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王, 軼華

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神戸大学大学院経済学研究科

経済学専攻

指導教員　衣笠智子

王　軼華

(Wang Yihua)

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（人口、住宅市場および居住形態に関する研究）

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Contents

Chapter 1

Introduction

Since the 1990s, the global economy has grown rapidly in face of numerous new challenges. Differences have increased by aging populations, financial crises, war crises, pandemics, and economic development disparities between regions. According to the National Bureau of Statistics of China, the working-age population started to decrease in 2012 and will continue to shrink gradually. Despite the two-child policy implemented in 2015, China's total fertility rate was 1.3 in 2020, and the proportion of the elderly aged 65 and above was 13.5% of the total population. Faced with labor shortages and unequal growth in the east and west, some undeveloped regions have seen massive population outflow. People prefer to live in cities, making those places become ghost towns. House prices in metropolis continue to grow beyond people's capabilities. At the same time, Japanese society is confronted with several issues. From the Cabinet Office, the population aged 65 and over also accounted for 28.4% of the total population in 2019. The concentration of people in Tokyo and the problem of empty houses have also become more serious. Given considerable changes in the social structure, policy choices must be made about what institutional reforms are required. It can be found that these difficulties focus on two major aspects: demographic considerations and the housing market.

Over a long period, the housing market is a good subject to study international issues. As an industry with a lengthy industrial chain and numerous connected businesses, the development of real estate is an important economic indicator in many countries (Wang & Liu, 2004). Moreover, as a place where people live, housing is closely related to human activities. If the real estate market is unstable, it will have a significant impact on people's daily life, hence harming societal stability. Also, when people's lives are substantially affected, such as when a pandemic reduces income and causes widespread defaults on loans, the real estate market is badly affected, and the economy is volatile. With a diminishing population and an aging population, it is essential to utilize past knowledge and preserve the system resilience. Faced with a fast-changing external environment, it is necessary to implement sound regulations to guarantee that people can live safely, engage in productive activities, and receive strong community support. Therefore, demographic issues and housing market research are crucial for macroeconomics and people's well-being and need additional investigation.

Demographic shifts have influenced the economy in numerous areas, including the housing market. Mankiw and Weil (1989) initially explored the impact of demographics on the demand for house purchases. Since then, this field has received increasing attention, and studies have found a negative impact of aging on house prices (Mankiw & Weil, 1989; Ermisch, 1996; Green & Hendershott, 1996; Ohtake & Shintani, 1996; Takats, 2012; Hiller & Lerbs, 2016; Saita et al., 2016). Meanwhile, the positive relationship has been also checked (Hiller & Lerbs, 2016; Li & Shen, 2013). According to Nishimura (2021), as housing is a durable asset, the influence of demographic changes on the housing market is hard to observe immediately until the long term. Thus, the relationship between the housing market and demographics may not correspond to expectations, and there is much to be discussed. This paper examines the long-term economic growth of housing markets in both China and Japan. It also investigates the link between demographic composition and the housing market over time as the economy expands. Then, demand and supply are measured regarding the demographic structure and housing market. The influence of population fluctuations on housing price changes is also simulated. Finally, this study suggests that there are new issues in Japan, such as income inequality related to the housing market and housing tenure choice.

In Chapter 2, this study estimates the effect of demographic changes on housing prices. The data analysis by region indicated that, increasing the old dependency ratio by 1% increased housing prices by 5.51%, whereas increasing the child dependency ratio by 1% decreased it by 3%. The development of the local economy was also found to influence the effect of age on housing prices. In underdeveloped area, changes in the age structure have a smaller impact on housing price. Mobility has greatly affected housing prices. This result indicates that the issue of ageing does not appear to be the most significant influencing factor in the Chinese real estate market at present and that even older people support the real estate market as part of their purchasing power. Consequently, regional differences in economic development have a greater impact on the real estate market than ageing, which contains some speculative elements.

Based on the findings, the housing market's supply-demand in connection to demographics is further investigated, and the impact of population changes on housing price fluctuations is explored as well. However, to explore how demographic factors influence the connection between supply and demand, the Chinese market does not seem to be a suitable subject as it contains a large number of speculative elements,

while Japan has a consumer-driven housing market. After the bubble burst, the Japanese real estate market entered a new stage.

In Chapter 3, various socioeconomic factors are introduced, and the supply and demand of land in the Japanese housing market are analyzed, respectively. In terms of housing demand, the site area per capita is increasing with ageing, while the child dependency ratio has a negative impact, and the demand for housing is also higher with the convenience of transportation. The surrounding environment may affect a person's decision, and living with family are negatively related to the demand for the site required per person. The fact that Japan's aging population continues to increase housing demand is of concern. This is because it should be determined whether changes in social structure led to an increase in housing demand due to older people living alone, or whether new housing demand develops due to the necessities of everyday life, such as health issues, aging care needs, etc. These two concerns needed to be clarified as they may result in different policy decisions.

To clarify this relationship, demographic and housing market studies are also conducted using microdata. According to the Keio Household Panel Survey (KHPS), for low-income groups, almost half of the income is allocated to housing expenditure, while this proportion gradually declines as income rises. Regarding income quintiles, for low-income quintile groups, many people choose renting. A recent issue in Japan demonstrates that income inequality has a substantial impact on residential life.

In Chapter 4, the determinants of housing tenure and housing expenditure in the Japanese housing market are examined. Additionally, the relationship between income inequality and housing expenditure is investigated. The probability of housing ownership increases with increasing age, getting married, being a male, having larger families, and living with parents. The number of children is negatively correlated. It also reveals that marital status has a greater influence on people with lower income and a minor influence on those with higher income. This offers a viewpoint on the current situation of low marriage rates. Furthermore, house ownership may increase if remote employment is permitted. This section reveals the choices made by individuals with various socioeconomic characteristics when faced with fundamental necessities (housing) in a setting of income inequality, as well as the focus on housing demand in various states, which may be used as a reference for policy formation regarding the housing market.

In Chapter 5, the findings of this study are summarized, and policy implications are made based on the results of Chapters 2-4.

Chapter 2
The Relationship between Demographic Change and House Price in China

2.1 Introduction

Rising house prices put pressure on the increase of nominal wages, and the final cost of labor is directly transferred to the prices of goods and services, thus creating inflationary pressure (Yu et al., 2012). At present, the continuous rise of commercial housing prices has become one of the most important social problems in China. Scholars often analyze the influencing factors of housing prices from the perspective of economics and finance, but as one of the important elements of economic growth, the population is also an indicator that cannot be ignored and is worth studying. A population is directly connected to the demand and is the most basic link in all economic production and consumption activities. The Central Economic Work Conference held in Beijing from December 10 to 12, 2019 determined that houses should be used for living, not for speculation (Purchasing a house and left it vacant, and sold it after the house price increased, which is called speculation.). This illustrates the close connection between housing and people's livelihood, and the government is also working to restore the normal supply and demand relationship in the housing market so that the role of demographic factors in this relationship can truly be reflected.

Demographic changes have affected the economy in many areas, including the real estate market. Mankiw and Weil (1989) first suggested the impact of demographic factors on purchase demand. Research on demographic factors can generally be divided into perspectives that a population's structure generally includes a natural, social, and spatial structure. The natural structure of a population mainly refers to its age and gender structures, and the social structure is influenced by factors such as society, the economy, and culture. It mainly includes the structure of the family and that of human resources, and the spatial structure refers to the distribution and population transfer between regions. The impact mechanism of demographics can be divided into direct and indirect impacts. The direct impact refers to the direct construction of a model for demographic structures (usually a population age structure denoted by the dependency ratio) and house prices. Meanwhile, the indirect impact refers to changes in demand due to demographic changes, which in turn influences the market. Most studies in this area have investigated the impact of demographic changes on housing demand and explored several intermediate variables such as saving and urbanization rates, cultural factors, etc.

In this study, we focused on the direct impact, that is, the relationship between

demography and housing prices. We combined the use of the age structure, spatial migration, cultural habits, the hukou system, and other variables, and conducted several fixed effects regressions based on panel data of 31 administrative units in China covering 16 years (2002–2017); the whole interaction has been rarely mentioned in the literature, which might otherwise help supplement previously conducted studies. We found that the old dependency ratio coefficient was positive: an increase by 1% led to a rise in housing prices by 5.51% when other variables were controlled. Meanwhile, the child dependency ratio coefficient was negative: an increase by 1% led to a decrease in housing prices by 3% when other variables were controlled. In addition, under certain conditions, population mobility had a greater influence on housing prices. This could greatly change the supply and demand relationship between regions. Furthermore, intergenerational transfer payments were positively related to housing prices, and this could be a reason for the positive relationship between aging and housing prices. However, this was only significant in developed areas; nevertheless, this was also within our expectations.

For the government, population policies may not be the best to control housing prices in less developed areas. Regional economic development and population migration could become increasingly important in policy research. In the future, we hope to focus on the diversified developments in the different market sectors, such as the house leasing and second-hand housing markets, the impact of the development of China's elderly care service industry on housing prices, etc. After conducting a series of studies, we hope to obtain valuable findings to identify the relationship between demographic structures and housing prices.

The rest of this chapter is divided into five parts. In Section 2.2, recent developments in the field are sorted into a literature review. In Section 2.3, we introduce our theoretical framework. In Section 2.4, the background of China's housing market is introduced, and empirical study is presented. In Section 2.5, we report our findings and interpretations; we also conduct a robustness test. In Section 2.6, a conclusion is reached based on our findings.

2.2 Literature Review and Chinese Situation

International evidence

To study this topic refers to the theoretical framework, life-cycle hypothesis, and overlapping generations model are mostly adopted. In recent years, overlapping generations model has even been expanded from that of a two-stage model to that of a three- and even four-stage model. The most representative is the seminal research by Mankiw and Weil (1989) and the theoretical model constructed by Takats (2012) to explore the relationship between

aging and asset prices, essentially deriving a negative correlation between population aging and house prices.

Regarding empirical studies, the prevailing postulation worldwide is that child and old dependency ratios are negatively correlated with house prices (Mankiw & Weil, 1989; Ermisch, 1996; Green & Hendershott, 1996; Ohtake & Shintani, 1996; Takats, 2012; Hiller & Lerbs, 2016; Saita et al., 2016). Mankiw and Weil (1989) suggested that there was a link between house prices and demographic factors and argued that the housing needs of people show a "bottom-up" trend across one's life cycle. Meanwhile, Levin et al. (2009) found that population aging and decline lead to a drop in housing prices. Takats (2012) was the first to use a dataset of house prices from 22 advanced countries and observed the occurrence of a major shift. That is, the average house price of advanced economies saw an annual increase of about 30 basis points due to demography in the past four decades but an annual decrease of about 80 basis points because of aging in the following four decades. Furthermore, Ohtake and Shintani (1996) applied the housing demand index of demographic factors put forward by Mankiw and Weil (1989), differentiated between short- and long-long effects in Japan by using the concept of cointegration and an error correction model, and found a high price elasticity of long-term housing supply, in contrast to findings from the United States. Some empirical findings obtained from the data of some countries and regions like Canada and Scotland showed no significant association between the two factors of housing price and dependency ratio (Engelhardt & Poterba, 1991; Chen et al., 2012). Using a micro-simulation methodology that combined a macro-level house price model with a micro-level household formation model, Chen et al. (2012) found that population aging has exhibited a less significant impact on house prices in Scotland. Findings from research on this topic about Scotland specifically remain controversial, which have shown that there is a downward pressure on house prices from its declining and aging population (Levin et al., 2009). Hiller and Lerbs (2016) indicated that the age dependence of individuals on different forms of housing demands can lead to heterogeneous effects of an aging population on different housing markets, an issue that remains overlooked in the literature. Their study showed that an aging population has heterogeneous effects on the real estate sector: The increase of sales prices in condominiums and single-family houses has a negative relationship with a strong rise in the old dependency ratio, but an aging population has a positive relationship with the growth of real rents.

Chinese situation

Regarding the situation in China, there is a little difference. The theoretical models used in China are more precise. Zhu et al. (2016) adopted the computable general

equilibrium (CGE) model to analyze the relationship between aging and urban housing demand and concluded that aging can increase urban housing demand. Meanwhile, Hui et al. (2016) developed a theoretical model to solve the untouched problems of the transfer of inter-generation wealth in the purchase of Chinese houses. Furthermore, Xu et al. (2011) built a three-stage overlapping generation model to verify whether the old dependency ratio is positively related to housing prices by introducing transfer payment factors from the old generation to the young and found that transfer payments are one of the reasons for the positive relationship. Li and Shen (2013) supposed that the relationship between the old dependency ratio and total expenditures on house consumption should be defined as an inverse-U shape. This can explain why the current aging population in China is positively correlated to house prices to some degree, possibly because the inflection point has not yet been reached.

Regarding empirical studies in China, the child dependency ratio has been found to be negatively correlated to house prices, consistent with findings worldwide, while the old dependency ratio has been found to be positively associated with house prices (Li & Shen, 2013; Shao & Ni, 2015; Zhang et al., 2015; Hui et al., 2016; Zhu et al. 2016; Wang et al., 2017; Wang et al., 2018; Zeng et al., 2019). Based on 2010 data from a sample of 287 large and middle Chinese cities, Zhu et al. (2016) used the software ArcGis9.3 to carry out an empirical study on the relationship between aging and urban housing demand and found that aging is positively associated with urban housing demand. To address the problem of endogeneity, Li and Shen (2013) found that population aging in China is non-linearly related to housing consumption and the inflection point of the related nonlinear curve would appear when the old dependency ratio amounts to 32%. Research by Wang et al. (2018) found that urban house prices will be boosted by the rise in urbanization levels and the proportion of inter-regional migrants. Through an augmented Dickey-Fuller test and ordinary least squares regression using panel data from Beijing, Shao and Ni (2015) found that 50% of housing price changes there could be explained by the gross dependency ratio. Zhang et al. (2015) focused on purchase limit policies, considering regional differences, and found that different price–volume causal relationships exist between coastal and inland cities. Wang et al. (2017) found that an 0.701% rise in housing prices could have been caused by a 1% increase in inter-regional migrants, based on data from the 2005 population sampling survey and the sixth city-level population census from 2010. Zeng et al. (2019) verified the positive relationship between the old dependency ratio and the negative relationship of the child dependency ratio and found that population aging

affects housing prices through household savings, and savings weaken this influence.

Scholars have researched demographic factors and housing from a variety of perspectives, such as economic development and cultural habits, leaving numerous valuable experiences for reference. Through investigating the literature, it was found that few put dependency ratios, intergenerational transfer payments, mobility, and other important variables that affect housing prices into one model. This study attempted to innovate in this area by controlling for the differences in regional economic development and exploring the impact of these factors on housing prices.

2.3 Theoretical Framework based on Overlapping Generations Model

The theoretical model we adopted regarding how to introduce housing as a kind of asset into the overlapping generations model was followed by Takats (2012) and Xu et al. (2011) that is an early study of population and housing prices based on Chinese data. In the model of Xu et al. (2011), the life of consumer i is divided into three periods: childhood, middle, and old age. It is more in line with the reality of society to create a model that is divided into three periods, as children are raised and the elderly are supported, while the elderly also provide a great deal of support to the young family. Consumers are assumed to only receive $y_{i,t}^{M}$, income in middle age. In addition, the middle-aged and old people are assumed to have intergenerational transfer payment. Middle-aged people take care of the elderly, who care for the middle-aged. The relevant utility function is expressed by the following function.

$$U_i = \left(lnc_{i,t}^{M} + u\emptyset lnc_{i,t}^{Y} + v\theta_1 ln\alpha_1 c_{i,t}^{O}\right) + \gamma(lnc_{i,t+1}^{O} + \frac{1}{v}\theta_2 ln\alpha_2 c_{i,t+1}^{M}) \qquad (2.1)$$

$c_{i,t}^{M}$ and $c_{i,t+1}^{O}$ respectively, indicate the consumption level of the consumers born at time t-1 among the middle-aged and the elderly. $c_{i,t}^{Y}$ refers to the consumption level of the children born at time t, u refers to the children dependency ratio, v refers to the old dependency ratio, and γ refers to the time discount factor of consumers among the middle-aged and the elderly. $\emptyset$ indicates the degree of concern of middle-aged people for the young, θ_1 indicates the degree of concern of middle-aged people for the elderly, and α_1 refers to the proportion of consumption that middle-aged people pay for the elderly; θ_2 indicates the degree of concern of the elderly for the middle-aged and α_2 refers to the proportion of consumption that the elderly pay for the middle-aged. The degree of concern refers to the willingness of a person to participate in transfer payments. For example, when an adult child needs to buy a house and is not able to afford one, parents whose degree of concern is high are more likely to pay for their child, using part or all their savings to buy a house for them, and the house is

recorded under the child's name instead of their own. Consumers earn $y_{i,t}^M$ only in middle age. It is assumed that consumers can invest in two kinds of assets—private bond B and housing asset H. The private bond is a risk-free asset, and its yield is r. It is assumed that the investment of middle-aged consumers in the real estate market is $S_{i,t}^M$. Thus, the budget is constrained by

$$c_{i,t}^M + uc_{i,t}^Y + \alpha_1 c_{i,t}^O + \frac{\alpha_2 c_{i,t+1}^M}{1+r} + B_{i,t} + S_{i,t}^M = y_{i,t}^M \tag{2.2}$$

$$c_{i,t+1}^O = B_{i,t}(1+r) + S_{i,t+1}^O \tag{2.3}$$

In the above, $S_{i,t+1}^O$ refers to the value of housing assets in old age. Here, it is assumed that the elderly can sell their housing assets to obtain funds to meet their consumption needs in old age. According to the no-arbitrage principle, the rate of return on housing assets must be equal to the rate of return on the bond market. Therefore, (2.2) and (2.3) can be sorted as follows:

$$c_{i,t}^M + uc_{i,t}^Y + \alpha_1 c_{i,t}^O + \frac{\alpha_2 c_{i,t+1}^M}{1+r} + \frac{c_{i,t+1}^O}{1+r} = y_{i,t}^M \tag{2.4}$$

At time t, the net supply of the private bond market is equal to zero, and the net savings of consumers in the real estate market is equal to the net supply of housing assets.

$$S_t^M - vS_t^O = S_t^M - (1+r)vS_{t-1}^M = p_t \frac{\bar{H}_t}{W_t} \tag{2.5}$$

In the above, v refers to the old age dependency ratio, while p_t and $\bar{H}_t$ refer to the housing price and total supply of housing, respectively. W_t refers to the number of middle-aged (working population) at time t. It is assumed that the economic growth rate is g and the population growth rate is 0, which is helpful to examine the impact of the age structure of populations separately. Combining (2.4) and (2.5), maximizing the utility function under constraints, we obtained

$$p_t = \frac{\frac{\theta_2\beta}{v}+\beta}{(1+u\emptyset+v\theta_1+\frac{\theta_2\beta}{v}+\beta)\ \bar{H}_t}(1-\frac{(1+r)v}{1+g})y_{i,t}^M \tag{2.6}$$

Based on the result of (2.6), $\frac{\partial p_t}{\partial u} < 0$, $\frac{\partial p_t}{\partial v} < 0$, evidently means that an increase in the dependency ratio could bring about a decrease in the housing price. However, $\frac{\partial^2 p_t}{\partial v \partial \theta_2} < 0$, which indicates that the increase of transfer payments from the old generation to the young would reduce the negative impact of the old dependency ratio on housing prices. In other words, if the elderly is willing to help the young, this may

weaken the negative impact on housing prices.

There may exist some bias between theory and empirical data. For example, the population growth rate in the real world is not equal to 0, and the overlapping generations model used in our study is introduced in a three-stage period, and the length of each period is the same. However, in the empirical study, the old dependency ratio represented the ratio of people aged above 65 years to working people, where bias may occur. In addition, there are many arbitrage opportunities when swapping between different assets (such as the housing market and the financial market). At the same time, housing is a special asset, which can exist as an investment good and consumer good concurrently. As a result, although the trend of theory and empirical results may be the same in the long run, this highlighted bias is still worth discussing. We will try to verify the positive effect with the following empirical estimates.

2.4 Data and Empirical Estimates

Data

An empirical analysis was conducted using data on national demographics, house prices, and other relevant data from the National Bureau of Statistics of China, as well as the China Statistical Yearbook, population and employment statistics yearbooks, and finance and banking yearbooks. The panel dataset obtained included the data of 31 Chinese administrative units, covering 16 years (2002–2017).

This data set only contains urban data because the sale of houses is banned in Chinese rural areas.[1] In addition, house prices before 1998 cannot fully reflect market conditions, since the housing market-oriented reforms of China were implemented that year. House prices in China have dramatically increased in the past two decades. Moreover, the period covered by the database started from 2002: detailed demographic records (child and old dependency ratios) dated back to that year.

Econometric Method

According to the Hausman test, a regression analysis was performed using fixed effects. The generic empirical model can be written as follows[2]:

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[1] More details of Chinese housing market see in "Background and hypothesis" of section 2.4.

[2] Refers to Li and Shen (2013), there is a nonlinear relationship (inverted U-shaped curve) between the old dependency ratio and housing consumption in China. However, in this paper, most of the variables become not significant after the addition of the quadratic term for regression, and the old dependency ratio and the house price do not show a solid inverted U-curve relationship. The details haven't been reported in this paper for space limited. The reason may be that the dependent

$$\text{Ln}HP_{it} = \beta_0 + \beta_1 old_{it} + \beta_2 child_{it} + \beta_3 birthrate_{it} + \beta_4 mortality_{it} + \beta_5 \text{Ln}mobility_{\text{it}} + \beta_6 sexratio_{\text{it}} + \beta_7 \text{Ln}collective_{\text{it}} + \beta_8 \text{Ln}unmarried_{it} + \beta_9 investratio_{it} + \beta_{10} GDP\ deflator_{it} + \mu_i + \varepsilon_{it}$$

LnHP_{it} refers to the dependent variable, indicating the logarithm of the housing prices. Subscripts i and t stand for province and time (year), respectively. β_0 refers to the intercept; μ_i represents the time fixed effect (capturing unnoticed common factors).

In the empirical analysis, regression was carried out according to the four economic zones of China in addition to a national regression according to province. These four economic zones[3] are (i) the eastern region, covering Beijing, Tianjin, Shanghai, Jiangsu, Hebei, Fujian, Zhejiang, Shandong, Hainan, and Guangdong; (Hong Kong, Macau and Taiwan are not included in this study) (ii) the middle region, covering Shanxi, Jiangxi, Henan, Anhui, Hubei, and Hunan; (iii) the western region, covering Inner Mongolia, Guangxi, Sichuan, Chongqing, Guizhou, Tibet, Yunnan, Shaanxi, Gansu, Ningxia, Qinghai, and Xinjiang; and (iv) the northeast region, covering Jilin, Liaoning, and Heilongjiang.

The mean variance inflation factor (VIF)—which characterizes the degree of multicollinearity between independent variables—the value of model (1) was 2.64, and the maximum VIF value was 4.41 (child dependency ratio). When 0 < VIF < 10, this indicated that there was no multicollinearity. When VIF ≥ 10, there was multicollinearity, and the larger the VIF, the more serious the multicollinearity. There was no multicollinearity in our model.

Background and hypothesis

Since the reform and opening up in 1978, China's real estate market has undergone several stages of development: 1) The initial formation period: In the two decades before 1978, China had almost no real estate market and industry, and only had a construction industry. From 1978 to 1991, with the initiation and advancement of the housing and land use systems' reforms, the real estate market initially took shape. 2) The real estate overheating period: From the second half of 1992 to the first half of 1993, China's real estate development companies increased sharply, and real estate development investment increased rapidly. 3) The market adjustment period: The government started macro-control from 1993 to 1994 and

variable of this analysis is the house price, meanwhile in the reference paper it is housing consumption, what's more, the selected variables are also different. Therefore, quadratic term is not introduced in this and subsequent empirical models.

[3] National Bureau of Statistics. (2011, June 13). M*ethod of dividing East, West, Central and Northeast regions.* (in Chinese) http://www.stats.gov.cn/ztjc/zthd/sjtjr/dejtjkfr/tjkp/201106/t20110613_71947.htm

continued to implement moderately tight fiscal and monetary policies from 1995 to 1997. After the Asian financial turmoil in 1997, the real estate market entered a low ebb. 4) Cultivating new economic growth period: Beginning in 1998, the government decided to cultivate the housing industry as a new economic growth pillar. Consequently, China's real estate market and industry entered a new period of development. 5) Macro-control period: After 2003, real estate investment has grown rapidly with a sharp rise in real estate prices. However, the irrational housing supply structure has prominent contradictions. Furthermore, the real estate market order is relatively chaotic. To mitigate these issues, many policies and measures have been promulgated to regulate and control the real estate market (Zou & Ouyang, 2008). By 2017, housing investment in China was 8,698.53 billion yuan, while the real estate residential investment was 7,514.79 billion yuan.

In the supply side, China has been implementing the strictest land management system to prevent the displacement of farmers after the transfer of homestead, and thereby, prevent this from affecting the overall social stability in China. Moreover, China's legislation prohibits urban residents from buying homestead. In the decision on deepening reform and strict land management, the State Council once again stressed: "strengthen the management of rural homestead and prohibit urban residents from purchasing homestead in rural areas." The provisions of the land management law on "the rural villagers who apply for the homestead after selling or renting their houses shall not be approved" also reflect the meaning of not allowing the right to use the homestead to be transferred to the urban residents outside the collective economic organization. In summary, the rural homestead can only be transferred among the members of the village collective, not to the urban residents. Therefore, the increase in supply-side housing mainly refers to the increase in urban housing. According to the National Bureau of Statistics of China, from 1978 to 2018, China’s urban housing stock increased from less than 1.4 billion square meters to 27.6 billion square meters, the urban per capita housing area increased from 8.1 square meters to 33.3 square meters, and the urban housing unit area increased from 44.9 square meters to 89.6 square meters. The surge in housing prices stimulated the speculative market. At the end of 2016, the Central Economic Work Conference proposed for the first time that “houses are used for living, not for speculation”. Since then, real estate-related departments have successively introduced policies to match the guidance, involving the financing of real estate enterprises and the credit of home buyers.

From the demand side, the demand from newlywed couples forms the main source of demand. In China, these newlywed couples are more willing to buy a house than to rent a house. According to a follow-up survey of Chinese college students in 2017, Hu et

al. (2019) found that young people born after 1990 showed a diversified concept of getting married and buying a house, but two-thirds still agreed that a house is a necessity for marriage. It may partly be because of the influence of traditional culture, and partly because of the choice of the advantages of local resource allocation, for example, school district housing for the children's education. The school district is divided by the education department according to the source of students in the district each year. Within this district, students can enroll nearby by enjoying compulsory education and exemption from entrance examinations. The real estate in this district is called school district housing. This issue may be also related to the *hukou* system[4] in China. China's *hukou* system assumes the special function of allocating resources. For the population with urban *hukou*, the allocation of resources is huge, mainly in housing, medical care, education, employment, and pension relief. These are some benefits that are not available to those with a non-residential household but work locally. Meanwhile, when people go to the big city, the collective *hukou* is often treated as a transitional identity. The collective *hukou* gives residents the rights to enjoy all resources of the city and the qualifications to buy house in the city. This is often the most convenient way to reside in a city. People within a collective *hukou* are also often potential buyers. Housing prices in Chinese cities have risen rapidly, especially in the big cities. Young people who have just entered the work market have to rely on the help of their families for buying a house. Referring to the intergenerational wealth transfer, Li and Shen (2013) note that due to the family planning policy, the birth rate decreased sharply. This was accompanied by a large-scale emergence of the "4-2-1 families" (i.e., families with four grandparents, two parents, and one child). Therefore, more and more families are willing to concentrate their wealth on their children, including buying houses for their children. Furthermore, when their adult children are in the process of buying a house, parents play an active role. During this process, parents may also negotiate with their children to establish a new intimate relationship with them, such as going to the residence of the children after retirement (Lin & Lin, 2020).

Competition in the marriage market also affects other aspects of the economy. Wei et al. (2011) discussed the impact of this competition on housing prices. The author pointed out that apart from being a consumer product and an investment product, a house also has an important social attribute: it can show the identity and social status of the homeowner. The author used this framework to analyze why China's home ownership rate and housing prices are much higher than other countries. In the Chinese marriage market, women's bargaining power has increased since there are more men than women. When other conditions are equal,

[4] *Hukou* system refers to a system of household registration in China.

the woman is willing to marry a man who possess more wealth. Faced with fierce competition, the man may do their best to buy a larger and more expensive house that exceeds their consumption (and financial investment) needs. Through micro-data analysis, the author found that this kind of competition led to an irrational increase in housing prices: it explains 30-48% of the increase in housing prices in Chinese cities from 2003 to 2009. Moreover, Lin and Lin (2020) found that due to the influence of individualization, an individual's pursuit of an independent private space, changes in family intergenerational relationships, and the rise of women's social status have jointly promoted the need for marriage housing among urban youths.

The descriptive statistics of our sample are reported in Appendix 2.1.

Housing price (LnHP). In this study, the average selling price of urban residential commercial housing was chosen as our variable of interest. In China, there are several categories of commercial housing selling prices, namely: the average selling price of commercial housing, the average selling price of residential commercial housing, the average selling price of villas and high-grade apartments, the average selling price of office buildings and commercial housing, and the average selling price of commercial premises and other forms of housing. We mainly studied the influence of the population structure on residential housing prices; thus, it was most suitable to choose the average selling price of housing as our variable of interest.

Old dependency ratio (Old, %). This ratio is defined as the number of individuals aged 65 years and over per 100 people of working age (those aged between 15 and 64 years). Typically, young people who recently enter the labor market and plan to get married or have recently gotten married have a higher demand for houses. Entering old age greatly reduces people's possibility of buying a house. Therefore, we assumed that this ratio is negatively related to housing prices.

Child dependency ratio (Child, %). The child dependency ratio is defined as the number of individuals aged zero to 14 years per 100 people of working age (those aged between 15 and 64 years). According to Hui, Wang, et al. (2016), a family will spend more money on raising children if they have more children, thus reducing their house consumption budget. This ratio is supposed to have a negative impact on housing prices.

Birth rate (‰). According to Yang et al. (2015), largely due to the baby boom in the 1980s and the rapid decline in birth rates in the 1990s, China's housing prices have been increasing since 2001 (the baby boomers entered marriage age in the 1980s, and around 2014, the baby bust generation of the 1990s entered marriage, leading to a decline in housing demand). Therefore, the birth rate is expected to have a positive effect on housing prices.

Mortality rate (‰). The mortality rate has directly reduced the demand for housing. On the other hand, the death of a house owner allows the asset to re-enter the market as a second-hand good, which in turn increases the housing supply. The combination of these two factors has eased the downward pressure on house prices. Therefore, the mortality rate is expected to have a negative effect on housing prices.

Mobility (%). Population mobility is measured as follows: (resident population − permanent population)/resident population (Li & Shen, 2013). Population mobility has changed the supply–demand relationship of the housing market in different regions. In general, developed cities are more attractive than less developed areas, and as a result, higher population mobility appears in developed areas. We assumed that mobility is positively correlated with home prices.

Sex ratio. This ratio represents the number of males per 100 females in provincial populations. In our study, the sex ratio served as a proxy for the level of transfer payment from the old generations to the young. Under the influence of traditional clan culture, China has developed a patriarchal family system. The patriarchal residence system stipulates that a wife should live with her husband. In this form of marriage and living, the pressure to buy a house falls mostly on men. Wei et al. (2011) demonstrated the impact of the sex ratio on the increased competition in the marriage market due to rising housing prices. Note that even if the transfer payment data are available from the parents' side, it is not easy to use such data. Since the cross-section observation unit is provinces, to reduce the bias, we assume that both parents and children live in the same province. The sex ratio is supposed to be positively related to housing prices.

The number of people who hold collective hukou. Hukou is a household registration system used in mainland China. People who live in collective households usually work in major cities without owning their own house. Buying a house is one of the most effective ways for people to move from being registered as a collective hukou holder to being a head of a private household. Therefore, collective household owners are also a potential group of home buyers. This ratio is assumed to be positively related to housing prices.

The number of unmarried people above 15 years old. In China, it is common that young people purchase houses before getting married (Hui et al., 2016). These people's housing demand is generally inelastic and rigid. The increase of unmarried people may lead to an increase in the demand for housing.

Investing ratio (%). This ratio represents the percentage of the investment amount in housing to the total investment amount in real estate. It usually represents the supply of housing and is supposed to be negatively related to housing prices.

GDP deflator. This index is used to measure the prices or cost of living indexes. The index is also used to calculate the components of GDP, such as personal consumption expenditures. Its components are broader than CPI, involving all goods and services, the means of production and capital, exports of goods and services, etc. Therefore, this index can more accurately reflect the price level change and is the most macroscopic measure of the price level. We could only obtain nominal GDP from the statistical yearbook, not actual prices. To examine economic variables more accurately, we must exclude the influence of inflation. The provincial data published by the China Statistical Yearbook is nominal GDP and the growth rate of real GDP. The real GDP and GDP deflator are not reported. Therefore, to use these data, we must compute the real GDP and GDP deflator. On the Statistics Bureau's website, the method of calculating the GDP deflator is described on the page explaining the system of national accounts as follows: GDP deflator = (current year's nominal GDP / previous year's nominal GDP) / (current year's real GDP / previous year's real GDP) * 100.[5] We calculate the GDP deflator based on the published nominal GDP and GDP index. The method is as follows: we first set the year 2002 as the base period and multiply the annual GDP index by GDP in the base period; the result is the actual GDP with constant price in 2002. We found that the real GDP is lower than the nominal GDP, and after deducting the price factor, the growth of real GDP is also more gradual. Its coefficient is supposed to be positive.

2.5 Empirical Result using Panel Data

Result overview

The following findings were revealed: (1) The positive impact of the old dependency ratio and negative effects of the child dependency ratio both showed a strong significance. (2) However, the former finding happened under certain conditions. (2) However, the former finding happened under certain conditions. In underdeveloped areas, changes in the age structure of the population have less impact on housing prices; other more important factors affect housing prices. This is rarely mentioned in the literature and might help supplement previous studies. (3) The impact of population mobility on housing prices was exceptionally large, even in underdeveloped areas. This greatly changed the supply and demand relationship between regions. (4) The transfer payments were significant only at the national

[5] National Bureau of Statistics. (2022, February 21). *V. National Accounts (17)*. http://www.stats.gov.cn/tjzs/cjwtjd/201308/t20130829_74319.html (in Chinese)
The base year of real GDP is 1952, 1957, 1970, 1980, 1990, 2000, 2005, 2010, and 2015 since China began calculating GDP. The base year is updated every five years. In this study, for the convenience of calculation, the real GDP up to 2017 was accounted for using 2002 as the base data.

level. However, this was also in line with our expectations because of the general need to lift one's family to buy a house. The reason why the result was significant at the national level is that the transfer payment is a national phenomenon, and in China's cultural background, the positive impact of the transfer payment on housing prices is well-reflected.

Result interpretation

First, we make group regressions on the four economic zones (Table 2.1). The population age variables showed a significant and stable correlation. Consider a full sample regression of all variables, according to Estimate (6), the old dependency ratio coefficient was positive: An increase by 1% led to a rise in housing prices by 5.51% when other variables were controlled. Meanwhile, the child dependency ratio coefficient was negative: An increase by 1% led to a decrease in housing prices by 3% when other variables were controlled. According to Estimates (6) ~ (10), after adding the control variables, the coefficient on old dependency ratio in Eastern (0.0546) is basically the same as that of the full-sample regression (0.0551). Furthermore, the coefficients decrease in order from the middle, west, and northeast. The coefficients of the variables are all significant at the 1% confidence interval. Thus, aging has a positive and significant impact on housing prices. The GDP deflator gradually decreases from the east to the northeast. Furthermore, it is significantly higher for the eastern region (2.226) than the national level. This is also stable after adding the control variables. This indicates that economic development also has a synchronous positive impact on housing prices. The degrees of significance were expressed as ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$. The standard deviations are reported in brackets.

Regarding the positive relationship between the old dependency ratio and housing prices, transfer payments and mobility were treated as mediating variables. In the era of the planned economy in China, many products were distributed in the form of welfare, including housing distribution. People who grew up in that era did not need to spend too much on buying a house at a young age and were thus able to generate additional savings. Elderly people with good economic conditions are more likely to re-purchase apartments for housing. In addition, the mentality of inter-generational transfer payment was further strengthened by the one-child policy implemented in the late 1970s and early 1980s, Chinese older generations are willing to save money and purchase houses for their children and even grandchildren. Therefore, the demand of the elderly for housing may also increase because of economic and social development at this stage in China.

As for the regions, we found that for the population age variable results, essentially only the results from the eastern region regression were consistent with those of the national data regression. The impact of the birth and death rates on housing prices weakened to varying

degrees in the central, western, and northeastern regions, and even the opposite was observed (Estimate (10), the coefficient of Birth rate is -0.0713 and the coefficient of mortality rate is 0.175). We can reasonably postulate that, in underdeveloped areas, changes in the age structure of the population have less impact on housing prices; other more important factors affect housing prices.

The impact of unmarried population on housing prices is contrary to expectations. The rigid demand for housing in China is the housing for those intending to get married. Theoretically, one may infer that the number of unmarried people and housing prices are positively correlated. However, a possible reason for the opposite phenomenon is that the willingness of Chinese young people to get married has generally declined. Marriage is not a must for everyone. Therefore, this part of the demand for buying a house has weakened. According to data from the National Bureau of Statistics and the Ministry of Civil Affairs, starting in 2013, the crude marriage rate in China has been declining year by year. The national crude marriage rate was 9.9‰ in 2013, reduced to 9.6‰ in 2014, 9‰ in 2015, 8.3‰ in 2016, and 7.7‰ in 2017. The factor responsible for the decline in the marriage rate is the change in the age structure of the population: the proportion of the marriage-aged population has correspondingly reduced. This will inevitably lead to a decline in the general marriage rate. From this perspective, the marriage rate in China will fall in the future as well. Consider this example: China's birth rate in 2019 was only 10.48‰. Taking 22 as the age of marriage, the population born in 2019 will enter the marriage and childbirth stage around 2041, which will naturally lower the marriage rate at that time.

Another influential variable in our analysis was mobility. By comparing the results of Estimate (1)-(5) and Estimate (6)-(10), a remarkably interesting phenomenon can be noted: before adding mobility, collectivity had a strong significance, but after adding mobility, the significance of the other regions even disappeared. Collectivity represented the demand situation of the housing market to a certain extent. In a relatively stable market, demand would not change much. However, the population mobility rate broke this balance and became an enormously powerful factor that affected housing prices. According to Estimate (6), the mobility ratio coefficient was positive at a 1-percent level: An increase by 1% led to a rise in housing prices by 13.8%; the size of its coefficient was also the largest one of all variables.

The sex ratio was only significant at the national level (1-percent level). The population tends to be concentrated in large cities, and China is gradually forming several metropolitan areas. Therefore, even if housing prices are too high to afford, people are still willing to spend all their savings to buy a house in a big city. In the middle and western regions, and especially

in the northeast, the population outflow is particularly serious. According to the *Statistical Yearbook of Heilongjiang Province*, the registered population of Hegang City in Heilongjiang was 1.109 million in 1997. This rose to 1.1126 million in 2001 and has been declining since. By 2017, the population had decreased by 99,500 in 20 years. In 2019, news of "cabbage price" housing in Hegang City attracted national attention, and unit prices were only around 400 yuan/square meter. In the second-hand housing market in Hegang City, the average price in November 2019 was 1,904 yuan/square meter, and the average price in March 2020 was 2,375 yuan/square meter. The sex ratio regression results also reflect the uneven regional economic developments.

Robustness test

As the regression in the former section is group regression analysis, there may be significant variable coefficients but significant differences between groups as well. In addition, grouping may make the samples smaller and affect the results. Therefore, here, we introduce cross-term to test whether the coefficient of old dependency ratio has differences between groups. Meanwhile, we also use full-sample regression to increase the sample size. Importantly, note that the assumptions of the interaction term and group regression are different. The cross-term assumes that the coefficients of all control variables do not differ across groups, and the cross items between the groups have the same distribution (because the samples are mixed in the estimation). Due to structural changes, sometimes, two kind of regression results are completely opposite. Here, we conduct the Chow test on the grouping. The results show that Chow Test = 20.22, P-Value > F (33, 354) = 0.0000. Therefore, there is no structural mutation between groups, and cross term regression analysis can be conducted on a single variable.

We added dummy variables for a robustness test. We must emphasize that all the models were regressed based on a nationwide database. Estimate (1) to (8) (Table 2.2) were all regressed using fixed effects. Considering the worldwide financial crisis of 2008, year dummy variables were introduced to reduce regression errors. The year dummy equaled 1 for years after 2007, otherwise, this equaled 0. Regarding the region dummy variables, the northeastern region existed as the base region. Dependency ratio*region denotes the cross-terminus between the dependency ratio and region dummy variables. The northeastern region was not used to avoid multicollinearity. The analysis was conducted based on nationwide data, and the degree of significance was expressed as ***p < 0.01, **p < 0.05, *p < 0.10. Standard deviations are reported in brackets.

The results of the regression revealed that the explanatory variables showed strong stability. They showed that the old dependency ratio coefficient was positive as before, while

the old*east coefficient was negative (in estimate (1), the coefficient of old*east is -0.144), indicating that the positive impact of the old dependency ratio on housing prices is weakened in developed regions. Since there is no structural change, for the old dependency ratio, there is a big difference in the influence in the eastern and non-eastern regions, which indicates that aging may has a significant impact on local housing prices within each region., but among regions, it needs further discussion. In addition, from Table 2.1, we find that before and after adding the variable of lnmobility, the impact of lncollective on housing prices shows a significant and consistent change. This may indicate that mobility and population structure are linked to some extent, and the unbalanced development of the regional economy has promoted the mobility of the population. To further discuss the contributions of the variables, we did a Relative Importance Analysis. Appendix 2.2 shows the importance of each variable to the overall regression from a statistical perspective, which is a Relative Importance Analysis (Grömping, 2007; Israeli, 2007). The principle here is to decompose the contribution of each variable to R-square and rank them. It should be noted that the method is a statistical analysis. Table 2.1 shows the national, eastern, and western areas where mobility is significant. We find that 1) mobility has a substantial influence in areas according to the rank level, especially in the national and eastern areas. 2) From east to west, the influence of mobility gradually decreases, which agrees with our previous conclusions from Table 2.1.

Before adding the variable of mobility, the child dependency ratio exhibited similar findings. This could indicate that the level of economic development can offset the positive impact of aging and the negative impact of the decline in birth rates to a certain extent. This may also be one of the reasons why aging and housing prices in developed countries are typically inversely related. Such a trend is gradually appearing in the developed eastern coastal areas of China. At the same time, except for the eastern region, the cross-terms of the western and central regions were not significant, which further verifies this conclusion: In underdeveloped regions, changes in the population age structure have a weaker impact on housing prices. In these regions, age factors are not the main reason for price changes.

2.6 Conclusion

The relationship between demographic transition and house prices has been studied extensively in recent years. China has experienced a remarkable demographic transition since the 1980s because of the one-child policy. In addition to population aging, people are anxious about whether China will gradually exhibit the phenomenon of a declining birthrate and aging population, and whether it will face the risk of asset meltdown. However, what is surprising

is that in China, aging has not only failed to reduce housing prices but has also shown a strong positive relationship. Scholars desire to explore the reasons for this and have conducted multi-angle research using age structure, spatial migration, cultural habits, and so on.

This study conducted a regression with panel data of 31 administrative units in China covering 16 years. We found that the old dependency ratio did have a strong positive influence on housing prices, and the child dependency ratio was negatively related significantly. However, this occurred under certain conditions. That is, in underdeveloped areas, changes in the age structure of the population have less impact on housing prices. There are also other important factors affect housing prices, and population mobility may be one of these. The impact of population mobility on housing prices is huge, even in underdeveloped areas. It has greatly changed the supply and demand relationship between regions. In addition, inter-generational transfer payments were significant only at the national level, and the degree of influence was not as large as expected. Nevertheless, this was also in line with our expectations, as almost only in first-tier developed cities was there the general need to lift the whole family's wealth if one planned to buy a house. For the transfer payments are a national phenomenon, and with China's cultural background, the positive impact of transfer payments on housing prices has been well-reflected in national wide. The interaction analysis of age structure, spatial migration, cultural habits, the hukou system, and other variables, is rarely mentioned in the literature, which might otherwise be helpful to supplement past studies.

Regarding policy implications. For the government, in less developed areas, population policies may not be the best to control housing prices. In the short-term, there are other ways to boost the economy and attract talent. At the same time, the rise in housing prices caused by aging need not be a cause for major alarm; the current trend in the east region has gradually weakened. As the economy develops, the positive relationship between aging and housing price in China could gradually become consistent with the situation worldwide. Based on studying the age structure, we can pay more attention in the future to the topics of population mobility and the imbalance of regional development, a series of market diversification explorations, such as the hukou system for house leasing, and the development of the elderly service industry.

Table 2.1 *Fixed effects on national wide and regional data*

	(1) National	(2) Eastern	(3) Middle	(4) Western	(5) Northeast	(6) National	(7) Eastern	(8) Middle	(9) Western	(10) Northeast
Old	0.0516***	0.0461***	0.111***	0.0927***	0.0522***	0.0551***	0.0546***	0.111***	0.0825***	0.0498***
	(0.0084)	(0.0101)	(0.0196)	(0.0142)	(0.0141)	(0.0082)	(0.0099)	(0.0196)	(0.0145)	(0.0137)
Child	-0.0323***	-0.0245***	-0.00755	-0.0330***	-0.0525***	-0.0300***	-0.0239***	-0.00649	-0.0293***	-0.0544***
	(0.0053)	(0.0074)	(0.0102)	(0.0075)	(0.0147)	(0.0051)	(0.0070)	(0.0104)	(0.0071)	(0.0167)
Birth rate	0.0913***	0.0658***	-0.0705*	0.0499*	-0.0797**	0.0852***	0.0615***	-0.0851*	0.0397	-0.0713**
	(0.0131)	(0.0164)	(0.0410)	(0.0259)	(0.0353)	(0.0127)	(0.0155)	(0.0441)	(0.0243)	(0.0344)
Mortality rate	-0.0830**	-0.289***	0.0669	-0.108*	0.189***	-0.0690*	-0.293***	0.113	-0.084	0.175***
	(0.0371)	(0.0590)	(0.0871)	(0.0598)	(0.0413)	(0.0358)	(0.0578)	(0.1040)	(0.0560)	(0.0573)
lncollective	0.0512***	0.0628**	0.0118	0.0592***	0.0441*	0.0109	0.00102	-0.014	0.00805	0.0356
	(0.0145)	(0.0285)	(0.0232)	(0.0186)	(0.0247)	(0.0166)	(0.0321)	(0.0338)	(0.0205)	(0.0307)
lnunmarried	-0.112	0.00107	-0.222	-0.497***	-0.252	-0.0864	0.0175	-0.2	-0.562***	-0.273
	(0.0998)	(0.1288)	(0.2131)	(0.1661)	(0.1896)	(0.0959)	(0.1221)	(0.2141)	(0.1563)	(0.1853)
Invest ratio	-0.623***	-1.294***	-0.821*	-0.371*	-0.131	-0.343*	-0.836**	-0.627	-0.0917	-0.0849
	(0.1876)	(0.3700)	(0.4149)	(0.2120)	(0.4538)	(0.1903)	(0.3755)	(0.4494)	(0.2070)	(0.4684)
GDP deflator	1.529***	2.226***	1.721***	0.965***	0.923***	1.341***	1.962***	1.631***	0.790***	0.715***
	(0.0849)	(0.1371)	(0.1795)	(0.1244)	(0.1376)	(0.0902)	(0.1479)	(0.2057)	(0.1221)	(0.1829)
lnmobility						0.138***	0.229***	0.0846	0.188***	0.0898
						(0.0359)	(0.0730)	(0.0979)	(0.0412)	(0.0760)
Sex ratio						0.0147***	0.00685	0.0144	-0.00377	0.0152
						(0.0041)	(0.0044)	(0.0098)	(0.0068)	(0.0179)
Constant	6.809***	7.091***	7.226***	10.43***	8.617***	5.541***	7.014***	5.733**	12.12***	7.771**
	(0.9660)	(1.2781)	(2.1901)	(1.4206)	(1.9527)	(1.0633)	(1.3586)	(2.4051)	(1.6437)	(2.9624)
N	398	130	77	152	39	398	130	77	152	39
Adjusted.R-sq	0.8205	0.9062	0.9035	0.8519	0.9614	0.8346	0.9158	0.9048	0.871	0.9639

Notes: Degree of significance expressed as ***p < 0.01, **p < 0.05, *p < 0.10. Standard deviation reported in brackets.

Table 2.2 *Robustness test based on the national wide data (Fixed effect)*

	(1)	(2)	(3)	(4)
Old	0.0828***	0.0728***	0.112***	0.0589***
	(0.0181)	(0.0083)	(0.0169)	(0.0075)
Child	-0.0363***	-0.0293*	-0.0171***	-0.0611***
	(0.0049)	(0.0172)	(0.0050)	(0.0168)
Birth rate	0.0810***	0.0796***	0.0817***	0.0792***
	(0.0131)	(0.0133)	(0.0121)	(0.0119)
Mortality rate	-0.144***	-0.133***	-0.114***	-0.109***
	(0.0389)	(0.0393)	(0.0337)	(0.0333)
Year>2007	0.632***	0.653***	0.288***	0.268***
(dummy)	(0.0321)	(0.0323)	(0.0358)	(0.0361)
Old*east	-0.0440**		-0.0818***	
	(0.0204)		(0.0181)	
Old*middle	0.0359		-0.0291	
	(0.0247)		(0.0226)	
Old*west	-0.00474		-0.0546***	
	(0.0211)		(0.0199)	
Child*east		-0.0256		0.0197
		(0.0179)		(0.0176)
Child*middle		-0.0042		0.0504***
		(0.0178)		(0.0177)
Child*west		0.00029		0.0586***
		(0.0166)		(0.0167)
lncollective			0.0451***	0.0471***
			(0.0128)	(0.0128)
lnunmarried			0.0428	0.00929
			(0.0924)	(0.0899)
Invest ratio			-0.549***	-0.612***
			(0.1668)	(0.1644)
GDP deflator			1.090***	1.190***
			(0.0938)	(0.0935)
lnmobility				
Sex ratio				
constant	7.698***	7.657***	5.727***	5.957***
	(0.2292)	(0.2330)	(0.8824)	(0.8545)
N	465	465	398	398
Adjusted. R-sq	0.8001	0.7976	0.8592	0.8632

Notes: The analysis is conduct based on national wide data, and the degree of significance expressed as ***p < 0.01, **p < 0.05, *p < 0.10. Standard deviation reported in bracket.

Table 2.2 continued

	(5)	(6)	(7)	(8)
Old	0.0794***	0.0770***	0.102***	0.0605***
	(0.0158)	(0.0073)	(0.0167)	(0.0073)
Child	-0.0337***	-0.0234	-0.0164***	-0.0522***
	(0.0043)	(0.0147)	(0.0049)	(0.0163)
Birth rate	0.0764***	0.0698***	0.0765***	0.0733***
	(0.0115)	(0.0114)	(0.0119)	(0.0115)
Mortality rate	-0.135***	-0.132***	-0.0990***	-0.0996***
	(0.0342)	(0.0338)	(0.0331)	(0.0323)
Year>2007	0.496***	0.507***	0.277***	0.258***
(dummy)	(0.0307)	(0.0303)	(0.0352)	(0.0350)
Old*east	-0.0262		-0.0668***	
	(0.0179)		(0.0179)	
Old*middle	0.0343		-0.0179	
	(0.0216)		(0.0221)	
Old*west	-0.0132		-0.0426**	
	(0.0187)		(0.0197)	
Child*east		-0.0295*		0.0119
		(0.0153)		(0.0170)
Child*middle		-0.0127		0.0395**
		(0.0152)		(0.0172)
Child*west		0.00564		0.0524***
		(0.0143)		(0.0161)
lncollective			0.0124	0.00777
			(0.0150)	(0.0146)
lnunmarried			0.0486	0.017
			(0.0900)	(0.0866)
Invest ratio			-0.331*	-0.336**
			(0.1714)	(0.1672)
GDP deflator			0.953***	1.021***
			(0.0980)	(0.0963)
lnmobility	0.244***	0.267***	0.116***	0.149***
	(0.0233)	(0.0228)	(0.0330)	(0.0319)
Sex ratio	0.00801**	0.00607*	0.00953**	0.00761**
	(0.0038)	(0.0037)	(0.0038)	(0.0037)
constant	7.409***	7.602***	5.105***	5.643***
	(0.4850)	(0.4687)	(0.9625)	(0.9394)
N	465	465	398	398
Adjusted. R-sq	0.8468	0.8511	0.8668	0.8732

Notes: The analysis is conduct based on national wide data, and the degree of significance expressed as ***p < 0.01, **p < 0.05, *p < 0.10. Standard deviation reported in bracket.

Appendix 2.1 *Descriptive statistics*

	Obs.	Mean	Max	Min	Std.Dev.
National wide sample					
Housing price	496	4,511.896	34,117	907	3,822.416
Old	465	12.631	21.9	6.7	2.728
Child	465	24.718	44.7	9.6	7.251
Birth rate	496	11.486	18.83	4.85	2.89
Mortality rate	496	5.987	7.4	4.21	0.703
Mobility	496	0.155	0.651	0.001	0.117
Sex ratio	465	104.099	120.43	92.25	3.774
Collective	460	1,278.89	25,093.699	1	2,288.565
Unmarried	465	6,593.533	38,028.398	587	4,759.571
Invest ratio	465	0.695	0.978	0.388	0.079
GDP deflator	496	1.330	2.015	0.960	0.235
East sample					
Housing price	160	7,329.095	34,117	1327	5,427.634
Old	150	13.362	21.9	8.6	2.513
Child	150	20.625	40.5	9.6	6.646
Birth rate	160	10.729	17.89	4.85	2.602
Mortality rate	160	5.825	7.4	4.21	0.748
Mobility	160	0.242	0.651	0.043	0.15
Sex ratio	150	104.216	120.43	94.92	5.093
Collective	150	2,387.005	25,093.699	33	3,401.452
Unmarried	150	7,913.451	38,028.398	1,481	6,221.343
Invest ratio	150	0.688	0.909	0.388	0.092
GDP deflator	160	1.296	1.733	0.977	0.190
Middle sample					
Housing price	96	3,172.937	7,307	907	1,529.752
Old	90	13.061	19.1	9.6	2.036
Child	90	27.313	37.8	18.7	4.652
Birth rate	96	12.058	14.74	8.26	1.438
Mortality rate	96	6.261	7.28	5.17	0.475
Mobility	96	0.1	0.215	0.021	0.049
Sex ratio	90	104.882	111.2	98.6	2.08
Collective	89	1,194.017	7,653.1	22	1,492.598
Unmarried	90	8,937.373	23,276.6	4,681	3,548.875
Invest ratio	90	0.711	0.815	0.499	0.054
GDP deflator	96	1.387	1.950	1	0.239

Appendix 2.1 continued.

	Obs.	Mean	Max	Min	Std. Dev.
Western sample					
Housing price	192	3,081.405	6,605	1,041	1,349.187
Old	180	11.88	20.6	6.7	3.046
Child	180	28.938	44.7	16.5	5.85
Birth rate	192	12.988	18.83	7.72	2.56
Mortality rate	192	6.045	7.3	4.26	0.738
Mobility	192	0.115	0.321	0.001	0.072
Sex ratio	180	104.067	112.01	92.25	3.395
Collective	176	582.737	7,417.4	1	966.598
Unmarried	180	4,664.409	20,225.4	587	3,342.272
Invest ratio	180	0.685	0.978	0.498	0.08
GDP deflator	192	1.362	2.015	1	0.263
Northeastern sample					
Housing price	48	3,521.108	6,458	1,447	1,432.098
Old	45	12.342	18.6	8.3	2.527
Child	45	16.296	22.2	12.8	2.379
Birth rate	48	6.859	8.3	5.36	0.735
Mortality rate	48	5.744	6.93	4.74	0.568
Mobility	48	0.132	0.258	0.047	0.051
Sex ratio	45	102.272	106.23	100.05	1.423
Collective	45	475.767	3,224.3	41	697.577
Unmarried	45	5,222.618	10,793.5	2,665	1,606.034
Invest ratio	45	0.728	0.827	0.543	0.049
GDP deflator	48	1.201	1.621	0.960	0.183

Sources: National Bureau of Statistics of China.

Appendix 2.2 *Relative Importance Analysis of variables*

	National		Eastern		Middle		Western		Northeast	
Old	10.65%	4	3.49%	10	18.39%	2	11.86%	3	19.00%	2
Child	15.72%	3	11.37%	3	9.97%	4	15.40%	2	23.49%	1
Birth rate	3.07%	6	3.68%	9	2.80%	6	5.55%	6	11.29%	5
Mortality rate	1.45%	9	8.59%	4	1.80%	9	1.19%	8	14.44%	4
lncollective	4.80%	5	5.13%	8	3.13%	5	6.66%	5	1.72%	8
lnunmarried	2.76%	7	5.92%	6	1.95%	8	2.69%	7	1.96%	7
Invest ratio	1.03%	10	8.19%	5	2.74%	7	0.47%	10	1.29%	9
GDP deflator	35.25%	1	22.09%	2	42.24%	1	44.52%	1	8.94%	6
lnmobility	23.72%	2	26.41%	1	16.37%	3	10.87%	4	16.62%	3
Sex ratio	1.56%	8	5.15%	7	0.61%	10	0.81%	9	1.26%	10

Notes: This table presents Relative Importance Analysis results corresponding to OLS results.

Chapter 3

The Supply and Demand of Land in Japanese Housing Market

3.1 Introduction

Interest in expanding demographic issues (declining population, aging, etc.) has increased the need to assess their effects on many facets of the economy. There is a consensus that demographic considerations directly impact housing prices, but whether this impact has been exaggerated and its direction have not yet been determined. Following Mankiw's (1989) foundational work on the topic of housing demand from a demographic viewpoint, scholars have conducted a series of studies based on these model and proposed critiques and improvements.

In the 1990s, research topics in Japan centered on the housing bubble, including the existence of the bubble and crisis that followed its bursting, and supply and demand in the housing market from an income and cost perspective, as well as a time-series analysis and shock simulation. Izu and Shimizu (1993) summarized several studies on the period of excessive land price inflation that occurred in the Tokyo metropolitan area from late 1980s to 1993. The price formation theories are organized into four major sections: the Bubble Land Price Theory, non-fundamental list model, theoretical analysis of bubbles, and demand theory for land price analysis. Among the studies that investigated the relationship between supply and demand, Iwata et al. (1993) investigated the formation of land prices primarily from an asset market perspective, focusing on the interaction between agricultural and residential land prices. Land taxes have also been the subject of debate.

As housing is the basis of people's daily lives, research is increasingly turning to the area of housing life and examining the housing market in terms of demographic factors. According to Nishimura (2021), there may be an overestimation of supply in the current estimations, as evidenced by the growing phenomenon of empty homes in Japan in recent years. Stock adjustment takes time because housing is a durable property. Therefore, studies on housing require long-term data to reflect the effects of demographic factors. This means that there is still a complex relationship between demographics and housing market needs to be studied. Specifically, this leads to a possible bias in the current models' estimates of the quantity of supply and demand in the market. These expectations can influence the market. During periods of demographic dividend, people have overly optimistic estimates of the market and real estate prices rise sharply. Conversely, when the demographic dividend fades and what was once a dividend becomes a cost, people develop overly pessimistic estimates

of the market and demand falls. However, as housing is a durable property, it is difficult to respond to the market in a timely manner, thus potentially creating an oversupply and leading to an increase in the number of empty homes (Nishimura, 2021).

In Chapter 2, we find that in China, aging positively affects house prices. This may be due to a specific cultural context in which parents generally buy houses for their children, especially under the influence of the family planning policy in the past decades. Parents are more able and inclined to pour all their assets into their only child. However, this may be different in Japan. In recent years, research in Japan has gradually begun to focus on the impact of demographic factors on residential land prices due to the declining and increasing aging of the population. The asset meltdown hypothesis states that when a large cohort retires and wishes to sell their assets to finance their consumption during retirement. Consequently, the prices of these assets are negatively affected.

Thus, it is vital to investigate the housing market's supply and demand factors. Owing to the distinctive characteristics of land, the function could not be a generic production function wherein the behaviors of people must be considered. People may buy and sell residences for a variety of reasons, such as relocation, changes in family composition and lifestyle, and inheritance of real estate. This work expands on prior research by developing simultaneous equations for the supply and demand function based on demographic considerations, as well as an empirical analysis based on data from 1993 to 2018 for the prefectures of Japan.

The results of the fixed-effect two-stage least squares (FE-2SLS) indicate that aging increases the demand for residential land, whereas mortality among older adults increases the residential land supply. Notably, demand is represented by the site area per capita. Thus, when the population ages, the site area per person increases. This is due in part to the growing demand for aging services and changing demographics. Although the population of Japan has declined, the number of households has increased and willingness of people to remain single has grown. Simultaneously, as children become adults and leave home, the site area per capita in households with only older adults increases (Yamazaki & Nakagawa, 2020). Based on the results of FE-2SLS, this study transforms the structural form into a reduced form and simulates the impact of continuing aging on the housing market. The findings have implications for government regulations on housing supply and building more efficient and suitable housing.

The rest of this chapter is structured as follows. In Section 3.2 organizes current developments into a literature review. In Section 3.3, we introduce the model and data. In Section 3.4, we present the findings and interpretations, and conduct simulations. In Section

3.5, the conclusions are drawn based on our findings.

3.2 Literature Review on Determinants of Supply and Demand

The determinants of housing supply and demand

Extensive research has been conducted on the demand and supply of housing. Most researchers have utilized reduced forms to analyze the elasticity of various factors. De Vries and Boelhouwer (2005) investigate this relationship from the perspective of market equilibrium. Construction cost is also an important factor that is usually considered, and according to Somerville (1999), the rise in construction costs negatively impacts the new supply. Hwang and Quigley (2006) created a simultaneous equation model for housing prices, housing supply, and vacancy rates. They noted that previous research did not explore the possibility that changes in vacancy rates for owner-occupied housing could offset trends in home prices or new construction. It found the impact of vacant homes on supply and, consequently, price. In addition, they discovered that the models used to describe variations in the housing supply were inadequate. Instead of housing stock, they defined new supply as the annual difference in housing stock, confirming the impact of lagging adjustments on demand and supply. Chow and Niu (2015) studied Chinese housing market based on simultaneous equations. Policy is also an important factor that affects supply (Hsu et al., 2017).

Several factors have driven up demand for housing. Higher incomes may induce the purchase of a house. Demographics also influence housing prices (Eichholtz & Lindenthal, 2014). According to the Life-cycle Theory, after people become older, the demand for housing could decrease. However, recent studies have found that aging does not directly reduce the demand for housing, moreover, despite stagnant household numbers and aging populations, total housing demand may continue to rise in the future. The human capital of a household can considerably influence housing demand, which normally rises with age. The negative impact of aging depends on the remaining years of life, and not on the increase in the dependency ratio of the effectively retired population. Overall, the data indicate that population aging is unlikely to result in declining housing prices because the negative effect is small (Eichholtz & Lindenthal 2014; Heo, 2022).

Related studies in Japan

Studies on the Japanese land market were mostly conducted in the late 1980s and 1990s. Numerous studies have been conducted on the variations in land prices during this period. These include several architectural, engineering, economic, geographical, and other analyses. In the 1990s, the growth in residential land was primarily attributable to the conversion of

agricultural land. The land pricing model also revolved around the conversion of agricultural land (Iwata et al., 1993). Izu and Shimizu (1993) summarized research on the land price formation theory and land tax system, which confirm that land price analysis based on supply and demand is one of the land price formation theories. Ohashi et al. (1995) modeled the phenomenon that agricultural land is converted into residential land by maximizing the utility of land consumers and suppliers, and simultaneously estimated the urbanized area and land prices of the metropolitan area. The urbanization model in this study addresses land transactions in the process of urbanization, wherein agricultural land around the city is converted into residential land. Based on the consumption capital asset pricing model, Okumura (1997) constructed a model of the housing market and validated the model using Japan time series data from 1955 to 1989. It has been proven that the diminishing adult population growth has a detrimental influence on housing investment. Toki and Sato (2005) divided the city into segments to characterize the demanders in terms of supply, housing construction, and ownership relationships. They found that the demand for housing by young singles and renewal of existing stocks were the main driving forces.

In addition to the declining birth rate and aging population, further concerns have emerged. Population is declining while households are increasing, and life cycles are becoming more diverse. After the modification of the Land and House Lease Law, Seko and Sumita (2007) explored changes in housing tenure and welfare among owner-occupied dwellings, general tenants, and fixed-term tenants. According to this report, younger and lower-income households benefit more from the introduction of fixed-term tenancy. In addition, the relationship between disaster prevention and real estate markets has been discussed (Seko, 2016). Nishimura (2021) formulated a nominal housing price function, stated as discounted present value, a population element that is implicit in a standard model. Enhancing data diversity by including cases from multiple nations, he built a panel dataset using 45 years of data on population, interest rates, and so on, for 17 nations worldwide. A 1% rise in the ratio of the population aged 0–14 years in the total population results in a 2.601% rise in the nominal residential property price index. Conversely, a 1% increase in the ratio of the population aged 65 years and older results in a 3.432% decrease in the nominal property price.

Previous research emphasizes property market fluctuations from a capital market perspective, while demographic considerations include population size, aging, and child dependency ratio. This study contributes to the literature in the following ways. First, it focuses on demographic factors to study the influence of supply and demand and finds that the change in demographic structure is an important factor that influences supply and demand

in the residential land market. Second, we found that the site area per capita increases gradually with age. The effect of demographics on the housing market may be the result of lifestyle preferences. Housing needs increase with age, and the rate of older adults living alone increases because of smaller households and higher rates of singleness; consequently, older adults also have more living space per capita than when they were younger. Finally, we simulated future market fluctuations using expected statistics on population aging.

3.3 Simultaneous Equations and Data

Model

In this study, residential land is treated as a general good. We estimate the supply and demand functions. The basic model is measured using simultaneous equations in the following structural form. For a simple structural form (Chow & Niu, 2015), we can estimate by

Demand:

$$q_t = a_1 + a_2 p_t + a_3 income_t + u_{1t} \quad (3.1)$$

(-) (+)

Supply:

$$q_t = b_1 + b_2 p_t + b_3 cost_t + u_{2t} \quad (3.2)$$

(+) (-)

where q_t, the site area per person (m^2), and p_t, the land price (10,000 yen/m^2), are endogenous variables. We use land area per capita to measure housing stock in the market. The housing stock includes new and existing housing. Income is income per capita (10,000 yen/year) and cost is the estimated construction cost for residential buildings per floor area (10,000 yen/m^2); both are exogenous variables. Here, plus or minus indicates the sign of the hypothesis. We can rewrite the equations into a reduced form as follows, and estimate the price and area, respectively.

Price:

$$p_t = \alpha_0 + \alpha_1 income_t + \alpha_2 cost_t + \varepsilon_{1t} \quad (3.3)$$

Area:

$$q_t = \beta_0 + \beta_1 income_t + \beta_2 cost_t + \varepsilon_{2t} \quad (3.4)$$

By adding demographic factors and controlled variables, the model comprises the following simultaneous equations:

Demand function:

$$\ln Area = f(\ln Price, \ln income, old\ ratio, child\ ratio, road, complaint, \ln rent, \ln co-residential)$$

Supply function:

$$\ln Area = f(\ln price, \ln cost, \ln nursing\ home, \ln habitat, death\ rate, lnvacancy)$$

The reduced form is as follows:

$$\ln Price = f(\ln income, old\ ratio, child\ ratio, road, complaint, \ln rent, \ln coresidential, \ln cost, \ln nursing\ home, death\ rate, \ln habitat, lnvacancy)$$

$$\ln Area = f(\ln\ income, old\ ratio, child\ ratio, road, complaint, \ln rent, \ln coresidential, \ln cost, \ln nursing\ home, death\ rate, \ln habitat, lnvacancy)$$

While constructing the model, it was necessary to consider the identification conditions of the simultaneous equations. Specifically, it is as follows:

k=g-1: Just identified

k>g-1: over-identified

k<g-1: under (not)-identified

(g = the number of all endogenous variables, k = the number of all variables that do not appear in the equation).

According to the above conditions, a simultaneous equation model was constructed for over-identification. It is also a static model. Regarding the identification conditions of this model, the demand function is k> g-1 for k = 5 and g = 2, which is an over-identification. For the supply function, k> g-1 for k = 7 and g = 2, which is also an overidentification. As all models are over-identified and satisfy the identification conditions, the analysis can be conducted using this method.

The analysis was conducted using fixed effects 2SLS, with several five-year dummies from 1993 to 2018. When estimating panel data models in the presence of endogeneity, fixed effects-2SLS works well, especially when instruments are correlated with the unobserved effect (Semykina & Wooldridge, 2010). The instrumental variable is the price of land estimated from the exogenous variables in the first stage.

Data

The data on the site area per capita, child dependency ratio, old dependency ratio, road, cost, complaints, co-residential, number of vacant houses, number of nursing homes, habitat, and death rate were obtained from the Statistics Bureau of Japan; the average price of residential area and monthly rent earned were obtained from the Ministry of Internal Affairs and Communications; and data on income per capita were obtained from the Cabinet Office. The child dependency ratio and old dependency ratio

are calculated based on population data as follows: child dependency ratio = total population (0–14 years old) / number of working age population; and old dependency ratio = total population (65 years old and above) / number of working age population. The data period was from 1993 to 2018, after the bursting of the bubble economy.

Based on the dependent variables, we employed the site area per capita. National housing prices are not published by the government as land prices, and the Tokyo Stock Exchange REIT Index is often used. Considering that house and land prices generally move in tandem, it is reasonable to use the land price index as a proxy for housing market situation in Japan (Kobayashi, 2016). The data for land area published by the Statistics Bureau include the site area per house and number of houses, while the data for site area per person are not published. Therefore, the total site area and site area per capita were calculated based on these data as follows: total site area = site area per house × number of houses; and site area per person (m^2) = site area per house × number of houses / total population.

The site area was used to match the average price data for the residential land area. In Japan, there is no officially published standard price per floor area, and private sector figures lack a certain degree of credibility and stability. As the floors are in the same building, the price of land and price of floors varies in the same direction; therefore, we utilized the price of floor area to preserve consistency[6].

Iwata et al. (1993) constructs simultaneous equations for the residential market from a fixed asset tax standpoint and estimates the price functions for residential and agricultural land. They utilized statistics regarding the overall land area in portions of Tokyo and Kanagawa. This method can be used as a reference. However, in this study, area per capita data was employed to examine the influence of demographics. In terms of the supply function, this reflects the market stock at equilibrium, whereas in terms of the demand function, it represents the area of land set aside for human habitation per capita at market equilibrium. This information has been unitized.

Interpretations and hypothesis of the variables

The demand can be considered from two aspects: the impact of changes in the population structure and impact of changes in people's living conditions.

From the perspective of the demographic structure, changes in the dependency ratio could affect housing demand. Levin et al. (2009) discovered that the aging and reduction of the population contributed to a decline in housing prices. According to Hui et al. (2016), a

[6] Appendix 3.4 illustrates the difference between floor area and site area.

family with more children would spend more money on child rearing, hence lowering their other consumption, such as housing spending. Here, to represent the population structure, we use old dependency ratio and child dependency ratio, which are negatively related to housing demand.

Death rate of older adults and the number of nursing homes. When people age, they often do not have enough energy to manage their houses or need others to take care of them. After the death of older adults, the houses they own could re-enter the market as second-hand houses or be demolished and rebuilt, which leads to an increase in supply. When social well-being is well developed, care for older adults could be shared by the society, and nursing homes can be used as permanent residences for older adults. Consequently, the supply of housing increases. According to Li and Shen (2013), the elderly care mode negatively affects housing prices, which can explain the positive relationship between aging and housing prices in China. As a result of a shortage of proper medical services and qualified personnel in senior welfare facilities, older adults have to rely heavily on family support.

Next, we discuss how changes in living conditions affect housing demand. According to *Survey of Housing Market Tendency of 2020* of Ministry of Land, Infrastructure, Transport and Tourism, people buy or relocate houses because they want: to live in a new house, to live in detached houses, reliable real estate builders, well-designed houses, to live in a familiar place, to live with parents or children, appropriate price of the new house, and to earn revenue by selling the house in the future. Based on this, we selected some relevant variables in the demand function.

Income: According to the *Survey of Housing Market Tendency of 2020*, people with higher incomes are more inclined to buy new houses. Among the people who buy new houses, the annual household income (including tax) is "four million to less than six million yen" nationwide, "six million to less than eight million yen" in the three major metropolitan areas, and the average annual household income is 7.38 million yen. The average annual income from buying houses is increasing annually. Exogenous increases in aggregate income have been confirmed to cause rises in housing prices (Hwang & Quigley, 2006). Moreover, the oldest group is the most sensitive to income. For older owners, housing services may as much as income (Eichholtz & Lindenthal, 2014). As the explained variable (land area) is calculated on a per capita basis, income also takes the per capita value.

Rent: Rent has a multiplicity of effects on housing prices. As the monthly cost of renting increases, more households are likely to buy a house instead, thus driving up housing prices. Additionally, the value of a land could be considered the present value of all the rent in the future, less any depreciation. If there is a temporal relationship between rents, then rent

changes today could lead to rent change in the future, which would impact housing prices. Therefore, rising rent indicates rising housing prices in the future (Hwang & Quigley, 2006).

Road length and the number of pollution complaints: Pollution complaints, including air, water, soil, and noise pollution, represent the surrounding environment of the house. The more convenient the transportation and life and the healthier the living environment, the more willing people will be to live there.

Number of co-residential households: The influence of this variable can be considered in two ways. On the one hand, according to the *Survey of Housing Market Tendency of 2020*, one of the reasons people buy housing is to live with their parents and children. If this desire is fulfilled, the demand for housing derived from this part will decrease. On the other hand, if the living space of co-residential households is crowded, then people are more willing to change to a larger house or live separately, and the corresponding housing demand will increase.

We can also consider the supply side from two aspects: the increase in the total amount and changes in the current housing market. The supply changes in the current housing market can be considered based on the motivation to sell houses. After people change to a new house, the way to deal with the previous house is to either sell it or leave it as a vacant house. According to the *Survey of Housing Market Tendency of 2020* on the methods of disposing of existing homes for households that have relocated from their own homes (excluding rebuilding), the most was "sold" in the nationwide and three major metropolitan areas categories.

Construction cost: This is the basic element of the supply function; cost is the basis for pricing, and it directly affects the quantity supplied. Here, we assume that construction cost negatively influences supply (Somerville, 1999).

Residential area (ha): This is the area of land on which a house can be built. It is hypothesized that the larger the area, the more houses can be built, which is positively related to supply[7]. In Japanese papers published in the 1990s, there were many topics discussing the conversion of agricultural land (Iwata et al., 1993). Approximately 30 years later, a lot of agricultural land has been converted into urban land, and now the main topic of discussion is how to preserve the agricultural land. As the area of agricultural land is also included in habitable land, this study uses the area of habitable land as a factor of supply.

[7] From the Statistics Bureau of the Ministry of Internal Affairs and Communications, *Prefectural Statistics 2019,* the area of inhabitable land is the total area minus the area of forest land (including forest area and non-forest grassland area) and the area of major lakes (natural lakes with an area of 1 km2 or more).

3.4 Results and Simulations

Results

The estimates for the structural-form equations are presented in Table 3.2. All coefficients were estimated using the FE-2SLS method. In the simplest Models (1) and (2), the coefficient on the changes in income is significantly positive and the cost is significantly negative. The change in price is negatively related to demand and positively related to supply, as expected. We focus on the results of Models (5) and (6). The demand and supply functions are as follows:

Demand:

$$\ln Area = -0.16 \ln price + 0.035 * \ln income + 0.3 * old\ ratio - 0.602 * child\ ratio + 0.473 * \ln rent - 7.819 * road - 20.653 * complaint - 0.009 * \ln coresidential\ + 0.144$$

Supply:

$$\ln Area = 0.202 * \ln price - 0.048 * \ln cost + 31.228 * death\ rate - 0.0001 * \ln nursing\ home + 0.213 * \ln habitat + 0.132 * lnvacancy - 0.248$$

Furthermore, the specific reduced form functions are as follows:

$$\ln price = 0.1 * \ln income + 0.83 * old\ ratio - 1.66 * child\ ratio + 1.31 * \ln rent - 21.60 * road - 57.05 * complaint - 0.02 * \ln coresidential\ + 0.13 * \ln cost - 86.27 * death\ rate + 0.0003 * \ln nursing\ home - 0.59 * \ln habitat - 0.36 * lnvacancy + 1.08$$

$$\ln Area = 0.17 * \ln income + 1.44 * old\ ratio - 2.9 * child\ ratio + 2.27 * \ln rent - 37.61 * road - 99.33 * complaint - 0.04 * \ln coresidential\ + 0.18 * \ln cost - 118.96 * death\ rate + 0.0004 * \ln nursing\ home - 0.81 * \ln habitat - 0.50 * lnvacancy + 1.64$$

Regarding housing demand, the child dependency ratio is negatively related to the change in land prices, while the old dependency ratio has a positive effect. When rent increases, the demand for housing increases and house prices rises. Rent and house prices change in the same direction. The housing demand in rural areas is lower than that in cities. When the surrounding housing environment worsens, the demand and housing prices in this area decrease accordingly. As the number of generations living together increases, the per capita living area decreases as results.

Regarding housing supply, mortality positively impacts housing supply. When the number of nursing homes increases, it negatively impacts housing supply, but the elasticity is very small (0.0001). The area of habitable land positively impacts the supply of residential land. The higher the number of vacant houses, the larger the residential area. Mortality rate, habitable area, and vacancy rate are negatively related to residential land prices.

Interpretations

From the relationship between the residential site area per capita, price, construction cost, and income, we can conclude that the residential land market in Japan is consistent with the performance of normal goods, indicating that consumption, not speculation, dominates the Japanese housing market. In other words, in Japan, demand for housing, that is, living, is still mostly driven by consumer demand.

The positive relationship between population aging and housing demand can be explained as follows. People typically consider their long-term needs when purchasing a property; according to Yamazaki and Nakagawa (2020), newlyweds would consider the number of children they will have when purchasing a home. From middle age onward, the number of household members decreases, while the living area per household continues to expand. Consequently, older adults, whose families often consist of fewer members, will have more living space. Additionally, the drop in the marriage rate led to a rise in the number of households, resulting in an increase in housing area per capita. Japan's divorce rate at retirement age has increased in recent years, increasing the number of older adults living alone, which requires more living space. From a microscopic perspective, the rising need for elderly care requires greater dwelling space. According to Eichholtz and Lindenthal (2014), older adults do not wish to downsize or exchange their detached homes for an apartment. In contrast, detached homes tend to be the most popular kind of housing for retirees.

Concerning the effect of the older adult population rate on the housing market, a survey conducted by the Ministry of Land, Infrastructure, Transport, and Tourism found that a 10% increase in the older adult population rate causes a 19.6% decline in land prices in general areas but a 26.7% increase in areas with declining populations. In areas with declining populations, there is a positive correlation between aging and housing prices[8]. As the population ages, these statistics indicate that the site area per capita will

[8] Land Economy and Construction Industries Bureau. (2021, March). *Report on the Study of Appraisal Methods for Land Use Changes in Population Declining Areas*. Ministry of Land, Infrastructure, Transport and Tourism. (in Japanese)
https://www.mlit.go.jp/totikensangyo/content/001403241.pdf

increase in the future. However, does this imply that people's real demands are constantly growing? There is also the risk of social land resources being inefficient. Currently, an aging population has a higher impact on the housing market than a shrinking population; however, the impact of a declining population will increase as the population continues to decline in the future (Yamazaki & Nakagawa, 2020).

The rate of change in the child dependence ratio negatively influences demand, partly because the population with purchasing power tends to be the working population, and the proportional increase in the number of children reduces the housing budget. Conversely, owing to the slow response time to changes in the housing market, an increase in the number of children reduces the living space per person given a relatively fixed stock.

The co-residential generation saves living space compared with generations living apart. According to the results, the negative relationship between the roads and demand suggests that urban areas are preferred over rural areas. The coefficient of complaints to surroundings was insignificant. Compared with the impact of a residence's surrounding environment, people would choose to focus more on residential convenience.

In the supply function, many residential lands are underutilized because of aging, and part of them re-enter the market, which increases the supply of residential land per capita. As the mortality and aging rates are highly correlated, the decrease in population could add to the supply of housing. Vacancy is also positively related to supply. This indicates that, in recent years, vacant houses have become a major part of housing supply in the Japanese land market. Vacant houses can be resold as second-hand houses or simply demolished to create new land for housing construction. In the 1990s, the increase in residential land was mainly due to the conversion of agricultural land, and the land pricing model revolved around the conversion of agricultural land (Iwata et al., 1993). With the progress of urbanization and importance of agricultural land conservation, the amount of agricultural land converted into residential land has been strictly controlled in recent years, and the supply of residential land has entered a new phase.

Simulation

Based on the results, we can predict the effects of exogenous shocks on the endogenous variables. We employed the estimates of Models (5) and (6) as the basis for the simulation. The simulation specifies a given change in the exogenous variable and traces its effects on endogenous variables. In this case, as our primary focus is on

the effect of demographic change on the housing market, changes in aging are predictable and informative relative to other variables. Therefore, we use predicted data on aging in our simulations. The National Institute of Population and Social Security Research is a national research institute affiliated with the Ministry of Health, Labor, and Welfare that conducts research on domestic and international social security policies and systems and monitors population and household trends. The institutes collected and disseminated data on demographic trends are essential for the formation of Japanese policies. Population and household data serve as the foundation for the medium- and long-term planning of Japan's social security system and design of numerous policies. Data from the institute are extremely authoritative. We have employed data that comes from the *Population Projections for Japan: 2016 to 2065* of National Institute of Population and Social Security Research. We simulate the shift of the demand curve when the old dependency ratio changes based on the results of the simultaneous equations.

Figure 3.1 shows the estimated supply and demand curves and the simulations when the old dependency ratio changes. As the old dependency ratio positively affects demand, we see a right shift from 2025 to 2045. The rate of change in price increases and is the same as the site area per person. Appendix 3.3 reports the specific values of these changes. Note that this is only the result of taking the mean value of all other variables but only the change in the old dependency ratio. As aging and mortality are highly positively correlated, when mortality is added to the model, house prices and demand may change in the opposite direction.

3.5 Conclusion

From a demographic standpoint, this study presents a new approach for constructing a supply and demand function for residential real estate in Japan. Using simultaneous equations, the demand and supply functions are modeled to address endogenous housing market issues. In addition, the influence of the old dependency ratio on the demand side was simulated based on these results.

This study contributes to the literature in three ways: First, the site area per capita is treated as housing stock, a better reflection of the individual, where there is no analysis available to estimate the supply-demand function in terms of site area per capita in Japan. Second, using demographic considerations as the primary component to estimate supply and demand functions allows for a more adaptable response to the problems currently facing society. The finding that aging positively impacts housing

demand reveals the current state of the Japanese housing market and possible issues in the country. Aging does not lead to an immediate decrease in demand. Older adults still require housing, and they call for the space necessary to meet the needs as well. Also, there is a significant lag when children are able to buy houses. Additionally, if a portion of the population moves immediately into houses left behind by earlier generations, this will minimize the formation of new demand. Third, from the supply side, price, and income elasticities as well as the issue of vacant dwellings are considered. An increase in the number of vacant houses positively and significantly impacts supply.

In the current study, as the population ages, the government should be aware that the housing demand is increasing and should target more housing for older adults. It is also prudent to analyze whether there is market overstock, which might be studied in the future, to further segment the market demand from older adults. Moreover, as Japan has a significant urban concentration, additional research should be conducted at a regional level, with more precise data on urban and rural locations.

Table 3.1 *Definitions of Variables*

Variables		Definitions
Endogenous variables		
	Area	Site area per capita (m^2)
	Price	Average price of land (10,000 yen/m^2)
Exogenous variables		
Demand		
	Child ratio	Child dependency ratio
	Old ratio	Old dependency ratio
	Income	Income per capita (10,000yen /year)
	Rent	Monthly rent (yen /month)
	Road	The length of road (km)/Total number of cars
	Complaint	The number of pollution complaints (Air pollution, Water pollution, Soil pollution, Noise, etc.)/Total population of the prefecture
	Co-residential	Number of co-residential households
Supply		
	Nursing home	The number of nursing home
	Habitat	Residential area(ha)
	Death rate	The number of dead (65 years old and above)/Total population
	Cost	Estimated construction cost for residential buildings (10,000 yen/m^2).
	Vacancy	The number of empty houses

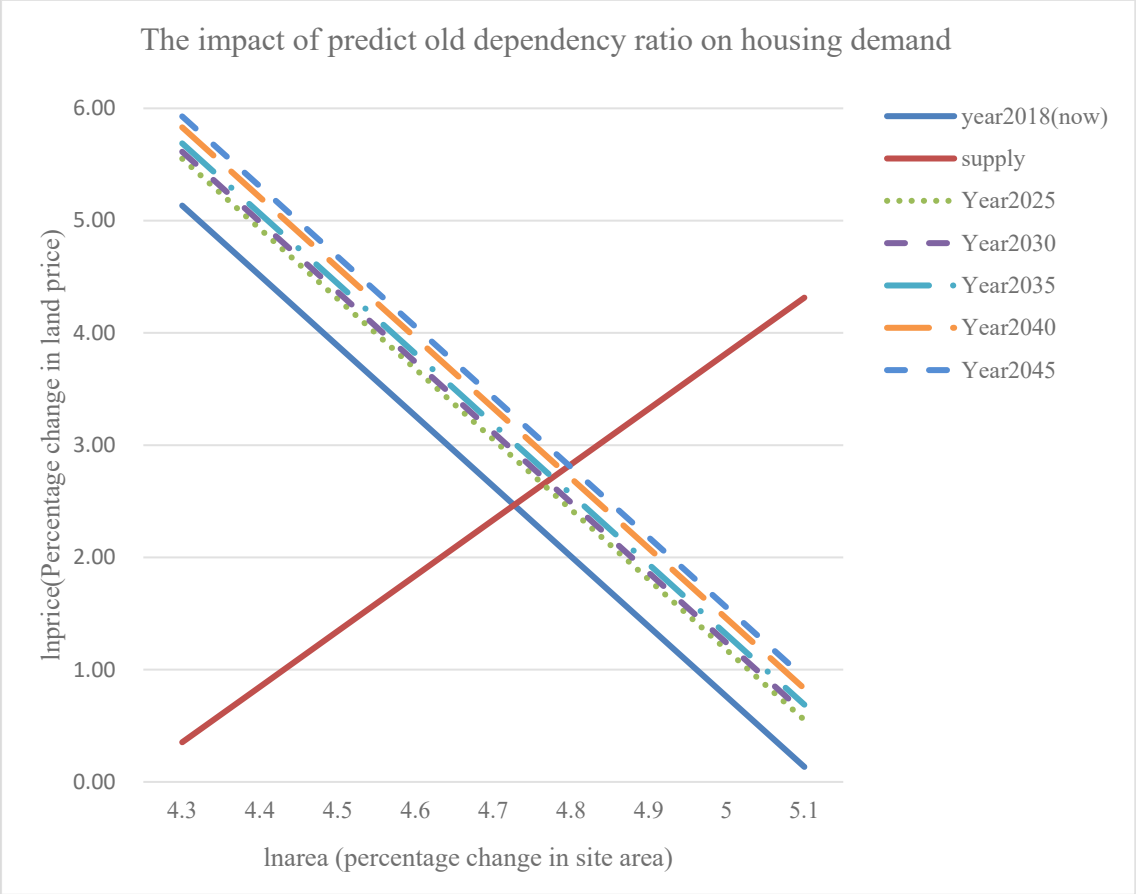
Table 3.2 *Estimates of demand and supply function (FE-2SLS)*

	(1) Demand	(2) Supply	(3) Demand	(4) Supply	(5) Demand	(6) Supply
Lnprice	-0.753**	3.999	-0.460***	0.291	-0.160***	0.202***
	(0.360)	(18.107)	(0.175)	(0.206)	(0.032)	(0.048)
Lnincome	0.196		0.131		0.035	
	(0.143)		(0.088)		(0.042)	
Oldratio			-0.141		0.300***	
			(0.337)		(0.114)	
Childratio			-1.023**		-0.602**	
			(0.492)		(0.253)	
Lnrent					0.473***	
					(0.064)	
Road					-7.819***	
					(2.631)	
Complaint					-20.653	
					(22.794)	
Lncoresidential					-0.009	
					(0.009)	
Lncost		-0.670		-0.089***		-0.048**
		(2.635)		(0.032)		(0.020)
Death rate				49.956***		31.228***
				(15.863)		(6.663)
Nursing home						-0.0001***
						(0.000)
Lnhabitat						0.213
						(0.263)
Lnvacancy						0.132***
						(0.033)
Constant	5.293***	-6.251	5.242***	3.416***	0.144	-0.248
	(0.958)	(48.313)	(0.652)	(0.614)	(0.641)	(3.369)
Observations	282	282	282	282	282	282
#Prefectures	47	47	47	47	47	47
Prefecture FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Notes: Degree of significance expressed as ***p < 0.01, **p < 0.05, *p < 0.10.

Standard deviation reported in brackets.

Figure 3.1 *Simulation of housing demand based on old dependency ratio*



Notes: Based on calculated data that simulated by the predict old dependency ratio of *Population Projections for Japan: 2016 to 2065.* (Details see Appendix 3.3)

Source: National Institute of Population and Social Security Research. (n.d.). *Population Projections for Japan: 2016 to 2065.* Retrieved October 9, 2022, from https://www.ipss.go.jp/pp-zenkoku/e/zenkoku_e2017/pp_zenkoku2017e.asp

Appendix 3.1 *Descriptive statistics*

	Obs.	Mean	Max	Min	Std.Dev.
Area	282	119.754	183.425	52.292	26.987
Price	282	8.792	60.42	2.14	7.206
Old ratio	282	0.361	0.679	0.126	0.116
Child ratio	282	0.225	0.347	0.169	0.024
Income	282	279.152	544.712	193.179	46.453
Rent	282	42,330.87	81,001	27,386	8,701.883
Complaint	282	0	0.001	0	0
Road	282	0.018	0.041	0.005	0.007
Co-residential	282	5,919.504	52700	300	8,352.186
Death rate	282	0.008	0.014	0.004	0.002
Cost	282	0.12	0.356	0.051	0.059
Nursing home	282	97.762	1119	0	174.539
Vacancy	282	146,000	817,100	18,300	145,000
Habitat	282	258,000	2,237,238	83,261	303,000

Appendix 3.2 *The prediction of old dependency ratio and child dependency ratio*

Year	Old dependency ratio	Child dependency ratio
2025	0.584	0.207
2030	0.617	0.203
2035	0.657	0.201
2040	0.733	0.208
2045	0.785	0.212

Source: Population Projections for Japan: 2016 to 2065 of National Institute of Population and Social Security Research

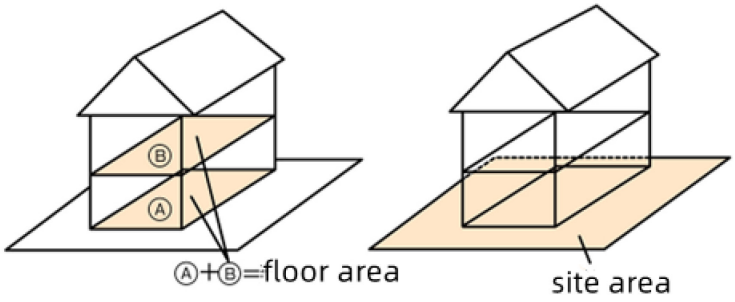
Appendix 3.3

Simulation of the impact of expected old dependency ratio on housing demand (lnarea)

x-axis	y-axis						
lnarea	lnprice						
	supply	demand					
		2018(now)	2025	2030	2035	2040	2045
4.3	0.35	5.13	5.55	5.61	5.69	5.83	5.93
4.4	0.85	4.51	4.93	4.99	5.06	5.21	5.3
4.5	1.34	3.88	4.3	4.36	4.44	4.58	4.68
4.6	1.84	3.26	3.68	3.74	3.81	3.96	4.05
4.7	2.33	2.63	3.05	3.11	3.19	3.33	3.43
4.8	2.83	2.01	2.43	2.49	2.56	2.71	2.8
4.9	3.32	1.38	1.8	1.86	1.94	2.08	2.18
5	3.82	0.76	1.18	1.24	1.31	1.46	1.55
5.1	4.31	0.13	0.55	0.61	0.69	0.83	0.93

Notes: Calculated by Author based on the results of simultaneous equations and *Population Projections for Japan: 2016 to 2065*.

Appendix 3.4 *The difference between floor area and site area*



Notes: Floor area refers to the total floor area of each floor of the dwelling. Site area refers to the area of the land on which the house and its attached buildings are situated.
Source: SUUMO. (2022, August 5). *What is building area? Are balconies and canopies included? What is the difference between site area, total area, and tot al floor area?*
https://suumo.jp/article/oyakudachi/oyaku/sumai_nyumon/other/kenchiku_menseki/

Chapter 4
The Determinants of Housing Tenure and Housing Expenditure in Japan

4.1 Introduction

Housing is the foundation of supporting people's lives and the cornerstone of society. The housing market and the business cycle are closely related, and the choice of housing tenure is closely related to other important life-cycle decisions, the proportion of homeowners in a country has an influence on several economic and social aspects of the country (Raya & Garcia, 2012). For individuals, it can add wealth accumulation, improve physical and mental health, and increase the physical and financial health of the elderly; for households, it can reduce divorce rates and improve school development and performance of children; for economics, it can improve labor market outcomes, and stimulate consumption and investment (Aaronson, 2000; Dietz & Haurin, 2003).

In the late 1980s, Japan experienced a tremendous real estate bubble. Many Japanese invested heavily in real estate from the mid-1980s, and house prices began to rise sharply until the 1990s bubble collapse (Aizawa & Helble, 2016). Since then, the Japanese real estate market has entered a new stage, and the main factors affecting the market are also changing. Land prices continue to fall across Japan due to a declining population, but due to continued migration to cities, housing prices in metropolitan areas have been stable or increasing. In terms of population concentration, Japan is likely to become a highly polarized country (Hashimoto et al., 2020). Geographic disparities are widening and the declining population in rural areas has generated empty houses across the country, reaching 13.6% in 2018 according to Statistics Bureau, Ministry of Internal Affairs and Communications. With the rapid development of technology and changes in the environment, people are forced to change their ways of life and work to accommodate the new normal changes, and these major changes in society are no exception to the housing policy. Housing policies must be developed based on the major trends occurring in people's housing needs and choices.

In recent years, more people work and live in separate locations, and a growing number of people work from home. The diversity and flexibility of life and work styles have increased. To achieve an affluent residential life in response to such major changes in the social environment and diversified values, it is necessary to shift to a policy system centered on existing housing and promote the construction of a housing

circulation system that enables people to repeatedly change housing following their lifestyles.

In this study, the following questions are taken into consideration. What are the determinants of housing tenure in Japan? What drives people to make the choice? The determinants of housing expenditure are also verified to make policy implications. An ordered logit model is constructed, and marginal effects are analyzed by using micro panel data from the Keio Household Panel Survey (KHPS) from 2004 to 2020. Moreover. the determinants of housing expenditure are analyzed using the Blinder-Oaxaca Decomposition. People are more likely to be owner-occupants if they are older, married, male, in larger families, have fewer children under the age of 16 and live with parents. In addition, the presence of a spouse has a stronger impact on individuals with lower incomes. When companies are more stable and allow for telecommuting, home ownership is more prevalent.

The rest of this chapter is divided into four sections. In Section 4.2, research in the field is organized into a literature review. In Section 4.3, the model and data are introduced. In Section 4.4, the findings and interpretation are reported. In Section 4.5, conclusions are drawn from the findings.

4.2 Literature Review and the Fixed-term Tenancy Contract in Japan

Literature Review

Purchasing a house could be the largest investment decision in a lifetime. The choice between renting and buying a house is often referred to as the choice of tenure (Špalková & Špalek, 2014), which means the state of life in which a person lives. The earliest study on the use of housing tenure could date back to Vipond and Walker (1972), investigating the determinants of housing expenditure and housing tenure, where housing tenure refers primarily to housing ownership. Since then, in most studies of real estate, housing tenure has been used to refer to the relationship between people and the house they live in. This concept is further refined by Raya and Garcia (2012), suggesting that there are two main definitions, tenure status and tenure transition, which are often used interchangeably. Tenure status discusses households at a given period, while tenure transition explains the dynamic transition from renting to ownership. For owner-occupiers, housing expenditure refers to the maintenance and operating costs, energy costs, and mortgage interest payments; for renters, housing expenditure is the basic rent and energy costs (Dustmann et al., 2022).

Regarding theoretical models, there are two approaches in Henderson and

Ioannides (1983), which could be the earliest theoretical model on this topic. One is to study the consumption behavior of a single consumer with specific factors (preference, life cycle solution, etc.). The other is to solve for market equilibrium with restrictive assumptions (perfect certain market, equal for all renters and owners, etc.). According to Henderson and Ioannides (1983), the choice of housing tenure is divided into four sub-tenures, concluding that the difference between the housing demand for the investment and consumption is a critical determinant of housing tenure. However, it requires some considerations as well, for the existence of tax regulation, transaction cost and borrowing constraint, owners and renters are faced with different investment opportunities and budget constraints.

Based on Henderson and Ioannides (1983), Ioannides and Rosenthal (1994) discussed the appropriateness of the difference between the two demands for housing (investment and consumption). They modified the model and found that tax effects, borrowing constraints and transaction costs could affect the choice of housing sub-tenure in a more complex way. Moreover, the primary dwelling of most owner-occupiers is determined by their consumption demand instead of investment demand.

Following Henderson and Ioannides (1983) and Ioannides and Rosenthal (1994), related empirical studies have also sprung up.[9] Arrondel and Lefebvre (2001) tested the model based on the French data, showing that the difference between investment and consumption demands cannot explain house purchases by itself. Public aid policies for home ownership, tax system, transaction cost and other market imperfections are also important. Raya and Garcia (2012) compared different methods used for the analysis of people's housing tenure choice and found that the best performance of models is the transition from renting to ownership, highlighting real determinants of tenure and transition, and the variable with the highest incidence is marital status. Dustmann et al. (2022) found that housing costs increase more for low-income than for high-income families and that larger prices increase for low-income families in the same goods. Younger individuals spend more on housing and save less than older people, which may affect wealth growth, especially at the bottom of the income distribution.

With regard to Japanese housing tenure, in the 1990s, it mainly focused on the demand for buying or renting a house, as well as income and price elasticity. Horioka

[9] This paper also attempted to conduct a Japanese study based on the model; however, the results do not show that the housing market in Japan would be more motivated to invest than consume in each state, the regression results are barely significant and there has no space for further discussion. The reason may lie in that the US and Japan have very different living cultures.

(1988) found that the elasticity of permanent income and price for owner-occupied housing was about 1.4 and -0.8, respectively. Moriizumi (1993) analyzed a family's demand for rental housing and choice of tenure as a joint decision to estimate the elasticity of price and income for rental housing demand. However, this study focuses on the demand for renting and fails to explore sensitive factors affecting consumption and investment, respectively. In the Japanese topic literature, the closest paper on this topic is by Seko and Sumita (2007), which conduct the study after the introduce of fixed-term tenant contract system. It discussed the determinants of housing tenure choice and verify welfare implications. Aizawa and Helble (2016) studied the determinants of Japanese tenure transition instead of tenure status. They found that Japanese house ownership is strongly influenced by family size and income. Yamazaki and Nakagawa (2020) considered the topic from the standpoint of information asymmetry and argued that this information asymmetry increases the likelihood that individuals prefer to purchase a house.

Taken together, there is a lack of compound discussion in the study of Japanese housing tenure choice and housing expenditure. This study has the following main features. Firstly, many of the variables have changed from binary to multivariate, increasing the possibility of discussing marginal effects. For explanatory variables, the category of owned house and rental land is included as a category, which has not been specifically examined in previous studies. Secondly, the impact of the possibility of working from home on tenure choice is examined among the variables, considering dramatic changes in the social environment in recent years. The housing demand for ageing services is also taken into account, adding to the diversity of research. Thirdly, housing tenure choice and housing expenditure across income quartile and marital status are examined. Finally, the dataset is significantly updated.

Fixed-term tenant contract system in Japan

The Japanese housing market has its uniqueness, and the choice of housing is very diverse. In the rental market, people can choose general rental housing, rental housing with fixed rental terms, or construct a house on rented land. Each of these concepts will be explained as follows.

The Japanese Tenant Protection Law (JTPL) was last amended in March 2000. This revision implemented a fixed-term tenant contract system for newly contracted rental housing (Seko & Sumita, 2007). A fixed-term tenant contract is a type of lease agreement in which the term expires and is not renewed. For a fixed-term tenancy, a written notice is required for terminating the contract at the end of the term, but there

is no requirement for a justifiable reason. For a general tenancy, on the contrary, the lessor's unilateral refusal to renew must be supported by justifiable grounds, etc. Regarding the continuation of the contract between the same parties, renewal is not permitted under a fixed-term tenancy contract. Thus, a new contract must be executed if the tenancy relationship is to continue. In the case of a general tenancy, the contract is renewed if there are no valid reasons for not doing so. The fixed-term tenancy contract has a duration, while it is undefined for general rental housing.

Leasehold is the right to rent land from the landowner to build a house. Although the land is leased, the building is owned by the owner and can be rebuilt, leased, or sold as an owner-occupied house, just like a normal detached house or condominium (the landowner's consent is required under normal circumstances). If people use a leasehold, they do not have to buy the land. Moreover, since they do not own the land, they are exempt from paying the real estate acquisition tax as well as the registration and license tax, but only the building portion of property tax and city planning tax. When using the land leasehold, it is necessary to pay a "deposit", which is equivalent to a security deposit for a rental property, and to pay monthly "land rent" to the landowner. As the land rent fluctuates, there is a risk that land prices will rise due to inflation, and if property values rise, the land rent will also rise. Land leasehold can also be roughly divided into "ordinary leasehold" and "fixed-term leasehold". "Ordinary leasehold" is a system that allows the landowner to renew the contract and continue to live in the property unless the landowner has a justifiable reason for not doing so. In contrast, a "fixed-term leasehold" is a system under which the land can be leased for a contract period of 50 years or longer. The land must be cleared and returned upon the expiration of the contract. There is a possibility to conclude a fixed-term lease contract again, but a security deposit and rights fee will be charged when the contract is resigned. [10]

4.3 Ordered Logit Model and Micro Panel Data

Data

Data are obtained from the Keio Household Panel Survey (KHPS) that was first performed in January 2004, with approximately 4,000 male and female respondents in the initial survey. It mainly covers comprehensive topics such as employment,

[10] Saito, W. (2017, March 8). *The option of renting the land and owning the house.* ARUHI Magazine. https://magazine.aruhi-corp.co.jp/0000-0813/ (in Japanese)
E-gov law search. (n.d.). *Land and House Lease Law (Act No. 90 of 1991)*. Retrieved September 12, 2022, from https://elaws.e-gov.go.jp/document?lawid=403AC0000000090 (in Japanese)

consumption, income, housing, family structure, personal attributes, educational background, employment and schooling status, allocation of living time, and residential relationship with parents. This study selects years from 2004 to 2020 that include a wide range of age groups from 20 to 86.

Models are estimated using an ordered logit model. The parallel regression assumption has not been violated according to a significant test statistic.

Dependent variables

Since these dwelling forms face different risks and are to some extent alternative goods, tenure types were divided into 2, 3, and 4 categories as explanatory variables to identify the status that people choose different dwelling forms. Explanatory variables are mainly chosen from demographic factors, housing characteristics, educational level, and occupational background to cover people's daily life as comprehensively as possible and better explain the model.

Independent variables

Hypotheses of independent variables are as follows: explanatory variables consist of household attributes, occupation and education attributes, housing attributes, and region dummies. Please refer to Table 4.1 for the definitions of variables.

For household attributes, Age (+) represents the age of the respondent, the older the respondent, the more likely they are to own a home. Sex (+), men are more likely to buy a home due to higher average income. Married (+), married people are more likely to own a home for a stable life. Size (+) and Coresidence (+), larger family size or living with parents implies a more stable life, typically including property ownership. Childnum (+) represents the number of children under 16 years old in a family is counted. According to previous studies (Seko & Sumita, 2007; Aizawa & Helble, 2016). variables about children is a binary variable representing whether or not a family has children. Here we use multivariate variables to examine the marginal effects.

For occupation and education attributes, Company size (+), the larger the company size, the more stable the life and the better the credit, and consequently the higher the likelihood of owning a home. Job (+) indicates whether or not work can be done in the office, which means that it is possible to work remotely. It is based on the occupational category in the questionnaire, where administrative occupations, clerical workers, information processing technicians, and professional and technical workers can be classified as a category where telecommuting is possible[11]. Commuting (+), the longer

[11] The occupational categories in the questionnaire in KHPS are as follows,

the daily commute, the more likely the respondent is to own a home. When people endure long commutes, it is typically because they live with family and own rather than rent a house. Otherwise, they have the choice of renting near their workplace. Income (+), the higher the income, the more likely the respondent is to buy a home. Education (+) is categorized by levels of education rather than years of education, which is more realistic. A higher level of education leads to a higher expected income and a higher likelihood of home ownership.

For housing attributes, Hage (-), home ownership is linked to a newer house, according to Seko and Sumita (2007). Avgarea (+), considering what will happen in the future as much as possible, people will be more inclined to buy a larger home, leading to a larger living area per person. Aging care (+) means whether or not there are facilities for ageing in the house to conduct daily duties without difficulties. There are several kinds of facilities for aging in the house,[12] and the barrier-free for aging is not added to avoid endogeneity.

For regional dummies, the Kanto region is the reference region, while the others are Chubu, Chugoku, Hokkaido, Kinki, Kyushu-Okinawa, Tohoku and Shikoku regions.

4.4 Results and Determinants of Housing Expenditure

Results and interpretations

1 Agricultural, forestry and fishing workers
2 Mining workers
3 Sales workers (e.g., retail and wholesale shop owners and clerks, diplomats, estate agents)
4 Service workers (e.g., hairdressers, beauticians, employees of restaurants, inns, etc., cleaners)
5 Administrative occupations (e.g., national, and local government councilors, section managers and above in companies, organizations and public offices)
6 Clerical workers (e.g., general office workers, accounting clerks, operators, etc., salesclerks)
7 Transport and communications workers (e.g. train, car, ship and aircraft drivers, conductors, wire and radio operators)
8 Manufacturing, construction, maintenance, and transport workers
9 Information processing technicians (e.g., system engineers and programmers)
10 Professional and technical occupations workers * Excluding information processing technicians (e.g., research and technical workers in companies and other organizations, healthcare and legal workers, teachers, artists)
11 Security professionals (e.g., self-defense personnel, police officers, firefighters, guards, etc.)
12 Other (specify)

[12] The facilities for aging in the house: Barrier-free, with handrails; bathtubs of easy-to-straddle height; corridors and other areas wide enough for wheelchair access; indoor areas with no steps; wheelchair access from street to entrance; no such considerations

The probability of current state and marginal effects was calculated for the tenure choice correspondence to different variables in Tables 4.2 and 4.3. In Table 4.2, model (3) is discussed as the main result. In terms of household attributes, the older the age of the household, or if married, the higher the propensity to live in an owner-occupied house. Households with more children under the age of 16 are more likely to live in rental houses, while those living with parents are more likely to avoid renting a house. In terms of occupational and educational attributes, the higher the income, the higher the propensity to choose owner-occupied housing; there is also a higher propensity to own a home when remote work is allowed; and job security is positively associated with the choice to own a home. Those with higher levels of education tend to avoid owner-occupied housing. In terms of housing attributes, rental housing is older and often smaller. People living in large cities are more likely to live in rental housing. Regional dummies have little impact.

Table 4.3 reports the marginal effects of several variables. The coefficients of marginal effects represent the probability of a change in the state of the corresponding different explanatory variables when the variable changes by one unit. For example, for each 1% increase in income, the probability of tenure choice at 0, 1, and 2 will decrease by 3.8%, 1.5%, and 0.5%, respectively, while the probability of becoming ownership will increase by 5.8%. It can be found that variable elasticity is higher when changing from a fixed-term tenant to a general tenant and from a renter to an owner-occupier. If living with parents, there is a higher demand for owner-occupied housing. In addition, teleworking has a greater impact on the type of residence than the impact of commuting time. It should be noted that commuting time is measured in minutes, and thus there is a significant influence but an insignificant marginal effect. According to the importance of teleworking, people are more likely to own a home when they can work from home, or when they have the flexibility to choose a place to live.

Determinants of housing expenditure

From the above analysis, it can be observed that income has a great influence on the choice of housing forms. According to Appendix 4.2, for low-income quintile groups, almost half of the income is spent on housing, but the proportion of housing expenditure gradually falls as income increases. According to Appendix 4.3, for low-income quintile groups, many people choose renting. Income inequality is found to have a significant impact on housing tenure.

To quantify changes in housing expenditure due to various factors documented above, the marital state for each income quantile group is decomposed into a coefficient

effect and a composition effect by the Blinder-Oaxaca decomposition method (see Table 4.4), to investigate the influence of income on housing expenditure and identify the determinants of housing expenditure for people in different marital status.

Housing expenditure for renters is defined as the basic rent and maintenance fee, while that for owner-occupiers is mortgage and interest payments. Data are divided into five groups according to income level. This method refers to Dustmann et al. (2022) for the definition of residential expenditure. Since statistical methods are different and not all variables can correspond to each other, some adjustments are made here to the actual situation of Japanese data.

Therefore, it can be found that there is a very significant change in people's housing expenditure from unmarried to married, and all of them increase significantly. This phenomenon is most pronounced in the low-income group, and this difference decreases with increasing income. There is almost no influence on the middle-income group, and none of the changes in these variables has much significant effect on them. The components that can be explained are called composition effects, which can be further decomposed. The difference that cannot be explained by existing variables is called coefficient effects.

4.5 Conclusions

This study analyzes the propensity and marginal effects of housing choice by adopting various variables from various aspects of individuals' daily lives (household and housing attributes, occupational and educational attributes, regional dummies, etc.). The determinants of housing expenditures are decomposed and studied in Japan. It is found that income inequality and marital status have a significant impact on housing expenditure. Blinder-Oaxaca decomposition method is used to measure the effect of changes in marital status based on income inequality.

The results show that households are more likely to reside in their own house (and more likely to avoid renting) if they are older, married, male, have more headcount in a household, have fewer children under the age of 16, and live with parents (in any of the above cases). The number of children may affect disposable income and lead to insufficient funding to purchase a home. Marital status has a greater impact on those with lower income. People tend to avoid renting when other options are available as income increases, although many choose to rent on a fixed-term basis. When company of employment are more stable and allow teleworking, people are more likely to become owner-occupiers. People with higher education tend to choose a more liberal

lifestyle. This can make policy recommendations for regional development by promoting a residence in rural and suburban areas through teleworking, etc.

This study also reveals a substantial correlation between remote work and job tenure and is worthy of future study. It turns out that people are more likely to purchase a home when remote work is available (when it is approved by companies or permitted by the characteristics of occupation). Less likely to purchase a house are those who live in a large metropolis. Individuals with a higher degree of education are more likely to rent, suggesting greater mobility. Working from home allows individuals to live locally while maintaining contact with the city, as well as to better mobilize the workforce and build regional development ties. Rapid developments in the field of artificial intelligence and virtual reality have contributed to the viability of remote work. Telecommuting promises to rejuvenate dwindling rural communities and preserve their social fabric. It may also provide young workers with cheaper housing and provide working couples with family support services. Individual mental health can also be improved by reducing time-consuming and increasingly expensive commuting and automobile use. Employers can hire competent professionals from all over the world, as opposed to merely recruiting local personnel. Furthermore, the greater mobility of individuals with a higher degree of education suggests that rural areas can retain highly skilled and professionally diverse people in this way.

Table 4.1 *Definition of Variables*

Variable	Definition
Tenure 2	1: Owned house, 0: Rental house
Tenure 3	2: Owned, 1: General rental house, 0: Rental house with a fixed-term tenancy contract
Tenure 4	3: Owned house and land, 2: Owned house and rental land, 1: General rental house, 0: Rental house with a fixed-term tenancy contract
Age	the Age of respondent
Sex	1: male, 0: female
Married	1: married, 0: unmarried
Size	Number of people in the household
Coresidence	1：Living with parents, 0：otherwise
Childnum	The number of children under 16 years old
Education	1: Junior high school, 2: High school, 3: Junior college, 4:University (4 years), 5: Graduate school
Companysize	1: if respondent works with over 500 workers, 0: otherwise
Job	1: if the job can be done in office, 0: otherwise
Commuting	Time taken by respondent to commute daily(mins)
Tele	1: allowed for telework, 0: otherwise
Income	The annual income of household (10000yen)
City	1: Government ordinance cities (including special wards), 0: otherwise
Hage	Age of house
Avgarea	Living space per person in the household (m^2)
Agingcare	1: there are facilities for aging in the house, 0: otherwise

Table 4.2 *Housing tenure choice (Ordered logit model)*

	(1) Tenure 2	(2) Tenure 3	(3) Tenure 4
Age	0.046***	0.032***	0.033***
	(0.004)	(0.004)	(0.004)
Sex	0.397**	0.317*	0.409***
	(0.174)	(0.167)	(0.150)
Married	1.016***	0.853***	0.826***
	(0.148)	(0.140)	(0.128)
Married male	-0.591***	-0.381**	-0.516***
	(0.192)	(0.187)	(0.168)
Size	1.108***	0.987***	0.726***
	(0.053)	(0.052)	(0.043)
Childnum	-0.262***	-0.241***	-0.106**
	(0.059)	(0.060)	(0.053)
Lnincome	0.608***	0.567***	0.551***
	(0.079)	(0.077)	(0.070)
Coresidence	1.591***	1.362***	1.059***
	(0.164)	(0.161)	(0.135)
Education	-0.102**	-0.068	-0.071*
	(0.042)	(0.042)	(0.038)
Companysize	0.136*	0.222***	0.161**
	(0.080)	(0.081)	(0.074)
Tele	1.124**	1.144***	0.802**
	(0.440)	(0.438)	(0.385)
Job	0.132	0.162*	0.134*
	(0.085)	(0.085)	(0.078)
Tele*Job	-0.789	-0.693	-0.362
	(0.488)	(0.497)	(0.439)
Hage	-0.003	-0.005	-0.011***
	(0.003)	(0.003)	(0.003)
Avgarea	0.084***	0.085***	0.073***
	(0.004)	(0.004)	(0.003)
Commuting	0.004**	0.001	0.003**
	(0.002)	(0.002)	(0.001)
Aging care	0.929***	0.751***	0.587***
	(0.086)	(0.088)	(0.078)
City	-0.438***	-0.383***	-0.478***
	(0.075)	(0.075)	(0.069)
Hokkaido	-0.066	-0.234	-0.046
	(0.185)	(0.180)	(0.172)
Tohoku	0.072	-0.018	-0.003
	(0.188)	(0.188)	(0.172)

Table 4.2 Continued.

	(1) Tenure 2	(2) Tenure 3	(3) Tenure 4
Chubu	-0.030	-0.086	-0.080
	(0.118)	(0.122)	(0.109)
Kinki	0.233**	-0.032	0.082
	(0.100)	(0.099)	(0.091)
Chugoku	0.113	-0.042	0.115
	(0.170)	(0.161)	(0.153)
Shikoku	-0.271	-0.417*	-0.264
	(0.230)	(0.226)	(0.214)
Kyushu	-0.668***	-0.646***	-0.477***
	(0.124)	(0.122)	(0.113)
cut1	11.400***	9.021***	7.778***
	(0.541)	(0.501)	(0.458)
cut2		9.735***	8.460***
		(0.504)	(0.461)
cut3			8.685***
			(0.462)
Observations	8,657	8,425	8,425

Notes： Degree of significance expressed as ***p < 0.01, **p < 0.05, *p < 0.10.

Standard deviation reported in brackets.

Table 4.3 *Marginal effects*

		Marginal	err.	z	P>|z|
Married	Pr(tenure4==0),	-0.0574	0.0089	-6.48	0
	Pr(tenure4==1),	-0.0224	0.0036	-6.22	0
	Pr(tenure4==2),	-0.0077	0.0013	-5.8	0
	Pr(tenure4==3),	0.0874	0.0135	6.48	0
Size	Pr(tenure4==0),	-0.0504	0.0031	-16.48	0
	Pr(tenure4==1),	-0.0197	0.0014	-14.53	0
	Pr(tenure4==2),	-0.0067	0.0006	-11.04	0
	Pr(tenure4==3),	0.0768	0.0044	17.54	0
Childnumber	Pr(tenure4==0),	0.0074	0.0037	2.01	0.044
	Pr(tenure4==1),	0.0029	0.0014	2.01	0.044
	Pr(tenure4==2),	0.0010	0.0005	2	0.045
	Pr(tenure4==3),	-0.0112	0.0056	-2.02	0.044
Lnincome	Pr(tenure4==0),	-0.0383	0.0049	-7.87	0
	Pr(tenure4==1),	-0.0149	0.0020	-7.51	0
	Pr(tenure4==2),	-0.0051	0.0008	-6.79	0
	Pr(tenure4==3),	0.0583	0.0074	7.92	0
Coresidence	Pr(tenure4==0),	-0.0735	0.0093	-7.89	0
	Pr(tenure4==1),	-0.0287	0.0038	-7.5	0
	Pr(tenure4==2),	-0.0098	0.0014	-6.82	0
	Pr(tenure4==3),	0.1121	0.0141	7.94	0
Tele	Pr(tenure4==0),	-0.0557	0.0267	-2.08	0.037
	Pr(tenure4==1),	-0.0218	0.0105	-2.08	0.038
	Pr(tenure4==2),	-0.0074	0.0036	-2.06	0.039
	Pr(tenure4==3),	0.0849	0.0407	2.09	0.037
Commuting	Pr(tenure4==0),	-0.0002	0.0001	-2.27	0.023
	Pr(tenure4==1),	-0.0001	0.0000	-2.26	0.024
	Pr(tenure4==2),	0.0000	0.0000	-2.24	0.025
	Pr(tenure4==3),	0.0004	0.0002	2.27	0.023

Notes: n=8425

Table 4.4 *Blinder-Oaxaca decomposition*

	income_q1	income_q2	income_q3	income_q4	income_q5
Overall					
Unmarried	3.906***	4.301***	4.545***	4.640***	4.870***
	(0.0177)	(0.0216)	(0.0311)	(0.0287)	(0.0455)
Married	4.161***	4.428***	4.549***	4.721***	4.899***
	(0.0191)	(0.0109)	(0.0099)	(0.0102)	(0.0110)
Difference	-0.255***	-0.127***	-0.0041	-0.0817***	-0.0282
	(0.0261)	(0.0242)	(0.0327)	(0.0304)	(0.0468)
Composition effect (explained)	-0.168***	-0.00863	-0.035	-0.0678***	-0.0588***
	(0.0270)	(0.0231)	(0.0218)	(0.0214)	(0.0218)
Coefficients effect (unexplained)	-0.0868**	-0.118***	0.0309	-0.0138	0.0306
	(0.0339)	(0.0313)	(0.0373)	(0.0355)	(0.0506)
Detailed decomposition of the composition effect					
Tenure4	-0.137***	-0.0665***	-0.0553***	-0.0375***	-0.0121***
	(0.0139)	(0.0080)	(0.0087)	(0.0073)	(0.0046)
Size	-0.0820***	-0.0391**	-0.0069	-0.0160*	-0.0020
	(0.0236)	(0.0174)	(0.0121)	(0.0083)	(0.0034)
Coresidence	0.0032	0.0199***	0.0276*	-0.0471***	-0.0598***
	(0.0057)	(0.0070)	(0.0142)	(0.0162)	(0.0193)
Avgarea	0.0240***	0.0551***	-0.0056	0.0237***	0.0135**
	(0.0083)	(0.0145)	(0.0071)	(0.0075)	(0.0067)
City	0.0236***	0.0220***	0.0051	0.0091***	0.0017
	(0.0058)	(0.0050)	(0.0037)	(0.0035)	(0.0032)

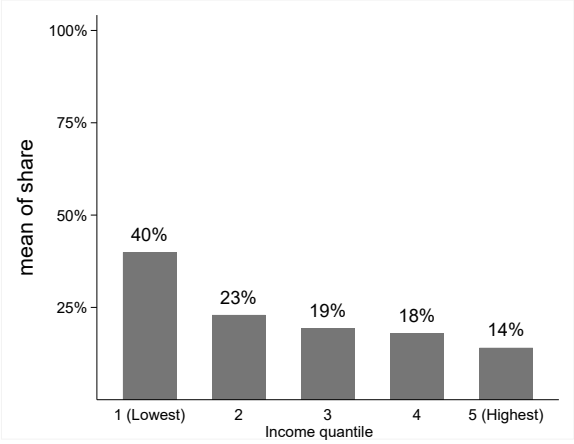
Notes：Degree of significance expressed as ***p < 0.01, **p < 0.05, *p < 0.10. Standard deviation reported in brackets.

Appendix 4.1 *Descriptive Statistics*

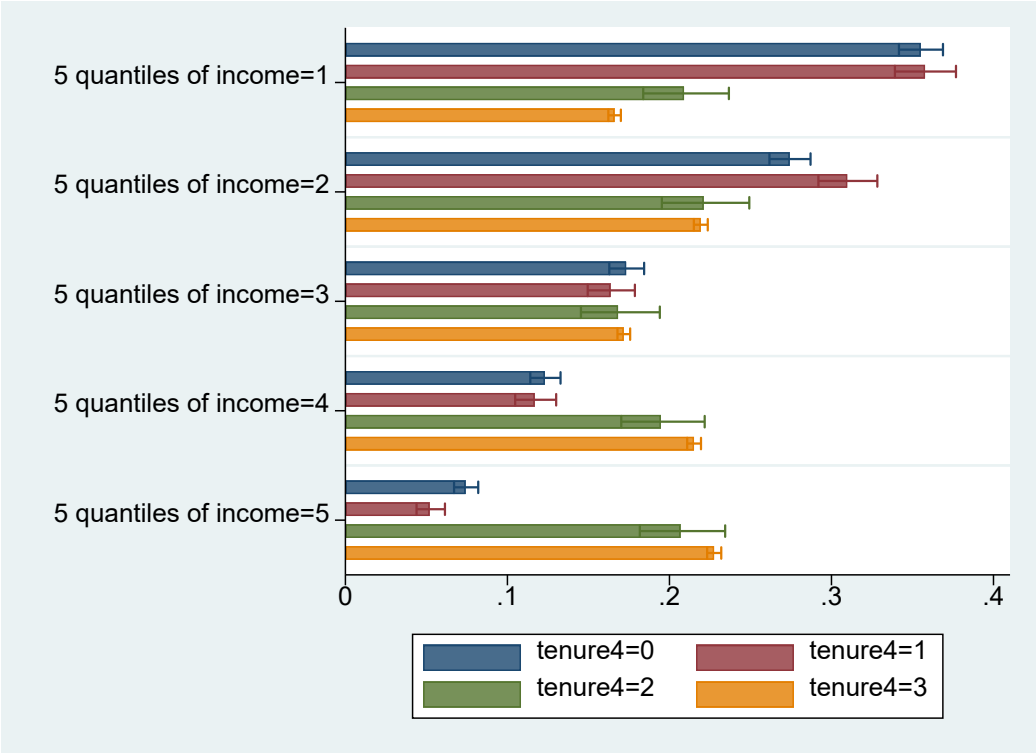
	Obs.	Mean	Max	Min	Std.Dev.
Age	54,356	52.276	86	20	13.877
Sex	54,356	0.485	1	0	0.5
Married	54,356	0.755	1	0	0.43
Education	51,211	2.589	5	1	1.004
Size	54,268	3.296	12	1	1.472
Childnum	51,276	0.506	7	0	0.899
Income	45,906	672.238	9400	0	0.665
Coresidence	53,334	0.199	1	0	0.399
Company size	37,848	0.269	1	0	0.444
Tele	24,938	0.047	1	0	0.211
Job	38,574	0.407	1	0	0.491
Hage	50,576	24.37	101	1	15.712
Avgarea	46,923	43.132	2227	1.429	49.265
Commuting	35,567	31.306	240	0	28.666
Aging care	35,562	0.397	1	0	0.489
City	54,356	0.279	1	0	0.448

Appendix 4.2 *Income quantiles and the share of housing expenditure to income*

Income Percentiles	(10,000yen)
1%	77
5%	170
10%	240
25%	376
50%	587
75%	850
90%	1,185
95%	1,460
99%	2,400



Appendix 4.3 *Tenure choices and income_quantile*



	income_q1	income_q2	income_q3	income_q4	income_q5	Total
Rental house with fixed rental term	1,690	1,305	825	586	353	4,759
General rental house	888	769	406	290	129	2,482
Owned house and rental land	190	201	153	177	188	909
Owned house and land	5,928	7,827	6,131	7,679	8,122	35,687
Total	8,696	10,102	7,515	8,732	8,792	43,837

Chapter 5

Conclusion

This study investigates the influence of demographic factors on the housing market and further analyzes the supply-demand of land in the housing market based on the demographic structure. Finally, based on microdata, how individuals make decisions about housing tenure is discussed and the determinant of household motives is examined to make the corresponding choice in housing expenditure. The results show that aging and living with parents or generations have a positive impact on housing demand. Families with more children and metropolitan residents typically reside in rental houses. Marital status has a significant influence on housing tenures choices and changes in housing expenditure have a substantial impact on low-income people.

This study estimates the influence of demographic changes on house prices. In Chapter 2, empirical research is conducted to verify the relationship, using panel data for 31 Chinese administrative units from 2002 to 2017. Analysis results showed that the old dependency ratio had a positive impact on house prices, while the child dependency ratio had a negative impact. Also, regional dummies are added for further analysis. Population mobility is found to be the most important factor in its impact, which affects regional supply and demand, as well as housing prices. Its impact on housing prices is stronger in less developed regions. In addition, intergenerational transfer payments from parents to children are significant at the national level, which is positively related to the housing price.

Regarding policy implications, based on the preceding conclusions, aging can still maintain house prices in the context of an aging society due to the existence of intergenerational transfer payments. With the increase of dropping birth rates and shrinking labor force, however, social pensions will become inadequate and transfer payments from parents to children will decrease, reducing the purchasing power of houses. Consequently, both in terms of social stability and elderly welfare, the government needs to reform the social security system, particularly the pension system. Moreover, regional differences in economic development are now a more significant element in the volatility of housing prices, and minimizing regional economic imbalances is an even more essential matter. China’s hukou policy controls the migration of people, and hukou is associated with a variety of issues, including

inhabitants' everyday healthcare, education, and social welfare. Future liberalization of the hukou policy may be more conducive to the mobility of talents and the elimination of regional development inequality.

Regarding the topic of how demographics affect market supply and demand, in Chapter 3, this paper estimates the supply-demand function in terms of site area per capita in Japan, by developing a simultaneous-equations model and conducting an empirical analysis by FE-2SLS based on data from 1993 to 2018. The results of Chapter 3 demonstrate a positive impact of ageing on housing demand, which may be somewhat different from general common sense, and it should be noted that this is the case of housing space per capita. This phenomenon can be explained by demographic transitions and lifestyle changes. Regarding demographic changes, according to Yamazaki & Nakagawa (2020), the expenditure of purchasing a house is such great that it may be the largest single expenditure of an individual's lifetime, therefore, when purchasing a house, individuals often consider their long-term housing demand, for instance, when acquiring a house, newlyweds may consider the number of children they will have in their lifetime, etc. Over time, the number of family members is reduced beyond middle age, while the average living space per family continues to expand. Therefore, older individuals, who typically have smaller families, will have a greater living space. In addition, the decline in the marriage rate has led to a rise in the number of households, which in turn increases the need for housing space per individual. Moreover, the increased demand for aged care necessitates more living space from a micro standpoint.

Besides, the results of Chapter 3 show that rent, convenient transportation, and good environment and income are positively associated with the demand of site area per capita, while child dependency ratio, living with parents results in a negative influence. On the supply side, mortality has the most significant positive influence on the housing supply, and the rate of increase in vacant housing has the greatest influence on supply.

Regarding policy implications, changes in the housing market may reflect the well-being of the elderly in the context of a declining and ageing population. In terms of policy, when the demand for housing in a particular area increases, it could be determined whether the number of older people living alone increases, whether the issue of ageing becomes more urgent and whether it is appropriate to add more housing for the elderly and provide adequate community support. Furthermore, the government should examine whether the current housing supply policy is appropriate and if not,

adjust the direction of the housing supply accordingly.

This study also focuses on the determinants of housing tenure in Japan. Chapter 4 uses micro-panel data from the Keio Household Panel Survey (KHPS) from 2004 to 2020 to conduct an ordered logit model and analyze marginal effects. Furthermore, the determinants of housing expenditure are analyzed using the Blinder-Oaxaca Decomposition. The results show that people who are older, married, have a larger family, and live with parents are more likely to own a house than those with more children. When working remotely is permitted, income is higher, or the employer's company is solid, and the desire to own a house increase; those with a higher degree of education are less willing to purchase a home. Residents living in a larger city are more likely to dwell in rental accommodation. There is considerable inequality between married and unmarried individuals, although this gap narrows with increasing income. Notably, married status has the greatest impact on the lowest-income group, the least impact on the middle-income group, and the least impact on the high-income group.

The association between remote work and tenure choice has been noticed in this study. Rapid advancements in the field of artificial intelligence and virtual reality support the viability of remote work. Then, what is an individual's intention? This paper provides evidence of the connection between teleworking and fostering local revitalization. It turns out that when remote work is available, individuals are more inclined to purchase a home (when it is approved by the company or permitted by occupational characteristics). Residents in large cities are less likely to purchase a house. People with higher levels of education are more likely to rent, implying higher mobility. Remote work allows individuals to live locally while preserving contact with the city, as well as to better mobilize the workforce and strengthen regional development ties.

Local governments can develop strategies to promote telecommuting, maintain a younger demographic structure and address a variety of regional economic and social challenges. For instance, it is feasible to provide more affordable housing for young workers and family support programs for working couples. It is reasonable for companies to recruit skilled people from all over the world, instead of just inside their locations. This also implies that rural communities can retain highly qualified and professionally diversified individuals, thus preventing the decline of rural areas.

The following describes the characteristics of this study and the differences from previous literature. Chapter 2 includes mobility, intergenerational transfer payments, dependence ratios and other variables that influence housing prices. Controlling the differences in regional economic growth and analyzing the impact of these variables on

housing prices, this study seeks to provide new knowledge to this field. Chapter 3 examines the impact of demographic characteristics on supply and demand, respectively. In the empirical part, the site area per capita is regarded as housing stock, which could better reflect the behavior of an individual, and there are few analyses from such a perspective in Japan. Chapter 4 adopts the variables changed from binary to multivariate, which increases the possibility of discussing marginal effects. The impact of the possibility of working from home on tenure choice is examined. Housing tenure and housing expenditure are also explored in the context of income disparity. Moreover, the dataset has been significantly updated.

It is often believed that ageing causes a decline in asset prices. However, in this study, through empirical research conducted in Chinese and Japanese data, the results show that ageing increases housing demand. This is a matter that requires careful consideration. It should be also emphasized that ageing does not imply a lack of housing demand, as older people also need to live in houses and have unique needs, and individuals nowadays prefer to live alone. In addition, some of the existing housing may not satisfy the current demand of individuals in terms of living cost, family support and amenities for the elderly, comfortable surroundings, and community support. Regarding future considerations, it is also requiring further segmentation in the market. Also, it is desirable to develop housing policies based on different income groups.

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