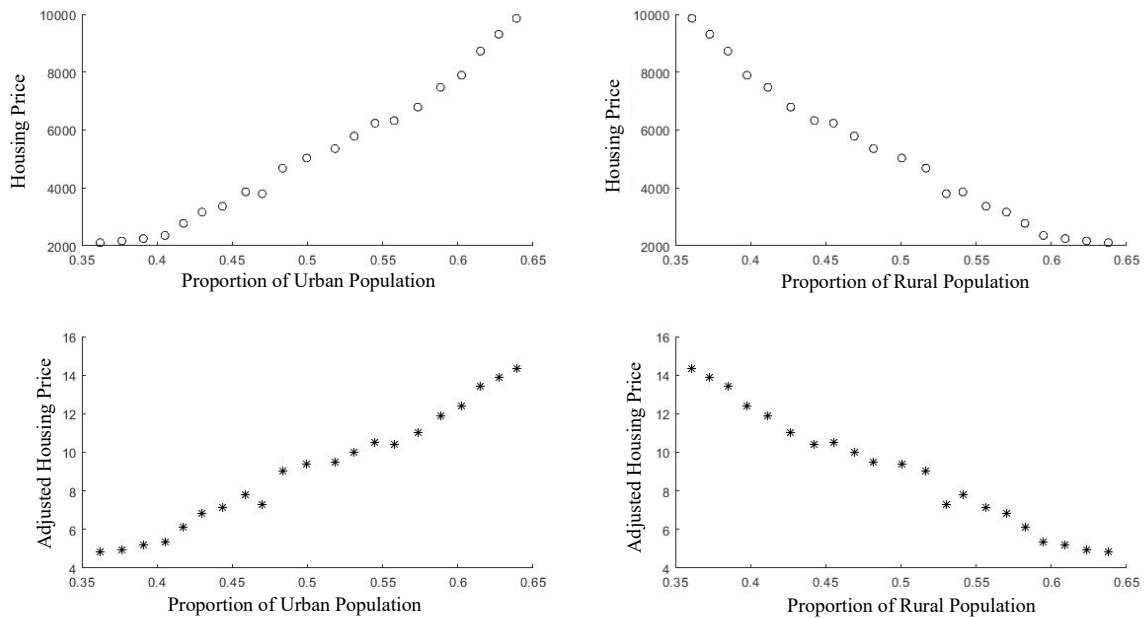
From the analysis above, the number of people employed in the primary sector continued to decrease; that in the tertiary sector continued to increase; that in the secondary sector first increased and then decreased from 1995 to 2020 along with the rapid growth of China's economy.

### 3.3 Correlation Analysis Between China's Population Structure And Housing Price

The analysis above shows that China's real estate market has experienced rapid development and finally grew into a pillar industry driving China's economic growth in the past decades. In this process, China's housing prices have risen fast while the urban-rural structure, age structure, and employment structure of China's population have experienced tremendous changes. To quantitatively analyze the relationship between

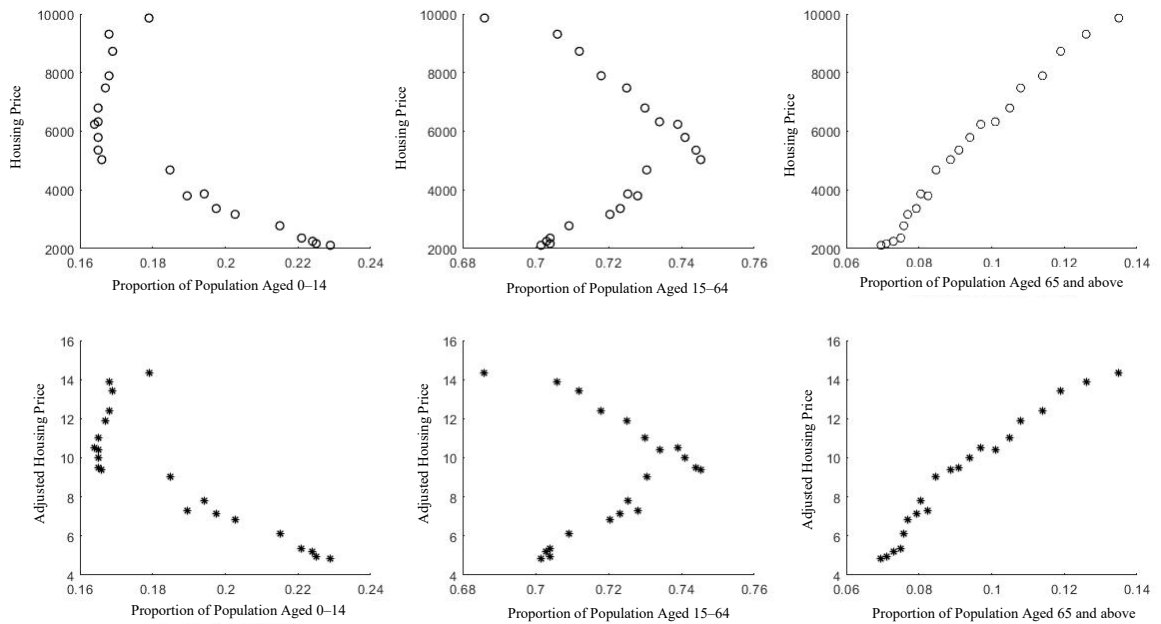
China's population structure and China's housing prices, the scatter charts below depict China's population structure and China's housing price for observing the effect of changes in China's population structure on China's housing prices on a preliminary basis.

Figure 17 shows the relationship between the changes in the urban-rural structure of China's population and China's urban housing prices from 2000 to 2020. The first row of Figure 17 shows the relationship between the unadjusted housing price and the urban-rural structure of population in China, and the second row shows the relationship between the urban housing price adjusted by the consumer price index and the urban-rural structure of population. From Figure 17, there is a significant positive correlation between China's housing price and the proportion of the urban population whether it is adjusted by the consumer price index or not. That is, the urban housing prices increase with the increase in the proportion of the urban population. There is a significant negative correlation between China's housing prices and the proportion of the rural population. That is, the housing prices increase with the decrease in the proportion of the rural population.



**Figure 17. Scatter Charts of Changes in China's Urban-Rural Structure of Population and Housing Price from 2000 to 2020**

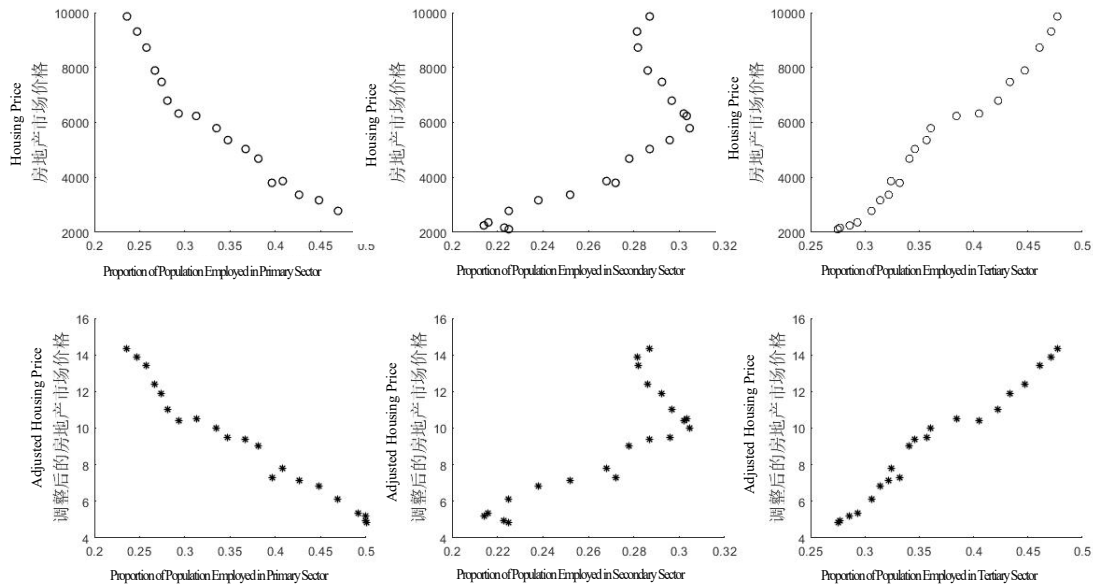
Figure 18 shows the relationship between the changes in the age structure of population and China's housing prices from 2000 to 2020. The first row of Figure 18 shows the relationship between the unadjusted housing price and the age structure of population in China, and the second row shows the relationship between the housing price adjusted by the consumer price index and the age structure of population in China. From Figure 18, there is a significant negative correlation between China's housing price and the proportion of people aged 0–14 whether it is adjusted by the consumer price index or not. That is, the housing prices decrease with the increase in the proportion of people aged 0–14. There is a significant positive correlation between China's housing prices and the proportion of people aged 65 and above. That is, the housing prices increase with the increase in the proportion of people aged 65 and above. The correlation between China's housing price and the proportion of people aged 15–64 is insignificant.



**Figure 18. Scatter Charts of Changes in China's Age Structure of Population and Housing Price from 2000 to 2020**

Figure 19 shows the relationship between changes in the employment structure and China's housing prices from 2000 to 2020. The first row of Figure 19 shows the relationship between the unadjusted housing price and the employment structure of population in China, and the second row shows the relationship between the housing price adjusted by the consumer price index and the employment structure of population in China. From Figure 19, there is a significant negative correlation between China's housing price and the proportion of people employed in the primary sector whether it is adjusted by the consumer price index or not. That is, the housing prices decrease with the increase in the proportion of people employed in the primary sector. There is a significant positive correlation between China's housing price and the proportion of people employed in the secondary sector and between it and the proportion of people employed

in the tertiary sector. That is, the housing prices increase with the increase in the proportion of people employed in the secondary sector and that in the tertiary sector.



**Figure 19. Scatter Chart of Change in Employment Structure and Housing Prices in China from 2000 to 2020**

### 3.4 Summary

This chapter first analyzes the development of China's real estate market, then analyzes the changes in China's population structure from three perspectives of urban-rural structure of population, age structure, and employment structure, and finally analyzes the relationship between changes in China's population structure and China's housing prices with scatter charts on a preliminary basis. This chapter divides the development of China's real estate market into six stages: initial development, rapid development, adjustment, prosperity, continued development, and stable development. The analysis of urban-rural structure of population, age structure, and employment structure of China's population finds that China's population structure has undergone tremendous changes in the past decades. Finally, the analysis of the correlation between

China's population structure and housing price finds there is a significant positive correlation between the proportion of urban population, the proportion of people aged 65 and above, the proportion of people employed in the secondary sector and the proportion of people employed in the tertiary sector, as one side, and China's housing prices, as the other side. There is a significant negative correlation between the proportion of rural population, the proportion of people aged 0–14, and the proportion of people employed in the primary sector, on one side, and China's housing prices, on the other side.

## CHAPTER 4. EMPIRICAL ANALYSIS

### 4.1 Model Building

Considering various factors affecting the housing price and the theoretical mechanisms of the population structure affecting the housing price, and considering the availability of data, this dissertation establishes the following econometric regression model of housing prices considering population structure factors:

$$\ln estate\_price_{it} = \beta_0 + \beta_1 \ln population\_structure_{it} + \gamma x_{it} + \varepsilon_{it} \quad (4)$$

Where,  $estate\_price_{it}$  represents the urban housing price, and  $population\_structure_{it}$  represents the population structure, which is further divided into urban-rural structure, age structure, and employment structure.  $x_{it}$  represents a vector composed of other control variables, and  $\varepsilon_{it}$  represents a residual term.

### 4.2 Indicator Selection And Data Description

In this dissertation, the sample contains data from 31 provinces, autonomous regions, and municipalities directly under the Central Government in China from 2000 to 2020, and the chosen indicators are as follows:

Explained variable: housing price (EP). The explained variable is housing price, which is represented by the average annual sales price of commercial housing in 31 provinces, autonomous regions, and municipalities in China from 2000 to 2020.

Core explanatory variable: population structure (DS). The core explanatory variable is population structure, which can be further into urban-rural structure, age structure, and employment structure. The urban-rural structure is represented by the proportion of the urban population (US), number of the urban population (UQ), proportion of the rural population (RS), and number of the rural population (RQ). The

age structure is represented by the proportion (A1S) and number (A1Q) of the population aged 0–14, the proportion (A2S) and number (A2Q) of the population aged 14-64, and the proportion (A3S) and number (A3Q) of the population aged 65 and above. The employment structure is represented by the proportion (I1S) and number (I1Q) of people employed in the primary sector, the proportion (I2S) and number (I2Q) of people employed in the secondary sector, and the proportion (I3S) and number (I3Q) of people employed in the tertiary sector.

Other control variables: Based on the comprehensive review of the existing literature and considering the availability of data, this dissertation chooses control variables from four aspects, i.e. city size, housing supply, government intervention, and public infrastructure, among the various factors affecting housing prices. Specifically, the control variables used in this dissertation include (1) population size (POP), which is measured by the number of the regional population; (2) housing supply (LS), which is measured by the area of purchased land; (3) government intervention (DGI), which is measured by the proportion of local fiscal expenditures to regional GDP as described by Chang (2015) and Ji (2016); (4) public infrastructure (CFL), which is measured by water supply, power supply, gas supply, transportation, environment, etc. in cities. Because the level of water supply, power supply, and gas supply differ slightly in different cities, this dissertation mainly measures the public infrastructure from two aspects, i.e. transportation and environment, which are specifically measured by the number of public transport vehicles per 10,000 people, per capita park and green space area, and per capita road area.

### **4.3 Descriptive Statistics**

The data used in this dissertation come from the EPS Global Statistics/Analysis Platform, China Statistical Yearbook, China Real Estate Statistics Yearbook, China Statistical Yearbook for Regional Economy, China Labor Statistical Yearbook, provincial statistical yearbooks over the years, etc. The descriptive statistics of relevant variables are given in Table 1.

**Table 1 Descriptive Statistics of Variables**

Variable	Meaning	Sample size	Mean value	Variance	Minimum value	Maximum value
ES	Housing price	619	5398.13	4777.45	949	37665
UQ	Number of urban populations	719	1966.83	1436.33	38.48	8226
US	Proportion of urban population	719	0.49	0.17	0.17	0.90
R1	Number of rural populations	719	2109.93	1604.91	160.78	7535.71
RS	Proportion of rural population	719	0.51	0.16	0.10	0.83
A1Q	Number of population aged 0 – 14	680	21290.64	45083.32	505	309790
A1S	Proportion of population aged 0 – 14	679	0.19	0.06	0.08	0.35
A2Q	Number of population aged 15 – 64	680	76467.14	160243	1503	1288354
A2S	Proportion of population aged 15 – 64	679	0.72	0.04	0.60	0.83
A3Q	Number of population aged 65 and above	679	9828.95	21865.01	101	178471

A3S	Proportion of population aged 65 and above	679	0.09	0.02	0.04	0.16
Table 1.(Continued)						
I1Q	Number of employed population in primary sector	524	996.14	784.09	27	3996
I1S	Proportion of employed population in primary sector	524	0.25	0.16	0.01	0.79
I2Q	Number of employed population in secondary sector	524	521.65	465.47	5.20	2526
I2S	Proportion of employed population in secondary sector	524	0.45	0.16	0.02	0.77
I3Q	Number of employed population in tertiary sector	524	671.04	474.17	20.40	3746
I3S	Proportion of employed population in tertiary sector	524	0.10	0.33	0.14	0.96

As shown in Table 1, the average housing price is RMB 5,398.13 per square meter with the highest housing price being RMB 37,665 per square meter and the lowest housing price being RMB 949 per square meter. In terms of the urban-rural structure of population, the average proportion of urban population is 0.49, which indicates that nearly half of China's population lives in urban areas in general. The maximum and

minimum proportions of urban population are 0.90 and 0.17 respectively. In contrast, the average proportion of rural population is 0.51 with the maximum and minimum values being 0.83 and 0.10 respectively. In terms of the age structure of population, the average proportion of people aged 0–14 is 0.19, and the maximum and minimum values are 0.35 and 0.08 respectively; The average proportion of people aged 15–64 is 0.72, and the maximum and minimum values are 0.60 and 0.83 respectively. The average proportion of people aged 65 and above is 0.09, and the maximum and minimum values are 0.16 and 0.04 respectively. In terms of the employment structure of population, the average proportion of people employed in the primary sector is 0.25 with the maximum and minimum values being 0.79 and 0.01 respectively; that of people employed in the secondary sector is 0.45 with the maximum and minimum values being 0.77 and 0.02 respectively; that of people employed in the tertiary sector is 0.10 with the maximum and minimum values being 0.96 and 0.14 respectively.

#### **4.4 Benchmark Regression Analysis**

After the adjustment of the housing price with the consumer price index, the results of benchmark regression are shown in Tables 4.2 through 4.9 below. In Tables 4.2 through 4.9, columns (1), (2), and (3) show the results obtained by least square estimation, random effect estimation, and fixed effect estimation without the addition of control variables respectively; columns (4), (5) and (6) show the results obtained by least square estimation, random effect estimation and fixed effect estimation after addition of control variables respectively.

Tables 4.2 and 4.3 show the effect of changes in the urban-rural structure of population on the real estate market in China. Table 2 shows the effect of the proportion

of urban population on China's real estate market, while Table 3 shows the effect of the proportion of rural population on China's real estate market.

**Table 2 Effect of Proportion of Urban Population on Housing Price: Benchmark Regression**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
lnUS	1.222** (0.185)	1.919*** (0.254)	3.854*** (0.338)	1.234** (0.207)	1.502*** (0.178)	1.248* (0.493)
lnPOP				0.169 (0.116)	0.284*** (0.064)	1.833** (0.637)
lnLS				-0.102 (0.064)	-0.043 (0.033)	-0.042 (0.031)
lnDGI				0.198 (0.123)	0.641*** (0.092)	0.678*** (0.179)
lnCFL1				0.329 (0.187)	0.220* (0.091)	0.142 (0.0878)
lnCFL2				0.367 (0.222)	0.261** (0.095)	0.186* (0.073)
lnCFL3				-0.0444 (0.152)	-0.192* (0.077)	-0.0872 (0.061)
_cons	9.100*** (0.183)	9.658*** (0.181)	11.18*** (0.267)	8.281*** (0.888)	8.243*** (0.631)	-4.376 (5.508)
<i>N</i>	154	154	154	151	151	151
adj. <i>R</i> <sup>2</sup>	0.584	0.634	0.639	0.669	0.771	0.833

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

As shown in Table 2, from the perspective of the proportion of urban population, changes in the urban-rural structure of population have a significant effect on China's housing prices. Specifically, the rising proportion of urban population has driven up China's housing prices. For every percentage point increase in the proportion of urban population, China's housing prices increase by 1.234, 1.502, and 1.248 percentage points respectively as shown by the results with the least square estimation, random effect estimation, and fixed effect estimation methods after the addition of control variables.

**Table 3 Effect of Proportion of Rural Population on Housing Price: Benchmark Regression**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
lnRS	-0.925*** (0.086)	-1.292*** (0.248)	-5.331*** (0.360)	-0.882** (0.146)	-1.175*** (0.242)	-1.991* (0.812)
lnPOP				0.075 (0.099)	0.344*** (0.067)	1.139 (0.890)
lnLS				-0.0156 (0.044)	-0.019 (0.030)	-0.036 (0.029)
lnDGI				0.107 (0.141)	0.698*** (0.081)	0.697*** (0.163)
lnCFL1				0.189 (0.159)	0.152 (0.080)	0.149 (0.077)
lnCFL2				0.545 (0.238)	0.368** (0.112)	0.208** (0.069)
lnCFL3				0.070 (0.151)	-0.137 (0.119)	-0.175* (0.073)
_cons	7.479*** (0.086)	7.221*** (0.151)	4.358*** (0.255)	5.578*** (0.514)	5.243*** (0.496)	-1.054 (7.071)
<i>N</i>	154	154	154	151	151	151
adj. <i>R</i> <sup>2</sup>	0.657	0.662	0.699	0.729	0.791	0.838

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

In contrast to Table 2, Table 3 estimates the effect of changes in the urban-rural structure of population on China's housing prices from the perspective of the proportion of rural population. From Table 3, the increase in the proportion of rural population has a significant negative effect on China's housing prices. This is contrary to the effect of the increase in the proportion of urban population on China's housing prices. For every percentage point increase in the proportion of rural population, China's housing prices

decrease by 0.882, 1.175, and 1.991 percentage points respectively as shown by the results with the least square estimation, random effect estimation, and fixed effect estimation methods after the addition of control variables.

Tables 4, 5, and 6 show the effect of changes in the age structure of population on China's real estate market. Table 4 shows the effect of the proportion of people aged 0–14 on China's real estate market; Table 5 shows the effect of the proportion of people aged 15–64 on China's real estate market; Table 6 shows the effect of the proportion of people aged 65 and above on China's real estate market.

**Table 4 Effect of Proportion of People Aged 0–14 on Housing Price: Benchmark Regression**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
lnA1S	-1.162** (0.182)	-2.065*** (0.128)	-2.594*** (0.231)	-0.674* (0.252)	-1.256*** (0.179)	-0.875** (0.292)
lnPOP				-0.103 (0.0980)	0.165* (0.0793)	1.394* (0.679)
lnLS				-0.00472 (0.0619)	0.0171 (0.0242)	-0.0100 (0.0282)
lnDGI				-0.196 (0.151)	0.578*** (0.105)	0.752*** (0.136)
lnCFL1				0.380 (0.200)	0.0769 (0.106)	0.0510 (0.117)
lnCFL2				0.805* (0.257)	0.304*** (0.0828)	0.194* (0.0757)
lnCFL3				-0.376 (0.178)	-0.147 (0.0786)	-0.0462 (0.0605)
_cons	6.104*** (0.307)	4.529*** (0.215)	3.602*** (0.403)	5.840** (0.786)	4.871*** (0.676)	-3.631 (5.492)
<i>N</i>	154	154	154	151	151	151
adj. <i>R</i> <sup>2</sup>	0.467	0.579	0.687	0.574	0.791	0.840

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

As shown in Table 4, the proportion of people aged 0–14 has a significant negative effect on China's housing prices. Specifically, for every percentage point increase in the proportion of people aged 0–14, China's housing prices decrease by 0.674, 1.256, and 0.875 percentage points respectively as shown by the results with the least square estimation, random effect estimation, and fixed effect estimation methods after the addition of control variables.

**Table 5 Effect of Proportion of the Population Aged 15–64 on Housing Prices: Benchmark Regression**

	(1)	(2)	(3)	(4)	(5)	(6)
	lnEP	lnEP	lnEP	lnEP	lnEP	lnEP
lnA2S	4.991*	8.655***	10.21***	1.588	3.879***	2.274*
	(1.418)	(0.764)	(1.256)	(1.218)	(0.910)	(0.996)
lnPOP				-0.117	0.242**	1.762*
				(0.103)	(0.0923)	(0.696)
lnLS				-0.00785	0.0109	-0.0219
				(0.0709)	(0.0247)	(0.0267)
lnDGI				-0.324	0.627***	0.829***
				(0.147)	(0.103)	(0.119)
lnCFL1				0.548*	0.219	0.119
				(0.197)	(0.123)	(0.111)
lnCFL2				0.933*	0.369***	0.213*
				(0.260)	(0.107)	(0.0790)
lnCFL3				-0.547*	-0.210*	-0.0444
				(0.186)	(0.105)	(0.0565)
_cons	9.727***	10.90***	11.39***	7.210**	7.557***	-4.233
	(0.502)	(0.275)	(0.401)	(1.022)	(1.081)	(5.885)
N	154	154	154	151	151	151
adj. R <sup>2</sup>	0.279	0.499	0.523	0.502	0.612	0.828

Standard errors in parentheses  
 \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

As shown in Table 5, the proportion of people aged 15–64 has a significant positive effect on China's housing price. It is worth noting that the proportion of people aged 15–64 has no significant positive effect on China's housing prices as shown by the results with the least square estimation method after the addition of control variables. This is consistent with the analysis of the correlation between the age structure of the population and the housing price in Section 3.3 above. The analysis of the correlation between the age structure of population and the housing price above shows that the positive correlation between the proportion of people aged 15–64 and China's housing prices is insignificant. This may be caused by the individual effect or time effect. In order to estimate the robustness of the results, I have estimated regression equation using both the random effect estimation and fixed effect estimation methods after the addition of control variables, the results in column (5) and (6) shows the proportion of people aged 15–64 has a significant positive effect on China's housing prices again.

***Table 6 Effect of Proportion of People Aged 65 and above on Housing Price: Benchmark Regression***

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
lnA3S	1.351* (0.311)	1.830*** (0.148)	2.263*** (0.271)	1.018** (0.390)	0.860*** (0.211)	0.259* (0.190)
lnPOP				-0.168 (0.0768)	0.170 (0.108)	1.668* (0.693)
lnLS				-0.0614 (0.0458)	0.00836 (0.0273)	-0.0301 (0.0298)
lnDGI				-0.315 (0.134)	0.641*** (0.120)	0.937*** (0.130)
lnCFL1				0.403 (0.147)	0.283* (0.112)	0.164 (0.0892)

Table 6.(Continued)

lnCFL2				1.000*	0.439***	0.229**
				(0.236)	(0.0957)	(0.0800)
lnCFL3				-0.484*	-0.245**	-0.0629
				(0.174)	(0.0940)	(0.0602)
_cons	11.39***	12.54***	13.58***	10.47**	8.829***	-3.354
	(0.781)	(0.360)	(0.653)	(1.387)	(1.206)	(5.999)
N	154	154	154	151	151	151
adj. R <sup>2</sup>	0.290	0.229	0.283	0.595	0.668	0.818

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Similar to the result shown in Table 5 that the people aged 15–64 have a positive effect on China's housing price, Table 6 shows that the proportion of people aged 65 and above also has a significant positive effect on China's housing price. Specifically, Table 6 shows that, for every percentage point increase in the proportion of people aged 65 and above, China's housing prices increase by 1.018, 0.860, and 0.259 percentage points, which are significant at the significance levels of 5%, 1%, and 10% respectively, as shown by the results with the least square estimation, random effect estimation and fixed effect estimation methods after addition of control variables.

Tables 7, 8, and 9 show the effect of changes in the employment structure of population on China's real estate market. Table 7 shows the effect of the proportion of people employed in the primary sector on China's real estate market; Table 8 shows the effect of the proportion of people employed in the secondary sector on China's real estate market; Table 9 shows the effect of the proportion of people employed in the tertiary sector on China's real estate market.

***Table 7 Effect of Proportion of People Employed in Primary Sector on Housing Price: Benchmark Regression***

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(1)	(2)	(3)	(4)	(5)	(6)
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	lnEP	lnEP	lnEP	lnEP	lnEP	lnEP
lnIIS	-0.691*** (0.0442)	-0.823*** (0.0811)	-1.721*** (0.192)	-0.680*** (0.0773)	-0.748*** (0.0777)	-0.347* (0.135)
lnPOP				-0.0230 (0.102)	0.231** (0.0752)	1.375* (0.615)
lnLS				0.0495 (0.0448)	0.0124 (0.0297)	-0.0249 (0.0320)
lnDGI				0.172 (0.111)	0.636*** (0.0910)	0.893*** (0.126)
lnCFL1				-0.0202 (0.156)	0.0634 (0.0890)	0.135 (0.0878)
lnCFL2				0.633* (0.210)	0.412*** (0.0841)	0.234** (0.0732)
lnCFL3				-0.0479 (0.109)	-0.114 (0.0845)	-0.0711 (0.0612)
_cons	7.446*** (0.0927)	7.315*** (0.0822)	6.420*** (0.191)	5.967*** (0.610)	5.692*** (0.533)	-2.029 (5.190)
<i>N</i>	154	154	154	151	151	151
adj. <i>R</i> <sup>2</sup>	0.702	0.399	0.478	0.756	0.779	0.826

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

As shown in Table 7, the proportion of people employed in the primary sector has a significant negative effect on China's housing prices. Specifically, for every percentage point increase in the proportion of people employed in the primary sector, China's housing prices decrease by 0.680, 0.748, and 0.347 percentage points, which are significant at the significance levels of 1%, 1%, and 10% respectively as shown by the results with the least square estimation, random effect estimation and fixed effect estimation methods.

**Table 8 Effect of Proportion of People Employed in Secondary Sector on Housing Price: Benchmark Regression**

	(1)	(2)	(3)	(4)	(5)	(6)
	lnEP	lnEP	lnEP	lnEP	lnEP	lnEP
lnI2S	0.691***	0.823***	1.721***	0.680***	0.748***	0.347*

	(0.0442)	(0.0811)	(0.192)	(0.0773)	(0.0777)	(0.135)
lnPOP				-0.0230 (0.102)	0.231** (0.0752)	1.375* (0.615)
lnLS				0.0495 (0.0448)	0.0124 (0.0297)	-0.0249 (0.0320)
lnDGI				0.172 (0.111)	0.636*** (0.0910)	0.893*** (0.126)
lnCFL1				-0.0202 (0.156)	0.0634 (0.0890)	0.135 (0.0878)
lnCFL2				0.633* (0.210)	0.412*** (0.0841)	0.234** (0.0732)
lnCFL3				-0.0479 (0.109)	-0.114 (0.0845)	-0.0711 (0.0612)
_cons	7.446*** (0.0927)	7.315*** (0.0822)	6.420*** (0.191)	5.967*** (0.610)	5.692*** (0.533)	-2.029 (5.190)
<i>N</i>	154	154	154	151	151	151
adj. <i>R</i> <sup>2</sup>	0.702	0.690	0.478	0.756	0.798	0.826

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

In contrast to the result shown in Table 7 that the proportion of people employed in the primary sector has a significant negative effect on China's housing price, Table 8 shows that the proportion of people employed in the secondary sector also has a significant positive effect on China's housing price. Specifically, for every percentage point increase in the proportion of people employed in the secondary sector, China's housing prices increase by 0.680, 0.748, and 0.347 percentage points, which are significant at the significance levels of 1%, 1%, and 10% respectively, as shown by the results of (4), (5), and (6) in Table 8 with the least square estimation, random effect estimation and fixed effect estimation methods after addition of control variables.

**Table 9 Effect of Proportion of People Employed in Tertiary Sector on Housing Price: Benchmark Regression**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
lnI3S	0.357** (0.0485)	0.251*** (0.0434)	0.214*** (0.0422)	0.254** (0.0534)	0.0761** (0.0289)	0.00453** (0.0155)

lnPOP				0.0334 (0.0619)	0.240 (0.132)	2.125* (0.874)
lnLS				0.0232 (0.0827)	0.0128 (0.0376)	-0.0106 (0.0388)
lnDGI				-0.0732 (0.171)	0.662*** (0.130)	0.913*** (0.150)
lnCFL1				0.557* (0.143)	0.380** (0.125)	0.0814 (0.0991)
lnCFL2				0.419 (0.229)	0.371* (0.150)	0.283** (0.0858)
lnCFL3				-0.494* (0.148)	-0.308*** (0.0823)	-0.0535 (0.0503)
_cons	8.842*** (0.128)	8.681*** (0.111)	8.600*** (0.0711)	6.862** (0.924)	6.480*** (0.992)	-7.992 (7.632)
<i>N</i>	108	108	108	105	105	105
adj. <i>R</i> <sup>2</sup>	0.587	0.791	0.249	0.712	0.887	0.832

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Similar to the result shown in Table 8 that the proportion of people employed in the secondary sector has a significant positive effect on China's housing price, Table 9 shows that the proportion of people employed in the tertiary sector also has a significant positive effect on China's housing price. Specifically, for every percentage point increase in the proportion of people employed in the third sector, China's housing prices increase by 0.254, 0.076, and 0.005 percentage points, which are significant at the significance level of 5%, as shown by the results in Table 9 with the least square estimation, random effect estimation and fixed effect estimation methods after addition of control variables.

#### 4.5 Robustness Test

To verify the robustness of the benchmark regression results above, this dissertation tests the robustness of the econometric model from the following two aspects: (1) replacement of explanatory variables; (2) explanatory variables lagged by one period and two periods.

#### 4.5.1 Replacement of Explanatory Variables

For replacement of explanatory variables, this dissertation replaces explanatory variables measured with relative quantities with those measured with absolute quantities. In testing the robustness of the effect of the urban-rural structure of population on China's housing price, this dissertation replaces the proportions of urban population and rural population with the numbers of urban population and rural population respectively and obtains the results of the robustness test of the effect of the urban-rural structure of population on China's housing price as shown in Table 10 and Table 11 below. As shown in Tables 4.10 and 4.11, the effect of the urban-rural structure of population on China's housing price remains robust after the replacement of the variables in relative numbers measuring the urban-rural structure of population with those in absolute numbers.

**Table 10 Effect of Urban Population on Housing Price**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
lnCITY	0.108 (0.0485)	0.765*** (0.223)	3.265*** (0.222)	1.234** (0.206)	1.501*** (0.178)	1.254* (0.495)
lnPOP				-1.065** (0.169)	-1.217*** (0.168)	0.583 (0.891)
lnLS				-0.102 (0.0637)	-0.0432 (0.0326)	-0.0424 (0.0306)
lnDGI				0.197 (0.123)	0.640*** (0.0917)	0.676*** (0.179)

Table 10(Continued)

lnCFL1				0.329 (0.187)	0.220* (0.0908)	0.142 (0.0877)
lnCFL2				0.368 (0.222)	0.262** (0.0948)	0.187* (0.0727)
lnCFL3				-0.0450 (0.152)	-0.195* (0.0776)	-0.0893 (0.0609)
_cons	7.347*** (0.366)	2.574 (1.699)	-15.66*** (1.620)	8.281*** (0.888)	8.245*** (0.631)	-4.393 (5.522)

<i>N</i>	154	154	154	151	151	151
adj. <i>R</i> <sup>2</sup>	0.036	0.178	0.764	0.669	0.678	0.833

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

As shown in Table 10, the number of urban populations has a positive and significant effect on China's housing price, which is consistent with the effect of the proportion of urban population on China's housing price. Specifically, the positive effect of urban population on China's housing price is significant at the significant levels of 5%, 1%, and 10% respectively with the least square estimation, random effect estimation and fixed effect estimation methods after the addition of control variables.

**Table 11 Effect of Rural Population on Housing Price**

	(1)	(2)	(3)	(4)	(5)	(6)
	lnEP	lnEP	lnEP	lnEP	lnEP	lnEP
lnrural	-0.182 (0.0857)	-0.224* (0.0903)	-3.517* (1.387)	-0.894** (0.144)	-1.205*** (0.232)	-2.051** (0.686)
lnPOP				0.972** (0.206)	1.555*** (0.249)	3.057*** (0.657)
lnLS				-0.0147 (0.0441)	-0.0206 (0.0322)	-0.0382 (0.0339)
lnDGI				0.114 (0.142)	0.704*** (0.0819)	0.707*** (0.146)

Table 11(Continued)

lnCFL1				0.184 (0.158)	0.143 (0.0774)	0.141 (0.0732)
lnCFL2				0.538 (0.233)	0.351*** (0.106)	0.187** (0.0663)
lnCFL3				0.0792 (0.149)	-0.109 (0.111)	-0.137* (0.0643)
_cons	9.477*** (0.677)	9.781*** (0.703)	34.05** (10.22)	5.555*** (0.521)	5.208*** (0.499)	0.00950 (6.539)
<i>N</i>	154	154	154	151	151	151
adj. <i>R</i> <sup>2</sup>	0.140	0.118	0.220	0.730	0.779	0.841

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

As shown in Table 11, the number of rural populations has a negative and significant effect on China's housing price, which is consistent with the effect of the proportion of rural population on China's housing price. Specifically, the negative effect of rural population on China's housing price is significant at the significant levels of 5%, 1%, and 5% respectively as shown by the results with the least square estimation, random effect estimation, and fixed effect estimation methods after the addition of control variables.

In testing the robustness of the effect of the age structure of population on China's housing price, the proportions of people aged 0–14, 15–64, and 65 and above are replaced with the numbers of people aged 0–14, 15–64, and 65 and above respectively, and the results of the robustness test of the effect of the age structure of population on China's housing price are shown in Tables 4.12, 4.13, and 4.14 below. As shown in Tables 4.12, 4.13, and 4.14, the effect of the age structure of population on China's housing prices remains robust after replacement of the variables in relative numbers measuring the age structure of population with those in absolute numbers.

**Table 12 Effect of Population Aged 0–14 on Housing Price**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
lnage1	-0.130* (0.0378)	-0.119*** (0.00532)	-0.118*** (0.00452)	-0.101** (0.0213)	-0.047*** (0.00738)	-0.038*** (0.00764)
lnPOP				-0.060 (0.0976)	0.294** (0.108)	1.395* (0.620)
lnLS				-0.0260 (0.0629)	0.00451 (0.0218)	-0.0278 (0.0255)
lnDGI				-0.503* (0.118)	0.645*** (0.119)	0.874*** (0.116)

lnCFL1				0.526*	0.232*	0.103
				(0.174)	(0.105)	(0.0884)
lnCFL2				0.778*	0.385***	0.202**
				(0.241)	(0.0699)	(0.0664)
lnCFL3				-0.536*	-0.224**	-0.0681
				(0.177)	(0.0742)	(0.0536)
_cons	9.309***	9.206***	9.207***	7.487***	6.429***	-1.356
	(0.404)	(0.106)	(0.0410)	(0.729)	(0.868)	(5.282)
N	154	154	154	151	151	151
adj. R <sup>2</sup>	0.145	0.298	0.479	0.528	0.698	0.848

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

As shown in Table 12, the number of people aged 0–14 has a negative and significant effect on China's housing price, which is consistent with the effect of the proportion of people aged 0–14 on China's housing price. Specifically, the negative effect of the number of people aged 0–14 on China's housing price is significant at the significant levels of 5%, 1%, and 10% respectively as shown by the results with the least square estimation, random effect estimation and fixed effect estimation methods after addition of control variables.

**Table 13 Effect of People Aged 15–64 on Housing Price**

	(1)	(2)	(3)	(4)	(5)	(6)
	lnEP	lnEP	lnEP	lnEP	lnEP	lnEP
lnage2	0.0852	0.119***	0.121***	0.0772*	0.0450***	0.0388***
	(0.0337)	(0.00520)	(0.00467)	(0.0261)	(0.00754)	(0.00788)
lnPOP				-0.0814	0.313**	1.403*
				(0.0932)	(0.112)	(0.621)
lnLS				-0.0283	0.00187	-0.0287
				(0.0673)	(0.0220)	(0.0257)
lnDGI				-0.516*	0.679***	0.884***
				(0.117)	(0.118)	(0.116)
lnCFL1				0.580*	0.240*	0.110
				(0.178)	(0.103)	(0.0878)
lnCFL2				0.877*	0.384***	0.204**
				(0.237)	(0.0702)	(0.0664)
lnCFL3				-0.584*	-0.223**	-0.0692

				(0.190)	(0.0730)	(0.0536)
_cons	9.028*** (0.410)	9.380*** (0.114)	9.400*** (0.0490)	7.348*** (0.660)	6.403*** (0.894)	-1.349 (5.307)
<i>N</i>	154	154	154	151	151	151
adj. <i>R</i> <sup>2</sup>	0.053	0.278	0.450	0.506	0.765	0.847

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

As shown in Table 13, the number of people aged 15–64 has a positive and significant effect on China's housing price, which is consistent with the effect of the proportion of people aged 15–64 on China's housing price. Specifically, the positive effect of the number of people aged 15–64 on China's housing prices is significant at the significant levels of 1%, 10%, and 10% respectively as shown by the results with the least square estimation, random effect estimation and fixed effect estimation methods after addition of control variables.

**Table 14 Effect of Population Aged 65 and above on Housing Price**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
lnage3	0.0613 (0.0371)	0.118*** (0.00545)	0.121*** (0.00490)	0.0526* (0.0339)	0.0446*** (0.00789)	0.0389*** (0.00801)
lnPOP				-0.0954 (0.0934)	0.303** (0.111)	1.407* (0.623)
lnLS				-0.0246 (0.0709)	0.00475 (0.0218)	-0.0287 (0.0256)
lnDGI				-0.489* (0.120)	0.657*** (0.119)	0.886*** (0.115)
lnCFL1				0.603* (0.182)	0.253* (0.108)	0.111 (0.0877)
lnCFL2				0.933* (0.244)	0.402*** (0.0716)	0.206** (0.0661)
lnCFL3				-0.597* (0.195)	-0.232** (0.0761)	-0.0691 (0.0532)
_cons	8.650*** (0.350)	9.123*** (0.110)	9.151*** (0.0412)	6.940*** (0.699)	6.254*** (0.876)	-1.461 (5.310)
<i>N</i>	154	154	154	151	151	151
adj. <i>R</i> <sup>2</sup>	0.026	0.167	0.442	0.493	0.567	0.847

Standard errors in parentheses  
 \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

As shown in Table 14, the number of people aged 65 and above has a positive and significant effect on China's housing price, which is consistent with the effect of the proportion of people aged 65 and above on China's housing price. Specifically, the positive effect of the number of people aged 65 and above on China's housing price is significant at the significance levels of 10%, 1%, and 1% respectively as shown by the results with the least square estimation, random effect estimation and fixed effect estimation methods after addition of control variables.

In testing the robustness of the effect of the employment structure of population on China's housing price, the proportions of people employed in the primary, secondary, and tertiary sectors are replaced by the number of people employed in the primary, secondary, and tertiary sectors respectively. The results of the robustness test on the effect of the employment structure of population on China's housing prices are shown in Tables 4.15, 4.16, and 4.17 below. As shown in Tables 4.15, 4.16, and 4.117, the effect of the employment structure of population on China's housing prices remains robust after the replacement of the variables in relative numbers measuring the employment structure of population with those in absolute numbers.

***Table 15 Effect of Number of People Employed in Primary Sector on Housing Price***

	(1)	(2)	(3)	(4)	(5)	(6)
	lnEP	lnEP	lnEP	lnEP	lnEP	lnEP
lnjob1	-0.197 (0.0731)	-0.243** (0.0782)	-1.142** (0.379)	-0.559** (0.0652)	-0.632*** (0.110)	-0.103* (0.125)
lnPOP				0.568* (0.152)	0.958*** (0.156)	1.714* (0.689)

lnLS				0.0390 (0.0531)	-0.000545 (0.0315)	-0.0313 (0.0308)
lnDGI				0.105 (0.135)	0.730*** (0.0978)	0.956*** (0.127)
lnCFL1				0.156 (0.164)	0.138 (0.0810)	0.165 (0.0874)
lnCFL2				0.686* (0.241)	0.369*** (0.0846)	0.235** (0.0789)
lnCFL3				-0.125 (0.124)	-0.0846 (0.0725)	-0.0545 (0.0566)
_cons	9.401*** (0.520)	9.694*** (0.545)	15.49*** (2.439)	5.190** (0.767)	4.854*** (0.614)	-3.665 (5.739)
<i>N</i>	154	154	154	151	151	151
adj. <i>R</i> <sup>2</sup>	0.204	0.229	0.134	0.681	0.743	0.817

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table 16 Effect of Number of People Employed in Secondary Sector on Housing Price**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
lnjob2	0.0670 (0.0514)	0.337*** (0.0694)	1.143*** (0.169)	0.414* (0.165)	0.464*** (0.112)	0.234* (0.0926)
lnPOP				-0.587* (0.184)	-0.297 (0.178)	1.517* (0.649)
lnLS				0.0103 (0.0694)	0.00557 (0.0289)	-0.0276 (0.0302)
lnDGI				-0.136 (0.129)	0.670*** (0.101)	0.873*** (0.122)
lnCFL1				0.441 (0.176)	0.295** (0.103)	0.169* (0.0825)
lnCFL2				0.983* (0.234)	0.440*** (0.0838)	0.243** (0.0714)
lnCFL3				-0.673** (0.144)	-0.350*** (0.0871)	-0.111 (0.0553)
_cons	7.736*** (0.341)	6.136*** (0.457)	1.343 (1.004)	8.517*** (0.917)	8.085*** (0.943)	-4.226 (5.486)
<i>N</i>	154	154	154	151	151	151
adj. <i>R</i> <sup>2</sup>	0.018	0.119	0.425	0.556	0.678	0.826

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table 17 Effect of Number of People Employed in Tertiary Sector on Housing Price**

	(1)	(2)	(3)	(4)	(5)	(6)
	lnEP	lnEP	lnEP	lnEP	lnEP	lnEP
lnjob3	0.0838 (0.0608)	0.344*** (0.0769)	1.015*** (0.206)	1.025** (0.171)	0.414** (0.135)	0.109* (0.0865)
lnPOP				-1.130** (0.201)	-0.212 (0.181)	1.607* (0.685)
lnLS				-0.0343 (0.0679)	0.0168 (0.0287)	-0.0294 (0.0317)
lnDGI				-0.313 (0.113)	0.556*** (0.116)	0.930*** (0.122)
lnCFL1				0.161 (0.168)	0.266* (0.113)	0.156 (0.0936)
lnCFL2				0.823** (0.159)	0.571*** (0.0969)	0.259** (0.0815)
Table 17 (Continued)						
lnCFL3				-0.300 (0.131)	-0.293** (0.101)	-0.0718 (0.0636)
_cons	7.602*** (0.396)	5.954*** (0.497)	1.691 (1.307)	9.347*** (0.930)	6.797*** (0.819)	-4.224 (5.824)
<i>N</i>	154	154	154	151	151	151
adj. <i>R</i> <sup>2</sup>	0.017	0.128	0.289	0.645	0.754	0.818

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

#### 4.5.2 Lagged Explanatory Variables

In the preceding subsection, the relative numbers measuring the urban-rural structure, age structure, and employment structure of population are replaced with absolute numbers. The robustness of the effect of the urban-rural structure, age structure, and employment structure of population on China's housing price shown in the benchmark regression analysis is tested by replacing the explanatory variables.

Considering the time lag in changes of housing price, the effect of changes in the urban-rural structure, age structure, and employment structure of population on China's housing

price may also have a delay. This section further explores the robustness of their effect on China's housing prices by lagging the variables for the urban-rural structure, age structure, and employment structure of population by one period and two periods. The results are shown in Tables 4.18 through 4.25 below. In Tables 4.18 through 4.25, columns (1), (2), and (3) represent the regression results obtained by lagging the explanatory variables by one period and then using the least square, random effect, and fixed effect estimation methods respectively; columns (4), (5), and (6) represent the regression results obtained by lagging the explanatory variables by two periods and then using the least square, random effect and fixed effect estimation methods respectively.

From the perspective of the urban-rural structure of population, the proportions of urban population and rural population are lagged by one period and two periods respectively, and then the robustness of the effect of the urban-rural structure of population on China's housing price is tested through regression. Tables 4.18 and 4.19 give the regression results of the explanatory variables for measuring the urban-rural structure of population lagged by one period and two periods respectively. As shown in Tables 4.18 and 4.19, the effect of the urban-rural structure of population on China's housing price remains robust after the proportions of urban population and rural population are lagged by one period and two periods.

***Table 18 Proportion of Urban Population Lagged by One Period and Two Periods***

	(1)	(2)	(3)	(4)	(5)	(6)
	lnEP	lnEP	lnEP	lnEP	lnEP	lnEP
L.lnUS	1.252*	1.474***	0.601*			
	(0.219)	(0.173)	(0.490)			
L2. lnUS				1.266*	1.608***	1.469*
				(0.223)	(0.155)	(0.548)
lnPOP	0.143	0.254***	1.422	0.164	0.254**	2.136

	(0.122)	(0.0654)	(0.743)	(0.120)	(0.0908)	(1.841)
lnLS	-0.0741 (0.0747)	-0.0330 (0.0310)	-0.0360 (0.0287)	-0.119 (0.0713)	-0.0474 (0.0427)	-0.0528 (0.0317)
lnDGI	0.163	0.629***	0.812***	0.137	0.629***	0.643**
lnCFL1	(0.132) 0.266	(0.112) 0.0866	(0.191) 0.0460	(0.111) 0.241	(0.101) 0.227	(0.191) 0.174
lnCFL2	(0.198) 0.242 (0.241)	(0.106) 0.300** (0.103)	(0.111) 0.244* (0.100)	(0.221) 0.164 (0.327)	(0.146) 0.176 (0.119)	(0.173) 0.0377 (0.154)
lnCFL3	-0.0995 (0.163)	-0.144 (0.0738)	-0.0357 (0.0653)	-0.0527 (0.182)	0.131 (0.122)	0.207 (0.176)
_cons	8.604** (0.926)	8.430*** (0.699)	-1.447 (6.297)	9.286* (0.947)	8.087*** (0.726)	-6.956 (15.24)
<i>N</i>	120	120	120	90	90	90
adj. <i>R</i> <sup>2</sup>	0.653	0.745	0.829	0.635	0.716	0.795

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table 19 Proportion of Rural Population Lagged by One Period and Two Periods**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
L.lnRS	-0.927* (0.163)	-1.154*** (0.227)	-0.724 (1.026)			
L2. lnRS				-1.097* (0.148)	-1.306*** (0.168)	-0.189 (1.953)
lnPOP	0.0514 (0.110)	0.305*** (0.0621)	1.076 (0.962)	0.0667 (0.109)	0.262** (0.0939)	1.852 (2.046)
lnLS	0.0119 (0.0512)	-0.0149 (0.0292)	-0.0339 (0.0290)	-0.000792 (0.0475)	-0.0101 (0.0516)	-0.0550 (0.0300)
lnDGI	0.0861 (0.153)	0.646*** (0.101)	0.856*** (0.188)	0.141 (0.138)	0.612*** (0.0953)	0.873*** (0.231)
lnCFL1	0.134 (0.172)	0.0379 (0.109)	0.0525 (0.109)	0.0616 (0.194)	0.0566 (0.157)	0.188 (0.192)
lnCFL2	0.376 (0.237)	0.421*** (0.122)	0.265* (0.100)	0.0975 (0.288)	0.255* (0.126)	0.0836 (0.141)
lnCFL3	0.0852 (0.194)	-0.0809 (0.126)	-0.0727 (0.0812)	0.339 (0.193)	0.445*** (0.134)	0.291 (0.247)
_cons	5.759** (0.497)	5.470*** (0.519)	0.451 (7.612)	6.029* (0.686)	4.647*** (0.796)	-5.907 (16.06)
<i>N</i>	120	120	120	90	90	90
adj. <i>R</i> <sup>2</sup>	0.713	0.749	0.828	0.699	0.723	0.777

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

From the perspective of the age structure of population, the proportions of people 0–14 years old, 15–64 years old, and 65 years old and above are lagged by one period and two periods respectively and then the robustness of the effect of the age structure of population on China's housing price is tested through regression. Tables 4.18 and 4.19 give the regression results of the explanatory variables for measuring the age structure of population lagged by one period and two periods respectively. As shown in Tables 4.20, 4.21, and 4.22, the effect of the age structure of population on China's housing price remains robust after the proportions of people aged 0–14, 15–64, and 65 and above are lagged by one period and two periods.

**Table 20 Proportion of People Aged 0–14 Lagged by One Period and Two Periods**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
L.lnA1S	-0.624 (0.262)	-1.185*** (0.201)	-0.504 (0.271)			
L2. lnA1S				-0.531 (0.235)	-1.199*** (0.267)	-0.463 (0.526)
lnPOP	-0.118 (0.113)	0.178 (0.0923)	1.182 (0.786)	-0.0892 (0.127)	0.109 (0.107)	1.508 (1.648)
lnLS	-0.00585 (0.0752)	-0.0205 (0.0298)	-0.0378 (0.0307)	-0.0543 (0.0717)	-0.0150 (0.0338)	-0.0503 (0.0342)
lnDGI	-0.285 (0.149)	0.527*** (0.124)	0.822*** (0.152)	-0.325 (0.138)	0.393*** (0.104)	0.759*** (0.176)
lnCFL1	0.351 (0.207)	-0.0218 (0.108)	-0.00435 (0.109)	0.365 (0.214)	0.272 (0.208)	0.200 (0.199)
lnCFL2	0.711 (0.294)	0.339*** (0.103)	0.229* (0.112)	0.777 (0.344)	0.324* (0.141)	0.0712 (0.176)
lnCFL3	-0.473 (0.172)	-0.0813 (0.0601)	-0.00607 (0.0680)	-0.537 (0.180)	0.0557 (0.125)	0.278 (0.230)
_cons	6.454** (0.721)	5.447*** (0.743)	-0.730 (6.474)	7.104* (0.716)	4.730*** (0.978)	-4.006 (13.76)
N	120	120	120	90	90	90
adj. $R^2$	0.551	0.681	0.832	0.537	0.683	0.785

Standard errors in parentheses  
 \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table 21 Proportion of People Aged 15–64 Lagged by One Period and Two Periods**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
L.lnA2S	1.213* (1.220)	3.872*** (1.005)	1.468* (0.963)			
L2. lnA2S				0.548* (0.976)	2.645* (1.179)	-1.508** (1.480)
lnPOP	-0.128 (0.120)	0.230* (0.104)	1.334 (0.721)	-0.0911 (0.137)	0.172 (0.124)	1.994 (1.799)
lnLS	-0.0161 (0.0893)	-0.0276 (0.0320)	-0.0418 (0.0314)	-0.0774 (0.0886)	-0.0133 (0.0428)	-0.0618 (0.0356)
lnDGI	-0.426 (0.134)	0.556*** (0.128)	0.854*** (0.135)	-0.476 (0.134)	0.450*** (0.126)	0.994*** (0.173)

Table 21(Continued)

lnCFL1	0.517 (0.204)	0.0597 (0.121)	0.0148 (0.103)	0.510 (0.200)	0.452* (0.226)	0.177 (0.181)
lnCFL2	0.867 (0.293)	0.502*** (0.107)	0.282* (0.105)	1.024 (0.365)	0.548** (0.207)	0.111 (0.159)
lnCFL3	-0.666* (0.158)	-0.216* (0.0879)	-0.0394 (0.0667)	-0.770* (0.155)	-0.127 (0.242)	0.301 (0.205)
_cons	7.670** (0.962)	8.271*** (1.080)	-0.577 (6.156)	7.994* (1.003)	6.729*** (1.518)	-7.170 (14.92)
<i>N</i>	120	120	120	90	90	90
adj. $R^2$	0.490	0.692	0.829	0.493	0.683	0.785

Standard errors in parentheses  
 \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table 22 Proportion of People Aged 65 and above Lagged by One Period and Two Periods**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
L.lnA3S	0.986 (0.392)	0.731*** (0.175)	0.0500 (0.247)			
L2. lnA3S				0.946 (0.372)	1.166*** (0.352)	0.542 (0.395)
lnPOP	-0.181	0.154	1.312	-0.165	0.0641	1.918

	(0.104)	(0.110)	(0.759)	(0.124)	(0.121)	(1.520)
lnLS	-0.0507 (0.0668)	0.00416 (0.0332)	-0.0328 (0.0297)	-0.0753 (0.0694)	-0.0201 (0.0453)	-0.0590 (0.0347)
lnDGI	-0.386 (0.141)	0.570*** (0.139)	0.924*** (0.148)	-0.391 (0.126)	0.416*** (0.126)	0.809*** (0.157)
lnCFL1	0.381 (0.159)	0.232 (0.142)	0.0703 (0.111)	0.375 (0.169)	0.432* (0.169)	0.215 (0.192)
lnCFL2	0.860 (0.281)	0.454*** (0.112)	0.275* (0.111)	0.908 (0.334)	0.595*** (0.128)	0.0638 (0.165)
lnCFL3	-0.544 (0.178)	-0.147 (0.0903)	-0.0243 (0.0757)	-0.585 (0.179)	-0.105 (0.174)	0.280 (0.215)
_cons	10.74** (1.342)	8.466*** (1.084)	-0.922 (6.499)	10.95* (1.487)	9.508*** (1.777)	-5.036 (12.04)
<i>N</i>	120	120	120	90	90	90
adj. <i>R</i> <sup>2</sup>	0.588	0.745	0.825	0.594	0.645	0.795

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

From the perspective of the employment structure of population, the proportions of people employed in the primary, secondary, and tertiary sectors are lagged by one period and two periods respectively and then the robustness of the effect of the employment structure of population on China's housing price is tested through regression. Tables 4.23, 4.24, and 4.25 give the regression results of the explanatory variables for measuring the employment structure of population lagged by one period and two periods respectively. As shown in Tables 4.23, 4.24, and 4.25, the effect of the employment structure of population on China's housing price remains robust after the proportions of people employed in the primary, secondary, and tertiary sectors are lagged by one period and two periods.

**Table 23 Proportion of People Employed in Primary Sector Lagged by One Period and Two Periods**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
L.lnIIS	-0.737** (0.0873)	-0.750*** (0.0755)	-0.229 (0.135)			
L2. lnIIS				-0.819* (0.0883)	-0.803*** (0.0972)	-0.310 (0.192)

lnPOP	-0.0555 (0.110)	0.195** (0.0698)	1.104 (0.829)	-0.0365 (0.113)	0.175 (0.105)	1.507 (1.667)
lnLS	0.0906 (0.0460)	0.0223 (0.0271)	-0.0261 (0.0282)	0.0510 (0.0444)	-0.0105 (0.0368)	-0.0575 (0.0288)
lnDGI	0.159 (0.113)	0.585*** (0.101)	0.893*** (0.141)	0.158 (0.0877)	0.499*** (0.0869)	0.829*** (0.158)
lnCFL1	-0.0860 (0.172)	-0.00664 (0.119)	0.0485 (0.107)	-0.174 (0.205)	0.0624 (0.154)	0.190 (0.172)
lnCFL2	0.406 (0.187)	0.395*** (0.0884)	0.251* (0.0985)	0.192 (0.243)	0.349* (0.149)	0.0734 (0.171)
lnCFL3	0.00299 (0.139)	-0.0186 (0.0763)	-0.0176 (0.0642)	0.168 (0.144)	0.256 (0.143)	0.271 (0.197)
_cons	6.064** (0.600)	5.744*** (0.644)	0.345 (6.853)	6.799* (0.738)	5.540*** (0.783)	-3.234 (13.68)
<i>N</i>	120	120	120	90	90	90
adj. <i>R</i> <sup>2</sup>	0.746	0.816	0.831	0.716	0.745	0.791

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table 24 Proportion of People Employed in Secondary Sector Lagged by One Period and Two Periods**

	(1)	(2)	(3)	(4)	(5)	(6)
	lnEP	lnEP	lnEP	lnEP	lnEP	lnEP
L.lnI2S	0.737** (0.0873)	0.750*** (0.0755)	0.229 (0.135)			
L2.lnI2S				0.819* (0.0883)	0.803*** (0.0972)	0.310 (0.192)
lnPOP	-0.0555 (0.110)	0.195** (0.0698)	1.104 (0.829)	-0.0365 (0.113)	0.175 (0.105)	1.507 (1.667)
lnLS	0.0906 (0.0460)	0.0223 (0.0271)	-0.0261 (0.0282)	0.0510 (0.0444)	-0.0105 (0.0368)	-0.0575 (0.0288)
lnDGI	0.159 (0.113)	0.585*** (0.101)	0.893*** (0.141)	0.158 (0.0877)	0.499*** (0.0869)	0.829*** (0.158)
lnCFL1	-0.0860 (0.172)	-0.00664 (0.119)	0.0485 (0.107)	-0.174 (0.205)	0.0624 (0.154)	0.190 (0.172)
lnCFL2	0.406 (0.187)	0.395*** (0.0884)	0.251* (0.0985)	0.192 (0.243)	0.349* (0.149)	0.0734 (0.171)
lnCFL3	0.00299 (0.139)	-0.0186 (0.0763)	-0.0176 (0.0642)	0.168 (0.144)	0.256 (0.143)	0.271 (0.197)

_cons	6.064** (0.600)	5.744*** (0.644)	0.345 (6.853)	6.799* (0.738)	5.540*** (0.783)	-3.234 (13.68)
<i>N</i>	120	120	120	90	90	90
adj. <i>R</i> <sup>2</sup>	0.746	0.776	0.831	0.716	0.735	0.791

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table 25 Proportion of People Employed in Tertiary Sector Lagged by One Period and Two Periods**

	(1) lnEP	(2) lnEP	(3) lnEP	(4) lnEP	(5) lnEP	(6) lnEP
L.lnI3S	0.259* (0.0523)	0.0966* (0.0395)	0.00472 (0.0270)			
L2. lnI3S				0.269* (0.0405)	0.147*** (0.0297)	0.0186 (0.0254)
lnPOP	0.0568 (0.0881)	0.140 (0.133)	1.112 (0.839)	0.0846 (0.0989)	0.210 (0.107)	2.351 (2.093)

Table 25(Continued)

lnLS	-0.00423 (0.0760)	-0.0123 (0.0487)	-0.0196 (0.0451)	-0.0518 (0.0718)	-0.0767 (0.0672)	-0.0885 (0.0676)
lnDGI	-0.107 (0.156)	0.368* (0.155)	0.901*** (0.200)	-0.0551 (0.158)	0.328 (0.188)	1.177*** (0.221)
lnCFL1	0.581* (0.145)	0.365* (0.181)	0.0497 (0.126)	0.560 (0.141)	0.586** (0.191)	0.112 (0.176)
lnCFL2	0.300 (0.233)	0.555*** (0.168)	0.382* (0.142)	0.415 (0.253)	0.552* (0.237)	-0.0250 (0.211)
lnCFL3	-0.481* (0.131)	-0.280*** (0.0815)	-0.0797 (0.0567)	-0.476 (0.149)	-0.310 (0.280)	0.183 (0.219)
_cons	7.285** (1.036)	6.779*** (0.897)	0.396 (7.255)	7.747** (0.641)	6.828*** (1.027)	-7.966 (17.30)
<i>N</i>	82	82	82	59	59	59
adj. <i>R</i> <sup>2</sup>	0.739	0.763	0.803	0.760	0.784	0.795

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

## 4.6 Summary

This chapter first constructs the panel econometric regression model and explains the variables and related data selected in this dissertation. Next, this chapter makes a

descriptive statistical analysis of the data of the explained variables and explanatory variables of the model. Then, this chapter uses the econometric regression analysis method to further analyze the effect of changes in the demographic structure on China's housing price from the three aspects of urban-rural structure, age structure, and employment structure of population. From the perspective of the urban-rural structure of population, this study finds that the increase in the proportion of urban population has a positive and significant effect on the housing price, while the increase in proportion of rural population has a negative and significant effect on the housing price. From the perspective of the age structure of population, this study finds that the increase in the proportion of people aged 0–14 has a negative and significant effect on the housing price, while the increase in the proportion of people aged 15–64 and that of people aged 65 and above has a positive and significant effect on the housing price. From the perspective of the employment structure of population, this study finds that the increase in the proportion of people employed in the primary sector has a negative and significant effect on the housing price, while the increase in the proportion of people employed in the secondary industry and that of people employed in the tertiary sector has a positive and significant effect on the housing price. Finally, the robustness of results is tested from the two aspects of replacement of explanatory variables and explanatory variables lagged by one period and two periods. In replacement of explanatory variables, the proportions of urban population and rural population, which measure the urban-rural structure of population, are replaced by the numbers of urban population and rural population respectively. The proportions of people aged 0–14, 15–64, and 65 and above, which measure the age structure of population, are replaced by the numbers of people aged 0–

14, 15–64, and 65 and above respectively. The proportions of people employed in the primary, secondary, and tertiary sectors, which measure the employment structure of population, are replaced by the numbers of people employed in the primary, secondary, and tertiary sectors respectively. In lagging the explanatory variables, the explanatory variables of the urban-rural structure, age structure, and employment structure of population are lagged for one period and two periods respectively. The results of the robustness test show that the effect of the urban-rural structure, age structure, and employment structure of population on China's housing price obtained from the aforementioned benchmark regression part remains robust.

## **CHAPTER 5. CONCLUSIONS AND POLICY RECOMMENDATIONS**

### **5.1 Conclusions**

Based on the realistic background of the development of China's real estate market and the transformation of population structure, this dissertation first constructed a local equilibrium model of the real estate market on the basis of reviewing the existing relevant literature, and theoretically analyzed the effect of the transformation of population structure on the housing price from three aspects: urban-rural structure, age structure, and employment structure of population. This dissertation puts forward the theoretical mechanism of the effect of population urban-rural structure, age structure, and employment structure of population on the housing prices. Secondly, this dissertation makes an in-depth review of the development process of China's real estate market and the changes in the urban-rural structure, age structure, and employment structure of China's population in the past decades, and uses the data of the housing price, urban-rural structure, age structure, and employment structure. The correlation between China's population structure and the housing price is preliminarily analyzed by drawing scatter charts. Finally, on the basis of the above theoretical analysis and preliminary data analysis, this dissertation uses the econometric regression analysis method to further analyze the effect of demographic structure change on China's housing prices from the three aspects of urban-rural structure, age structure, and employment structure of population. This study reaches the main conclusions as follows:

First, in terms of the urban-rural structure of population, the increase in the proportion of urban population and quantity has a positive effect on China's urban

housing prices, while the increase in proportion of rural population and quantity has a negative effect on China's urban housing prices.

Second, in terms of the age structure of population, the increase in the proportion and number of people aged 0–14 has a negative effect on China's urban housing prices, while the increase in the proportion and number of people aged 15–64 and the increase in the proportion and number of people aged 65 and above have a positive effect on China's urban housing prices.

Third, in terms of the employment structure of population, the increase in the proportion and number of people employed in the primary sector has a negative effect on China's urban housing prices, while the increase in the proportion and number of people employed in the secondary sector and the tertiary sector has a positive effect on China's urban housing prices.

It should be pointed out that in the empirical analysis part of this paper, since the right side of the regression equation is not completely independent of each other, the above regression analysis conclusion cannot be regarded as the identification of clean causality, but the preliminary correlation analysis between population structure and real estate market price.

## **5.2 Policy Recommendations**

To help promote the steady and healthy evolution of China's housing prices, this dissertation puts forward the following policy suggestions based on the above conclusions:

First, it is important to strengthen the social security for the migrant population in small- and medium-sized cities and appropriately divert the flows of migrants to and

from big cities to stabilize housing prices in big cities. The migrant population is the main body in the process of urbanization in China. If the migrant population is not guided and diverted, the migrant population would continue to gather in large- and medium-sized cities, such as Beijing, Shanghai, and Hangzhou. This would increase the burden on large- and medium-sized cities, resulting in the imbalance in development between regions and the coexistence of high housing prices and high housing stock. Therefore, small- and medium-sized cities should formulate differentiated policies for attracting talented people according to local development needs and industrial transformation objectives, and retain talented people by relaxing policies on settlement, offering rent subsidies, building long rental apartments for young people, and implementing other specific measures. Only differentiated talent guarantee measures adapted to local conditions can effectively divert the migrant population to small- and medium-sized cities and reduce the pressure of high housing prices in big cities.

Second, the rise in urban housing prices caused by changes in the age structure of population is unsustainable. The government should focus on the negative effect of aging factors on urban housing prices and avoid large fluctuations in housing prices. By assuming that the last generation who enjoyed welfare housing distribution before 1998 was born in the early 1970s, this generation would enter old age between 2020 and 2030. This means the indirect housing demand from aging would disappear released in 2030 in the latest case. The urban housing prices would be negatively affected by the aggravating level of aging after that. According to the population forecast data of the United Nations, the proportion of people aged 60 and above in China is expected to increase by 16%–35% from 2017 to 2050. This indicates that the elderly population would further grow in

China in the future. Therefore, the indirect housing demand brought by the elderly would weaken or disappear, and the increase in the elderly population would inhibit urban housing prices in the future. The government should encourage population growth in an all-around way to counter the negative effect caused by the increase in the elderly population. It is necessary to improve other supporting services for childbearing at the same time.

Third, the transformation and upgrading of industrial structures is an inevitable trend of economic development. The labor force is gradually shifting from the primary sector to the secondary sector and the tertiary sector along with continued economic development. The labor force mobility is high in the secondary sector and the tertiary sector, which is different from the case with the primary sector, where the labor force mobility is low as it is closely tied to the land. The government should appropriately increase the supply of transitional housing and lower the threshold for moving into cities and the down payment ratio for housing purchases. While vigorously attracting labor required for industrial development, local governments should actively improve housing and other supporting facilities, provide enough transitional housing, and promote the conversion from ineffective demand due to short-term inability of payment or high threshold to effective demand to realize the dynamic balance of moving into and out of transitional housing and the stability of housing prices according to the changing pattern of real estate prices in their regions.

### **5.3 Other Comments**

It is notable that at the time of the completion of this paper, namely in the second half of 2021, a substantial transformation occurred in the Chinese real estate market,

marked by a turning point and an entrance into a downward cycle. From the inception of China's real estate market reform in 1998 to the emergence of the turning point and the descent into the downward trend in 2021, over a period of 24 years, the Chinese real estate market underwent a full-fledged one-way bullish cycle. Influenced by the subprime crisis and the global economic crisis, 2008 was the sole year when the Chinese real estate market declined during these 24 years, but it rebounded rapidly following the macro policy adjustment in 2009. Against this backdrop, numerous perplexities emerged. Firstly, why did the 24-year rapid growth of China's real estate come to an abrupt halt? How long will this current downward trend in the real estate market persist, and what kind of impact will it exert on the Chinese economy?

This paper posits that the essence of the current downward trend in China's real estate market does not stem from the macroeconomic dimension but from the micro one, namely, the "Three Red Lines" policy has pierced through the unhealthy "Three High Model" of the Chinese real estate sector. It is evident from the preceding discourse that the overall operation of China's macroeconomy is sound, and the central government has long been implementing prudent monetary and fiscal policies. The real estate market ought not to have witnessed such a rapid downward trend. The current downward trend primarily stems from the abnormal factor of the "Three High Model" within the real estate industry. The "Three Red Lines" policy precisely identified the fundamental cause for the escalating real estate prices and the expanding investment scale in China. The timely and precise introduction of this policy has effectively curbed the excessive speculation and the bubble phenomenon in the Chinese real estate market.

It can be learned from the experience of the Japanese real estate crisis in 1991 that sudden adjustments in macro policies can have fatal consequences for the development of the real estate market. The "precedent" of the Japanese real estate crisis is the "teacher of future events" for China's real estate development. The initial intention of the central government's "three red lines" policy is to limit the unorderly expansion of real estate enterprises and promote the healthy and orderly development of the real estate industry. The central government also gave real estate enterprises a longer adjustment period when implementing this policy. If real estate enterprises had realized the central government's firm belief in adjusting real estate policies at the time, they would have stopped their blind expansion in time, and the Chinese real estate market could have avoided such a sharp downward trend. However, the real estate industry in China, which has grown rapidly for 24 years, still has illusions about the traditional "three high model". There is indeed a high degree of dependence on the real estate industry in the process of promoting economic development by local governments. This phenomenon has also played a role in fueling the real estate enterprises' blind optimism to some extent. The fact that the "three red lines" policy has been implemented objectively has formed a sudden adjustment in macro policies. In view of this situation, the government should continue to implement a series of prudent policies in response to the downward pressure on the current real estate market.

In the coming years, it will still be necessary to adhere to the basic principle that the real estate industry is one of the pillar industries of the national economy. There is still huge potential in the Chinese real estate market, especially in the areas of urbanization and urban renewal, with considerable untapped market potential. Although the urban

landscape and living conditions in China have improved significantly in recent decades, there is still a considerable gap in per capita living space and living quality compared to developed countries. Therefore, it will still be necessary to adhere to the basic principle that the real estate industry is one of the pillar industries of the national economy for a considerable period. At the same time, real estate enterprises urgently need to transform their business models and fundamentally abandon the quantity expansion-oriented business model of "high turnover, high leverage, high return on capital," and instead focus on structural optimization and quality and quantity improvement, gradually moving towards a fine-tuned, quality-oriented and sustainable development path.

Based on the above analysis, this paper puts forward the following policy ideas for China's future real estate market.

First, the core and focus of China's current real estate industry policy regulation is to repair the credit system of real estate enterprises. In the development process of China's real estate market, there have also been downward trends, but the market has always been able to recover quickly after each policy adjustment. However, after a series of policies were introduced, the real estate market has not regained its previous vitality. The reason behind this is multifaceted, and the most important reason is that a large number of real estate enterprises in China, especially the top real estate enterprises, have encountered credit crises and credit collapse. Therefore, in addition to implementing relaxed financial policies such as lowering interest rates and increasing loans to support the real estate industry, repairing credit at the micro level by injecting funds specifically into enterprises or specific projects is one of the effective ways to solve the problem.

Second, integrate the restoration of credit for real estate market entities with the settlement of local debt issues. In China, the land revenue and tax income of local governments constitute a significant portion of public budgets. When local governments raise debts for public infrastructure construction, their primary sources of repayment rely heavily on the real estate industry and related sectors. Consequently, the correlation between local debt problems and the downward trend of the real estate market is highly significant. Currently, local governments must undertake the crucial task of ensuring the delivery of housing projects, which itself poses a considerable challenge to local finances. If on top of this, local governments are further required to assist real estate entities in restoring credit, it undoubtedly adds to the difficulties. Nowadays, the problems in the real estate market have spilled over into the domain of local debt. To address the issue fundamentally, it is essential to consider the resolution of local debt problems in combination with the restoration of credit for real estate market entities.

Third, enhance financial regulation and transform the existing real estate financing model. Although the significant fluctuations in the real estate industry seem to be internal industry issues, the underlying causes are closely intertwined with policies in the financial sector. Greater supervision should be imposed on financial institutions, the financial leverage in the real estate industry should be reduced, and disorders in the real estate industry should be managed to ensure its stable development. Particularly as China's economy becomes increasingly open and dependent on the international market, the impact of the international financial market on China's industrial markets, including the real estate sector, is escalating. The implementation of scientific and robust financial regulation is of paramount importance. The regulation of various types of financial

institutions should be continuously strengthened, allowing only one leverage for real estate project loans. Stringent requirements should be placed on the financing and loan procedures for real estate to ensure the safe and closed operation of funds after the entry of current financial institutions for market rescue.

Fourth, establish a system for the long-term coexistence of the affordable housing market and the competitive commercial housing market. The affordable housing market and the fully competitive commercial housing market ought to be two parallel markets. However, local governments, to attract investment, guarantee local fiscal revenue, and alleviate fiscal payment pressure, have been unable to effectively implement relevant policies for the affordable housing market. At present, China's real estate market is in a downward cycle. Local governments and state-owned financial institutions can seize the opportunity of entering the market for rescue and fully leverage policy support to construct the local government affordable housing market system. This is not only an effective solution to current problems but also an important measure to achieve high-quality development of the real estate market and explore new development models.

Fifth, establish a system for the long-term coexistence of the affordable housing market and the fully competitive commercial housing market. The affordable housing market and the fully competitive commercial housing market ought to be two parallel markets. However, local governments, to attract investment, guarantee local fiscal revenue, and alleviate fiscal payment pressure, have been unable to effectively implement relevant policies for the affordable housing market. At present, China's real estate market is in a downward cycle. Local governments and state-owned financial institutions can seize the opportunity of entering the market for rescue and fully leverage policy support

to construct the local government affordable housing market system. This is not only an effective solution to current problems but also an important measure to achieve high-quality development of the real estate market and explore new development models.

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