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Homeownership and Residential Mobility during the "Lost Decades"

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Abstract

Using household survey data from the recent economically depressed period, we attempt to identify typical household characteristics by residential type and study whether households change their residence in different stages of life. We find that the general trend in residential choice is influenced by their socioeconomic backgrounds. Multinomial probit estimation results show that the probability of homeownership is higher in rural areas and increases with the age of household heads, income, and family size. In contrast, the probability of renting a home increases in urban areas along with rising mortgage rates. Moreover, despite market imperfection, there is a significant tendency among people to adjust residential size according to their needs in different stages of life. Indeed, there is a strong tendency for dwelling size to increase with household age, but it begins to reduce once households reach the age of 55. However, because of the small scale of this reduction in the late life-cycle, we conclude that post-war housing policies were not very supportive of the elderly.

Keywords: Homeownership, Life cycle, Dwelling size, Multinomial probit method, Bayesian approach, Difference-in-differences, Japan, Lost decades
JEL classification: R3, C5

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1 Introduction

A home is one of life's necessities, and thus, most people consider homeownership at some point in their life. However, since a home is usually a very expensive and durable asset, people often confront difficulties in deciding whether or not, and when, to become a homeowner. Traditionally, the analysis of housing markets seems to have been carried out at a micro level, but today it has become increasingly important and forms an essential element in macroeconomic analysis (Leung 2004, Jorda et al. 2016); housing finance is found to be closely linked with business cycles and financial crises. Therefore, there are a number of studies investigating what factors indeed affect household decisions on homeownership (e.g., Moriizumi 1993, Deutsch et al. 2006).

We study the Japanese property market because it is unique in several respects. First, the market is not as extensive as in Western countries. There is a relatively small secondary market, with much fewer repeat-buyers. Renovating houses is not as popular as in other developed countries as the value of buildings becomes almost zero in 20 years after their establishment and only residential lands remain a significant part of assets. Partly for this reason, there is no strong tendency to consider purchasing a house as an investment strategy. Second, whereas there are many types of residences, there is a stronger preference to live in condominiums in Japan. People opt to live in condominiums even after marriage, particularly in urban areas, because they are more affordable than detached houses in the same areas. Furthermore, living in high-rise condominiums often equipped with modern and luxurious facilities is considered to be a symbol of wealth.[1]

Against this background, we will generalize household characteristics in association with homeownership using socioeconomic information available from very comprehensive household survey data in Japan. Thus, this study is related to the demand side of the housing market. Whereas costs such as house prices and rents are important factors in making household decisions, calculating price and income elasticities is not the objective of this paper.[2] Second, we study whether people change homes in different stages of life. This an important question regarding residential mobility and is relevant when formulating

[1] See also Horioka (1988) about the unique features of the Japanese housing market including relatively high prices of houses, the importance of intergenerational transfers, wide regional disparities in housing conditions, and relatively unavailability of housing loans until the 1960s. Kobayashi (2016) reviews Japanese housing market policies after World War II.

[2] This is due to lack of price data by residential type.

housing policies, considering Japan has become one of the most aged countries in the world.[3]

In short, this paper has the following distinguishing elements: First, we use the National Survey of Family Income and Expenditure (NSFIE, *Zenkoku Shouhi Jittai Chosa*). This is the most comprehensive household survey in Japan and collects household-level information on income and expenditure as well as characteristics of each household. In particular, this dataset enables us to explore more detailed background information about households than previous studies, and departs from most economic analyses that relied on a Hedonic equation where home prices are variables of the interest. Second, we analyze household characteristics during the lost decades—the recent period of low economic growth and inflation. After the collapse of the bubbles in the financial and real estate markets in the early 1990s, Japan experienced two decades during which consumers faced little income growth and price changes. This was also a period when the focus of the government's housing policy shifted towards improving housing for the elderly.

Third, as the dataset does not allow us to identify the same households across different sampling periods, we analyze household behavior with respect to changing residence during different life stages by looking into the relationship between dwelling size and household age. Therefore, this study is related to residential mobility and more generally, to the level of market perfection. We use a statistical approach called the difference-in-differences (DID), which is a popular analytical tool to check the effectiveness of public policies in repeated cross-sectional data. To identify the timing of a reduction in dwelling size, we propose a recursive estimation method to disentangle age effects into two different groups in the context of DID. To the best of our knowledge, this is the first attempt to use the DID approach in real estate analyses.

2 Literature review

Realizing the importance of housing markets in economic analyses, there are a number of studies conducted across countries. However, among them, we mostly review literature directly related to homeownership and residential mobility in Japan where currently, basic

[3]In 2015, people more than 60 years old accounted for 33.1 percent of Japan's population, and this figure was the highest in the world, followed by Italy (28.6 percent) and Germany (27.6 percent).

needs are often a focus of debate due to the increasing numbers of unemployed young people and retired people.

Generally speaking, the Japanese market is considered to be less perfect than Western markets. Consumers were often confronted with liquidity constraints, which was reflected in high savings until the 1990s. Since people did not have enough access to external financing, saving for the future was an essential part of life. Presently, there are more means to borrow money, but the down-payment remains a heavy financial burden to many consumers. As a result, the average age of homeownership in Japan is higher compared to other developed countries, and inheritance and bequests are important elements in the decisions of potential homeowners (Hayashi et al. 1988, Deutsch et al. 2006). The imperfection of the Japanese housing market is also documented by identifying asymmetric information among market participants – between buyers and sellers in the secondary market (Harano et al. 2012) and between private and institutional participants in the condominium market (Nagayasu 2016). Furthermore, unlike European countries (e.g., Germany), the law and taxation system in Japan is very complicated: Japan's civil law treats residential land and houses (i.e., building parts) separately, and therefore, different types of laws and taxation applies to them. This substantially increases the administrative costs of becoming a homeowner.

Among factors that affect household decisions, the financial standing of potential homeowners is reported to be important. Henderson and Ioannides (1983) pointed out the importance of the timing of the receiving of wealth. When a larger portion of wealth is received at an earlier time in one's life cycle, it is more likely to own houses. Deutsch et al. (2006) analyzed causes of the slowdown in the timing of homeownership between 1992 and 2000, and showed that becoming a homeowner was delayed by the poor financial standing of consumers as well as stagnant macroeconomic conditions. Similarly, Moriizumi and Naoi (2011) showed that unemployment risks affected the timing of homeownership in Japan. The effect of unemployment risks on homeownership is reported to be greater than that of income variation.

Furthermore, Horioka (1988) and Moriizumi (1993) studied price and income elasticity in the Japanese housing market. Using household information (the Consumer Expenditure Survey), Moriizumi calculated the price and income elasticities from the tenure choice

function for homeowners and borrowers. Focusing on young households in Tokyo, she found that the price and income elasticities of becoming homeowners are marginal, and so is the income elasticity of rental housing demand, leading her to conclude that income transfers to encourage people to purchase homes is not an effective housing policy.

Household decisions are also known to be influenced by social backgrounds. Borsch-Supan et al. (2001) studied household data for Germany and Japan (1988 and 1993) using a multinomial logit (MNL) model. They considered housing prices, household income, and family size, and found that a 10 percent increase in permanent income raises homeownership by 2 percent, and so does a large family. Furthermore, the household age is reported to be an important factor for homeownership in both countries. Thus, they confirm internationally the importance of socioeconomic factors in explaining housing demand.

With respect to changing residence, theoretical developments have been made, for example, by Artle and Varaiya (1978) and Henderson and Ioannides (1993, 1989). Henderson and Ioannides (1989) reported that households with higher income and education are generally more mobile in the USA, and discussed that a decision to rent or own houses is determined largely by the life cycle of household heads. Seko and Sumita (2007) studied the effectiveness of public policies in Japan and confirmed that both tax reduction and amendments in the Rental Act to overprotect borrowers resulted in residential mobility. Moreover, based on survey data conducted in Kanto region (areas surrounding Tokyo), Ishikawa and Fukushige (2015) suggested that improved access to public transportation, shopping areas, and medical facilities becomes motivations to move houses. Using the 1993 data on metropolitan regions, Seko (2000) showed that the decisions of the elderly to purchase residences were influenced by household size and whether the households already owned a residence; for example, those in rental residences tend to choose the same option. On the other hand, Kobayashi and Yukutake (2008) reported from data in 1993, 1998, and 2003 that households in the Tokyo area tend to rent residences initially and purchase later in life.

3 Survey data

We use household survey data from the National Survey of Family Income and Expenditure (NSFIE, *Zenkoku Shouhi Jittai Chosa*), which has been conducted every five years since 1959 to gather the most comprehensive and detailed information related to household financial status, including income and expenditure, as well as social background. Furthermore, this survey covers an entire country, which is more comprehensive geographical coverage than previous studies (Seko 2000, Kobayashi and Fukutake 2008, Ishikawa and Fukushige 2015) and is designed to exclude identical persons across different surveys.

Although there is a long history of the data compilation, household-level information in the NSFIE is disseminated to the public for only four years: 1989, 1994, 1999 and 2004.[4] We use household information for 1994, 1999, and 2004 (about 50,000 households each year); the 1989 household data lack the consistency in the data definition of other years. Since the financial and real-estate bubbles collapsed in the early 1990s, our data capture the economic activities of households in the post-bubble period.

This is a period of economic depression and low inflation, with a number of crises originating both in Japan and overseas. The Great Hanshin earthquake, the second worst earthquake in Japan in the 20th century, took place in 1995, incurring casualties of more than 6000 people. Furthermore, large Japanese financial institutions (e.g., Yamaichi Securities and the Hokkaido Takushoku Bank) collapsed in 1997/98, and the Asian Financial Crisis occurred in Thailand in 1997. As a result, profound non-performing loans were widespread across banks in Japan, and banks' lending activities were constrained by severe screening criteria implemented for new investments. This lending practice particularly damaged the business performance of small- and medium-size firms that employed over 99 percent of the labor force in Japan. A sluggish investment resulted in a slow economic growth nationwide and rendered Japan's employment security fragile, and the life-time employment system that supported the economic miracle had collapsed. The slow economic recovery meant the stagnation of household income, and thus, consumers

[4]Owing to the regulation set by the data provider (the Ministry of Internal Affairs and Communications), the confidential data used in this study cannot be passed on to the third party, but are available for purchase from the provider.

were constrained to not spend, with a precautionary motive.[5] At the same time, weak private consumption resulted in a bad spiral where firms did not find strong demand for the products, and thus, there existed no opportunity for a large-scale investment.

The NSFIE classifies the household choice regarding residential type (RT) into 7 categories: 1) own home, 2) home rented from the private sector, 3) home rented from local governments, 4) home rented from public corporations (*Kodan*) or government agencies (*Kosha*), 5) home rented from an employer (*Shataku* or *Komuninjutaku*), 6) rented residence provided by companies, and 7) house shares. As can be seen from this classification, there are many rental options, and it is quite common for households to rent a residence through employers because those properties are more reasonable in terms of payments and administrative costs (e.g., without finding a guarantor or paying a deposit). In contrast, RT2 is probably the most expensive rental option for households, but this category includes very modern and fashionable houses and condominiums.

The description and basic statistics of key data are reported in Table 1. Several types of residence are identified in the dataset, and more than 70 percent of households were homeowners in 1999 (Figure 1), which is higher than the percentage reported in previous studies (e.g., Nagayasu 2016). In addition, we have collected architectural areas (*Nobeyukamenseki*) of houses, and consumer characteristics such as household age, annual income, family size, savings, occupation type, gender, residential location, and the number of workers in the family. The last three are binary variables; notably, households with two or more workers have a value of "1", and are expected to be in a more sound financial position. Similarly, females are identified as "1" under Gender, and metropolitan areas as "1" under Metro.

The demographic structure suggests that most household heads (nearly 13 percent) are aged between 50 and 54, and two-person households are the most common family size (Figure 1). Employees in the private and public sectors are the most typical occupational type, and equally important is family business that includes farmers and fishermen. Furthermore, the distribution of both annual income and saving is skewed to the right (Figure 2), with an average of around 7 million yen and 14 million yen, respectively. The shape of the distribution implies that the majority of people are less wealthy than what

[5]The consumption tax (VAT) was increased from 3 to 5 percent in 1997.

the average statistics indicate.

Table 2 summarizes the characteristics of properties such as the establishment date, residential type, and equipment in houses, based on the 1999 survey. In addition to nationwide statistics, residential characteristics are shown by geographical location (metropolitan and non-metropolitan areas). This geographical distinction follows that of the government and is determined by population size. This table shows that the average establishment date of houses is around 1981 (i.e., 18 years old) and houses in metropolitan areas were constructed slightly more recently. Furthermore, the proportion of detached and wooden houses is higher in non-metropolitan areas. The houses in non-metropolitan areas are less frequently equipped with flush toilets, and have less access to piped town gas. In contrast, almost all houses are equipped with a bath or shower regardless of geographical location.

Table 3 shows the financial status of households by residential type. This status is expressed in terms of income, savings, and debt. The income is the total amount of all types of actual earnings, and savings include deposits in financial institutions, life and non-life insurance, stocks, bonds, and mutual funds. The debt comprises loans from financial institutions, employers, mutual benefit associations (unions), as well as borrowing from relatives and friends. According to this table, the wealthiest in terms of annual income are homeowners, followed by those renting residences provided by companies. Furthermore, wealthy households are also ones who possess large amounts of personal savings. The large amounts of savings for homeowners may also reflect our definition of savings, which includes savings for business of self-employed households (*Kojineigyo*). Similarly, there is a tendency for households with high income and savings to have a high level of debt, reflecting that high earners are considered to be more credible and can obtain large personal loans more easily.

4 Household characteristics on homeownership

4.1 Household characteristics by residential type

As shown in Table 1, there are many types of residence that households can choose, and thus, the first question is what socioeconomic factors households in a particular type of

residence exemplify. Because household decisions are recorded in the dataset by residential type, we use a multinomial probit (MNP) model where the dependent variable represents discrete choices. The MNP is a useful analytical method when there are multiple outcomes that do not have a meaningful order. The MNP is known to have a number of advantages over the multinomial logit (MNL) model; particularly, it relaxes independence of irrelevant alternatives (IIA) assumed in the MNL (Train 2009).[6] However, the MNP with a great deal of household information requires heavy computation and thus has rarely been used in the past. Indeed, Borsch-Supan et al. (2001) study homeownership in Germany and Japan using the MNL. Presently, developments in IT allow us to use the MNP.

In the latent variable framework, the MNP for the jth alternative of household i can be expressed as

$$\nu_{ij} = z_i \alpha_j + \xi_{ij} \tag{1}$$

where $j = 1, ..., J$. One can interpret ν_{ij} as utility caused by opting for choice j, and z_i is a matrix of observed variables. Eq. (1) can be derived from economic theories of utility maximization. A household will chose jth alternative, when $\nu_{ij} > \nu_{ik}$, rather than kth alternative ($j \neq k$).

$$\nu_{ij} - \nu_{ik} = z_i(\alpha_j - \alpha_k) + \xi_{ij} - \xi_{ik} \tag{2}$$

Or

$$\nu_{\tilde{k}} = z_i \alpha_{\tilde{k}} + \xi_{\tilde{k}}$$

where, unlike the MNL, $\xi_{\tilde{k}} \sim MVN(0, \Sigma)$ and $x_{\tilde{k}} = x_j - x_k$. On the other hand, the probability that household i chooses the kth alternative is[7]

$$Prob(i \ \text{ chooses } k) = Prob(\nu_{\tilde{k}} \leq 0) \tag{3}$$

As Eq. (2) suggests, empirical results from the MNP are interpreted in a relative sense; in other words, the probability of a particular choice is evaluated in comparison with a benchmark choice. Here, for identification purposes, the baseline alternative, α_1 (i.e., homeowners) is constrained to be equal to zero.

[6] However, the IIA is found to be particularly not restrictive in many applications (Dow and Endersby 2004).

[7] Also see Appendix for further explanations.

To explain the selection of RT, we have chosen explanatory variables based on previous studies, which comprise household characteristics such as household age, gender, family size, and residential location, as well as financial factors, such as household income and savings. In addition, we consider the number of other working family members as a proxy for extra family wealth. Some variables (e.g., gender, household savings, and the number of other workers in a family) have not been considered in previous research. But, they are believed to be important for household homeownership decisions; for example, Artle and Varaiya (1978) discussed that age and present wealth (savings) are more relevant to household decisions than current income. The use of the NSFIE makes it possible to expand the dataset.

We expect the following relationships between residential type and the explanatory variables: First, we assume that wealthy households tend to own houses, and thus a higher value of all the financial factors (i.e., household income, savings, and the number of workers in the family) will lead to choosing RT1. Given Japan's salary system, high earners in a particular year are assumed to earn a similar amount in the future also, during our sample period. Thus, high income earners in our dataset can also be interpreted as high permanent income earners, considered to be more relevant in studies on consumption (i.e., the permanent income hypothesis).

With respect to household characteristics, we expect that older household heads are more likely to own a house since they are less likely to face liquidity constraints. Similarly, consumers in rural areas are expected to have purchased a house, since these regions are relatively more spacious and provide more affordable homes with a similar configuration and equipment. Large families obviously need a large residence to accommodate their many members, and thus, other things being constant, they tend to own houses that are often not available as rental properties.

Our results show that the explanatory variables are often significant in characterizing household decisions. Table 4 shows that parameter estimates for age, income, family size, savings, and number of workers in a family are all generally negative and statistically significant. If a household age increases, renting from the private sector is a less likely option compared to a choice of owing a house (the reference option). Similarly, large and wealthy households are less likely to opt for renting from the private sector. On the other

hand, females and households in urban areas tend to live in homes rented from the private sector rather than own houses. However, females have a tendency to avoid other types of rental properties (i.e., renting from or through employers) since these properties are typically old-fashioned and may lack adequate security systems. Among the determinants, household income exercises maximum influence over a household's choice of the housing type. This finding is in contrast to theoretical predictions of Artle and Varaiya (1978); however, it is consistent with Japan's assessment criteria used by banks for housing loans; annual salary is one important factor in determining the size of bank loans.

We also report the marginal effects of explanatory variables in Table 5. The statistics in this table provide information about changes in the probability to choose a particular residential type in response to, for instance, increases in household income. Therefore, this table shows that a one-percentage increase in income will increase RT1 by 13.5 percent while reducing the likelihood of selecting other options (0.135-0.099-0.001-0.054-0.005+0.024+0.000=0.000). Exceptions are RT6 (rented accommodation provided by companies) and RT7 (renting share houses). Indeed, household decisions to choose share houses are only marginally affected by our determinants, which makes share houses a unique residential choice in Japan. Similarly, the likelihood of owning a house increases as consumers become older and wealthier, and is higher when household heads live in rural areas. In addition, large families typically own houses, and when there exists more than one employed person in a family, there is a higher likelihood of owning a house.

Among these characteristics, income is the most critical element in consumers' decision to become homeowners. Therefore, our results generally confirm the fact that the financial situation was one of the important factors for household decisions during the bubble period (Borsch-Supan et al. 2001), remains unchanged even during the post-bubble periods. However, compared with the results from the bubble period in previous studies, the role of income has become more important during the post-bubble period.

In contrast, these determinants often have the opposite impact on households' renting properties. For example, renting from the private sector is popular for younger and less wealthy households, residing in urban areas in particular. Furthermore, rental homes are a popular choice among small families where no one else apart from household heads is employed.

4.2 Purchasing or renting houses

More generally, households may first face a simpler question of whether to purchase or rent a residence, rather than choosing a residential type in details. Therefore, using the standard binary probit model, this section provides a broader picture of household characteristics by residential type than the previous subsection. By simplifying the statistical model, we can also characterize households by occupational type (see Table 1).

Results from the standard probit model, where homeowners are identified as 0 and borrowers (i.e., RT2—7) as 1, are summarized in Table 6. This table reports both parameter estimates and marginal effects, which are calculated using the maximum likelihood estimation method. In addition to the economic determinants considered in previous sections, our probit specification includes a mortgage rate that is obtained from Datastream as well as occupational information. During our sample, the average mortgage rate remains at a historic low and is in a declining trend from 4.133% in 1994 to 2.375% in 2004. It is expected that a higher mortgage rate that increases financial burden on homeowners leads to a higher demand for rental properties.

We find that household age, income, family size, savings, gender, and the number of workers other than household heads are found to be negatively correlated with our dependent variable. It follows that older, wealthy, and male household heads with other working family members tend to be homeowners, and so do individuals living in rural areas. This seems to confirm again that the financial position of a household is important in deciding whether to purchase or rent a residence in Japan, in line with the findings of Henderson and Ioannides (1989). In addition, the importance of social factors is consistent with our findings from disaggregate data in the previous subsection. Similarly, consistent with theoretical predictions, the mortgage rate has a positive parameter, indicating that households tend to select the rental option when mortgage rates increase.

However, it is interesting to note that when households are given a choice in housing options (i.e., renting or purchasing residences), gender differences have diminished over years, consistent with modifications to the civil law to grant more rights to spouses. According to our disaggregate analysis reported in Tables 4 and 5, this result is attributable to the choice of renting from public corporations, which was designed to provide middle-income families with various types of residences often located near shops, banks, and post

offices.

We also find differences in homeownership by occupational type. Many parameter estimates for the occupational dummy variable are found to be negative, implying that many households prefer owning a house, regardless of occupational type. Given that the dummy variable for private company employees (i.e., Occupation 1) is equal to zero, in 1994, more public sector employees and the unemployed tend to have opted for renting properties than private company employees.

However, in recent years, people from a greater variety of occupations tend to choose the rental option; consequently, occupational differences have been diminishing in recent years, as the number of insignificant occupational parameters doubled during 1994—2004. One notable exception is public sector employees who exhibited a significant preference to the rental housing, but only in 2004. This trend appears to be because much public housing, established more than 20 years ago, became obsolete; the government could not afford replacing them with new residences or renovating the existing ones due to public debt.

5 Life-cycle and dwelling size

5.1 The inverse-U relationship

Do people change residence according to their needs? Previous studies reported that consumer decisions to change residence are influenced by public policies as well as by the financial standing of consumers. Henderson and Ioannides (1989) showed that the likelihood of residential mobility is high in the USA as households are wealthier and possess higher education. Seko and Sumita (2007) suggested that the income tax deduction scheme for homeowners (2004) encouraged homeownership; furthermore, a legal framework (the Rental Act) to protect borrowers from eviction and unusual increases in rental fees have contributed toward residential immobility in Japan.

More generally, homeownership was analyzed in the context of life-cycle by Artle and Varaiya (1978). Generally, we expect people to change dwelling size according to the different stages of life. Married couples likely live in a larger residence than single-person households, and couples with children need even larger houses than couples without

children. However, when children grow up and become independent, the couples no longer require houses as large as before, and older couples may find it difficult to maintain a large residence. As the demand functions for own homes and rented properties are very similar (Henderson and Ioannides, 1989), we expect an inverse-U shaped relationship between household age and property size, regardless of dwelling type. Thus, this analysis is relevant particularly to aging societies such as Japan, which have a high proportion of elderly and nuclear families in the country.[8] Indeed, we can observe evidence of the hump-shaped relationship between dwelling size and household age in our data (Figure 3); however, this figure shows that the shape of this relationship is asymmetric with little reduction in dwelling size in the late life stage, indicating limited residential mobility.

A Bayesian hierarchical model is used here to prove this relationship formally. The Bayesian statistical approach can be used to analyze complicated models that cannot be estimated by the frequentist approach (e.g., by maximum likelihood). Therefore, it has become a very popular analytical tool in all academic fields. The hierarchical model is one of such complex models, where the data are classified into three groups (j) in this analysis, as we have observations for three different years. The choice of year as a grouping variable is a natural candidate since household decisions may vary over time due to socioeconomic shocks specific to the given year.

More precisely, for classifying households (i) into j groups, the following two-level random model is considered.

$$y_{ij} = a + bx_{ij} + u_j + e_{ij} = bx_{ij} + f_j + e_{ij} \tag{4}$$

where y is the average architectural area (dwelling size) of the residence having household heads in the same age group. Since there is no identification of individuals across the surveys, we conduct the analysis using the dwelling size of age groups (AG) and assume that changes in the dwelling size indicate a change of residence.[9] x is a vector of household characteristics that can be reasonably assumed to be exogenous in our setting and includes the extra variable Age2 (Age×Age), since we expect a non-linear relationship

[8]Takats (2012) reports a significant relationship between demography and house prices in a panel of advanced countries.

[9]In case of condominiums, the common area among residents is excluded from the calculation of architectural areas.

between architectural areas and consumers' age as described by an inverse-U shape. The u_j is a random effect assigned to each time period, and i represents household. Therefore, our specification accommodates variations in the constant term that are specific to group j. Generally, using the Bayesian theorem, the posterior distributions ($prob(\theta|y)$) of parameters of interest (say θ) can be expressed as a function of the prior distribution ($prob(\theta)$) and the likelihood function ($prob(y|\theta)$).

$$prob(\theta|y) \propto prob(y|\theta)p(\theta) \tag{5}$$

To estimate this equation using the Bayesian method with Gibbs sampling, we make the following assumptions for the prior distributions for the parameters:

$$\begin{aligned} a &\sim N(0, 10000) \\ b &\sim N(0, 10000) \\ e_{ij} &\sim N(0, 100) \\ f_j &\sim N(0, 100) \\ \sigma_0^2 &\sim IG(0.01, 0.01) \\ \sigma_1^2 &\sim IG(0.01, 0.01) \end{aligned}$$

where parameters a, b, e, and f are assumed to follow a normal (N) distribution and the variance an inverse-gamma (IG) distribution. Because we do not have any information regarding the parameters, we assume a fairly large variance, which makes our priors close to uninformative distributions. The Gibbs sampling is conducted with 45,000 iterations and a burn-in size of 15,000, which seem to yield reasonable samples of the key parameters, which are well-mixed and converge (see Figures 4 and 5).

Table 7 summarizes the posterior distribution of parameters from the full-sample analysis. First, we have found that results from the hierarchical model are similar to those from the linear model. There is a positive relationship between architectural area and household age (Age), and this relationship is significant in the sense that the 95% confidence interval does not include zero. It follows that people tend to live in larger houses as they become older. Thus, despite the number of imperfections in the Japanese property

markets (Hayashi et al. 1988, Deutsch et al. 2006, Harano et al. 2012, Nagayasu 2016), there is a strong tendency for people to change houses in different life stages.

However, this investigation based on Age does not provide complete information about the inverse-U relationship that suggests that the architectural area increases along with household age but declines when household heads become very old. In this regard, it is Age2 that contains additional information about the exact shape of this relationship; the theoretical relationship needs a negative parameter value for Age2 whereas that of Age may be insignificant in the full-sample analysis. As expected, we find that there is a negative relationship between Age2 and the architectural area (Table 7). It thus provides some favorable evidence for the inverse-U relationship. However, given that the coefficient of Age is positive and has a large impact on the dwelling size, our results give evidence of a very weak form of the inverse-U relationship, where the peak of the curve may correspond to the most senior group. To ensure that dwelling size is statistically smaller for the elderly and identify the turning point in life cycles, we analyze our data using the DID method.

5.2 Difference-in-Differences

The difference-in-differences (DID) has been widely used to analyze the effectiveness of public policies. An earlier pioneered work by a prominent epidemiologist (John Snow 1855) used the DID to identify sources of the cholera outbreak in London in 1854. He considered drinking contaminated water as the main source of the transmission and compared death rates in regions where water was provided by different companies. In economics, DID is used to study the effectiveness of public programs in labor, health and development economics, among many others. For example, Card and Krueger (1994) investigated the effect of minimum wage policies on employment in the USA.

In repeated cross-sectional data like ours, where we cannot trace the same households across surveys conducted in different periods, the DID serves as a useful statistical approach for investigating if residential size generally drops at a later stage of a life cycle. Here, we use young household groups as control groups that are expected to exhibit steady increases in architectural areas and use older households as treatment groups that are expected to reduce the residential size. However, unlike the application of a standard

DID, we do not have the exact information to classify households into two groups (e.g., experiment and control regions). Furthermore, since the timing of retirement may differ by individual households, we estimate the DID with different combinations of control and treatment groups using the recursive method.[10]

For household i, the determinants of architectural size (y_{ist}) can be studied using the DID with age group (AG) and time (Time) variables.

$$y_{ist} = \alpha + \gamma \mathrm{AG}_s + \lambda \mathrm{Time} + \delta(\mathrm{AG}_s * \mathrm{Time}) + \beta x_{it} + \epsilon_{ist} \tag{6}$$

where AG denotes the age group that classifies our observations into the control ($\mathrm{AG}_s = 0$) and treatment ($\mathrm{AG}_s = 1$) groups. As we are unfamiliar with the exact definition of young and old household groups, different combinations of control and treatment groups are considered by changing the threshold age (AG6 to AG11). The other explanatory variables are included in x_{it} that captures household-specific elements. Greek letters are the parameters that are estimated, and the residual $\epsilon_{ist} \sim N(0, \sigma^2)$. Time is a binary variable, with zero for 1994 observations and one for 2004. Initially, we study changes in the residential size between 1994 and 2004 since household decisions related to real estate normally take a long time. However, we also study changes in the residential size between 1994 and 1999 to check the robustness of our findings.

An examination of whether the dwelling size has declined after households reach a particular age can be performed through the parameter δ that summarizes the effectiveness of an intervention, which, in this study, is expected to occur due to retirement and the death of partners, among others. The negative δ indicates that older people live in relatively smaller houses. Conversely, when $\delta > 0$, it becomes evident that people have enlarged houses. The other parameters, γ and λ, measure differences in residential size between control and experimental groups and increases in residential size over time, respectively.

Table 8 summarizes ordinary least squares (OLS) estimates of the DID with robust standard errors. By using 1994 and 2004 observations, our results show that households started to reduce residential size when they reached the age of more than and equal to AG 8 (i.e., AG>7). AG8 denotes people aged between 55 and 59 years, which is considered

[10]We assume a parallel trend in the control and treatment groups before an intervention event like retirement. This assumption is reasonable because all the households live in the same (relatively homogeneous) country and period.

retirement age in many firms. Our results also provide evidence that households have a significant tendency to increase the residential size up to AG7 ($\delta > 0$), indicating that old households defined here still include many young households. This result is consistent with our previous analysis reported in Table 7.

Other determinants of dwelling size have expected signs. For example, wealthy and large families tend to live in large residences, other things being equal. Parameters of financial wealth variables (i.e., income, savings, and the number of workers) and family size are all positive and statistically significant. Furthermore, households in metropolitan areas and with female heads tend to live in smaller residences. These results remain the same even when we analyze changes in dwelling size in the observations in 1994 and 1999 (Table 8).

Finally, we check if our results are sensitive to residential places. Here, the exercise is conducted separately for metropolitan and non-metropolitan areas (Table 9), by dropping Metro in the specification used for Table 8. The results remain similar among regions; again, the evidence of a reduction in dwelling size is provided for the age of more than and equal to AG 8, in both regions. But, there is weak evidence that households in non-metropolitan areas, where residents have less access to medical facilities, shopping areas and public transportation, tend to reduce dwelling size earlier than those in metropolitan regions since their δ is already negative for threshold points, AG>5 and AG>6, although statistically insignificant.

Our overall conclusion of statistically significant but weak evidence to support the residential mobility of old households is consistent with the general view of post-war housing policies in Japan. After World War II, the government's priority was to accommodate the strong demand for housing of a large number of people. This strong demand was generated by baby booms, returnees from battlefields, and those who lost homes to aerial bombardment. To meet the demand, the Government Housing Loan Corporation (*Jutaku Kinyu Kouko*, 1950-2007) was established to provide long-term, low-interest rate housing loans to households. However, this scheme only targeted households in sound financial positions, and the poor and old were not often eligible for this scheme. Thus, the government provided pubic housing to very poor households, and the Japan Financing Corporation (*Nihon Jutaku Kodan*) was established in 1955 to help relatively poor households own

houses.[11]

In 1966, the government launched a 5-year plan to provide "houses for each household"; however, this plan was implemented largely by the efforts of private firms that considered providing houses to employees to attract good workers. Therefore, the poor and elderly were excluded from this government plan. Only in 1991 did the government recognize that housing policies should also target the elderly (Kose 1997). Our empirical finding of small adjustments in housing size suggests that such policy changes were inadequate to address the housing needs of th elderly during our sample period, and indeed, this has become a more acute socioeconomic problem today, as the number of retirees in Japan continues to increase.

6 Conclusion

Using the comprehensive survey data on household income, savings and social backgrounds, we identify typical characteristics of households according to residential type during the post-bubble period. Therefore, this paper provides some information related to residential demand factors. We find that households' financial positions and other economic factors are found to affect homeownership decisions in Japan. At the same time, we suggest that several social factors are relevant to deciding on a residential type, thereby confirming that decisions on homeownership are influenced by not only financial situations but also by the social backgrounds of households. Thus, taking into account previous studies focusing on the bubble period, the basic decision factors generally remain the same. However, unlike findings from other countries, we report that income has a significant influence over housing choice in Japan, and moreover, there was decline in gender differences in broad homeownership decisions during the economically depressed period.

Furthermore, despite several imperfections in the Japanese market, there is significant evidence that the Japanese change residences according to their needs in different stages of life. Residential sizes tend to increase with household age, particularly when a household is young; however, the pace of increase slows with age. Furthermore, although dwelling sizes reduce in the late life cycle, it remains larger than in most younger periods. Several

[11] It has been known as Urban Renaissance Agency (*Toshi Saise Kikou*) since 2004.

statistical specifications confirm this weak form of the hump-shaped relationship between household age and dwelling size. We discuss that this finding is consistent with post-war housing policies.

Such findings have important policy implications. As the Japanese society is rapidly aging and the population is declining, it is expected that the demand for medium-sized residences is going to be stronger in theory. In this regard, the government has implemented public policies focusing on housing elderly people in Japan since 1991 (e.g., Kose 1997), and directed to increase the number of newly built houses with barrier-free features. Nevertheless, given our finding of little reaction of the elderly to such policies during the lost decades, the demand for such properties may not become as strong as expected. Rather, the renovation of residences that meets the needs of the elderly should have a higher priority, rather than building new houses for them. Such a policy is more promising to reduce a mismatch between the demand and supply sides of the housing market, and in this area, public support can help to implement very effective housing policies in Japan. This implication is reinforced by weak economic recovery that does not seem to improve the financial status of most consumers in the foreseeable future. Finally, needless to say, as discussed in the Introduction, amendments to a legal framework related to real estates are urgent agendas for encouraging the transaction of owned houses and thereby facilitating increases in the mobility of retired people.

Appendix

Using the notations used in the main text, the probability of i choosing j can be expressed in the MNP framework as

$$Prob(v_{i1} \leq 0, \ldots, v_{iJ-1} \leq 0) = \frac{1}{(2\pi)^{\frac{(J-1)}{2}} |\Sigma|^{\frac{1}{2}}} \int_{-\infty}^{-\lambda_{i1}} \cdots \int_{-\infty}^{-\lambda_{iJ-1}} \exp\left(-\frac{1}{2} z' \Sigma^{-1} z\right) dz \quad (7)$$

We have used STATA to compute the MNP statistics, which use the Gaussian quadrature approximation for the integral in the above equation.

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Table 1: Summary statistics of key data

	Average	Std Err	Min	Max	Description
Residential type	1.656	1.461	1	7	1 (Own house) 2 (Renting from the private sector) 3 (Renting from local governments) 4 (Renting from public corporations(*Kodan*) or government agency(*Kosha*) 5 (Renting houses as employers (*Shataku* or *Komuinjutaku*)) 6 (Rented accommodation provided by companies) 7 (Renting share houses)
Architectural area	1113.624	516.8727	66	2000	
Age	6.893	2.837	0	14	0 (15-19 yrs old) 1 (20-24 yrs old) ... 14 (85 yrs old or above)
Income	716.829	418.913	1	2500	10000 yen
Family size	3.204	1.387	1	7	People
Saving	1395.721	1607.913	1	9500	10000 yen
No. of workers	0.459	0.498	0	1	0 (A household head is the only worker) 1 (There are more than one worker in a family)
Gender	0.107	0.309	0	1	0 (Male) 1 (Female)
Metro	0.413	0.492	0	1	0 (Non-metropolitan areas) 1 (Metropolitan areas)
Occupation	4.068	3.310	1	10	1 (Employees in private companies) 2 (Employees in the public sector) 3 (Merchants) 4 (Owners of private companies) 5 (Employees in agricultural forestry industries and fisheries) 6 (Owners of corporations) 7 (Self employed) 8 (Other occupations) 9 (No work) 10 (Family business)

Note: Statistics based on the 1999 Survey.

Table 2: The description of properties

Variable	Mean	Std Err	Mean	Std Err	Mean	Std Err	Description
	Full sample		Metropolitan		Non-metropolitan		
Year of establishment	1980.543	11.668	1981.561	11.146	1979.861	11.957	
Detached houses	0.739	0.439	0.636	0.481	0.811	0.391	0 (Non-detached houses) 1 (Detached houses)
Wooden houses	0.463	0.499	0.393	0.488	0.512	0.500	0 (Non-wooden houses) 1 (Wooden houses)
Flush toilet	0.859	0.348	0.942	0.233	0.800	0.400	0 (Dry toilet) 1 (Flush toilet)
Bath and/or shower	0.990	0.100	0.990	0.097	0.990	0.102	0 (No bath or shower) 1 (Bath and/or shower)
Gas with a pipeline	0.460	0.498	0.669	0.471	0.314	0.464	0 (No gas supplied by a pipeline) 1 (Gas supplied by a pipeline)

Note: Statistics based on the 1999 Survey.

Table 3: Financial positions of consumers by type of houses

Residential type (RT)	Variable	Mean	Std Dev	Min	Max
1. Own house	Income	773.520	438.016	1	2500
	Saving	1620.910	1710.479	1	9500
	Debt	582.624	966.064	0	4500
2. Renting from the private sector	Income	531.943	282.565	5	2500
	Saving	643.656	880.189	1	9500
	Debt	114.931	428.206	0	4500
3. Renting from local governments	Income	458.317	267.265	71	1218
	Saving	592.793	863.530	1	5000
	Debt	154.537	444.861	0	2750
4. Renting from public corporations	Income	426.067	218.114	16	1870
(*Kodan*) or government agency (*Kosha*)	Saving	535.394	681.734	1	7287
	Debt	67.885	247.639	0	3060
5. Renting houses as employers (*Shataku*	Income	603.936	298.354	50	2387
or *Komuinjutaku*)	Saving	951.394	1215.606	3	9500
	Debt	108.154	442.098	0	4500
6. Rented accommodation provided by	Income	729.747	309.952	92	2500
companies	Saving	1071.726	1173.398	3	9500
	Debt	214.725	598.476	0	4500
7. Renting share houses	Income	401.389	172.156	60	1287
	Saving	312.923	512.012	2	5500
	Debt	58.270	253.217	0	4500

Table 4: Household decisions on homeownership

Residential type (RT)	Coef 1994	Std Err	p-value	Coef 1999	Std Err	p-value	Coef 2004	Std Err	p-value
RT2									
Age	-0.254	0.005	0.000	-0.222	0.004	0.000	-0.220	0.004	0.000
Income	-0.875	0.030	0.000	-0.480	0.025	0.000	-0.418	0.026	0.000
Family size	-0.071	0.008	0.000	-0.125	0.007	0.000	-0.136	0.008	0.000
Saving	-0.063	0.010	0.000	-0.345	0.010	0.000	-0.341	0.010	0.000
No. of workers	-0.098	0.031	0.001	-0.137	0.027	0.000	-0.119	0.028	0.000
Gender	0.323	0.050	0.000	0.347	0.037	0.000	0.330	0.037	0.000
Metro	0.514	0.028	0.000	0.398	0.023	0.000	0.298	0.025	0.000
RT3									
Age	-0.321	0.017	0.000	-0.242	0.012	0.000	-0.279	0.013	0.000
Income	-0.480	0.098	0.000	-0.175	0.093	0.058	-0.410	0.086	0.000
Family size	-0.435	0.030	0.000	-0.681	0.035	0.000	-0.611	0.034	0.000
Saving	-0.012	0.032	0.709	-0.261	0.031	0.000	-0.151	0.033	0.000
No. of workers	-0.328	0.109	0.003	-0.243	0.104	0.019	-0.177	0.106	0.096
Gender	-0.059	0.134	0.660	-0.282	0.115	0.014	-0.380	0.123	0.002
Metro	-0.035	0.093	0.703	0.011	0.081	0.889	0.048	0.084	0.570
RT4									
Age	-0.236	0.006	0.000	-0.220	0.004	0.000	-0.209	0.004	0.000
Income	-0.976	0.036	0.000	-0.739	0.029	0.000	-0.698	0.030	0.000
Family size	-0.180	0.010	0.000	-0.209	0.009	0.000	-0.272	0.010	0.000
Saving	-0.039	0.013	0.002	-0.262	0.012	0.000	-0.252	0.012	0.000
No. of workers	-0.052	0.038	0.179	-0.098	0.033	0.003	-0.067	0.036	0.063
Gender	-0.050	0.060	0.400	-0.059	0.044	0.188	-0.014	0.044	0.747
Metro	0.032	0.035	0.373	-0.027	0.029	0.349	-0.059	0.032	0.063
RT5									
Age	-0.255	0.008	0.000	-0.256	0.006	0.000	-0.225	0.006	0.000
Income	-0.427	0.052	0.000	-0.229	0.041	0.000	-0.333	0.044	0.000
Family size	-0.369	0.015	0.000	-0.390	0.013	0.000	-0.498	0.016	0.000
Saving	-0.041	0.017	0.016	-0.139	0.017	0.000	-0.153	0.017	0.000
No. of workers	-0.268	0.052	0.000	-0.185	0.042	0.000	-0.137	0.051	0.007
Gender	-0.468	0.095	0.000	-0.178	0.062	0.004	-0.265	0.064	0.000
Metro	0.736	0.048	0.000	0.869	0.038	0.000	0.638	0.043	0.000
RT6									
Age	-0.275	0.006	0.000	-0.283	0.005	0.000	-0.283	0.006	0.000
Income	0.078	0.040	0.050	0.260	0.040	0.000	0.406	0.044	0.000
Family size	-0.038	0.009	0.000	-0.064	0.009	0.000	-0.120	0.011	0.000
Saving	-0.032	0.012	0.008	-0.110	0.016	0.000	-0.086	0.017	0.000
No. of workers	-0.726	0.037	0.000	-0.729	0.035	0.000	-0.629	0.040	0.000
Gender	-0.295	0.078	0.000	-0.338	0.070	0.000	-0.320	0.075	0.000
Metro	0.243	0.033	0.000	0.184	0.030	0.000	0.061	0.035	0.085
RT7									
Age	-0.422	0.016	0.000	-0.308	0.009	0.000	-0.301	0.009	0.000
Income	-1.485	0.072	0.000	-0.512	0.057	0.000	-0.433	0.061	0.000
Family size	-0.586	0.032	0.000	-0.703	0.023	0.000	-0.691	0.026	0.000
Saving	0.041	0.026	0.121	-0.485	0.020	0.000	-0.400	0.021	0.000
No. of workers	-0.418	0.119	0.000	-0.726	0.089	0.000	-0.531	0.090	0.000
Gender	0.006	0.099	0.954	-0.224	0.074	0.002	-0.145	0.077	0.060
Metro	1.190	0.076	0.000	1.234	0.053	0.000	1.055	0.058	0.000

Note: Based on year 1994, 1999 and 2004. The dependent variable is residential type.

Table 5: Marginal effects from the multinominal probit (MNP) model

Residential type (RT)	Coef 1994	Std Err	p-value	Coef 1999	Std Err	p-value	Coef 2004	Std Err	p-value
RT1									
Age	0.055	0.001	0.000	0.047	0.001	0.000	0.038	0.000	0.000
Income	0.135	0.005	0.000	0.077	0.004	0.000	0.061	0.003	0.000
Family size	0.024	0.001	0.000	0.033	0.001	0.000	0.034	0.001	0.000
Saving	0.010	0.002	0.000	0.052	0.002	0.000	0.045	0.001	0.000
No. of workers	0.056	0.005	0.000	0.047	0.004	0.000	0.031	0.004	0.000
Gender	-0.006	0.009	0.501	-0.015	0.006	0.018	-0.017	0.005	0.001
Metro	-0.077	0.005	0.000	-0.060	0.004	0.000	-0.035	0.003	0.000
RT2									
Age	-0.025	0.001	0.000	-0.020	0.000	0.000	-0.019	0.000	0.000
Income	-0.099	0.004	0.000	-0.050	0.003	0.000	-0.039	0.003	0.000
Family size	-0.005	0.001	0.000	-0.010	0.001	0.000	-0.010	0.001	0.000
Saving	-0.007	0.001	0.000	-0.037	0.001	0.000	-0.033	0.001	0.000
No. of workers	-0.002	0.004	0.661	-0.009	0.003	0.005	-0.008	0.003	0.004
Gender	0.047	0.006	0.000	0.045	0.004	0.000	0.037	0.004	0.000
Metro	0.058	0.003	0.000	0.042	0.003	0.000	0.029	0.002	0.000
RT3									
Age	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Income	-0.001	0.000	0.017	0.000	0.000	0.786	-0.001	0.000	0.001
Family size	-0.001	0.000	0.000	-0.001	0.000	0.000	-0.001	0.000	0.000
Saving	0.000	0.000	0.811	0.000	0.000	0.000	0.000	0.000	0.084
No. of workers	-0.001	0.000	0.053	0.000	0.000	0.192	0.000	0.000	0.343
Gender	0.000	0.000	0.674	-0.001	0.000	0.016	-0.001	0.000	0.003
Metro	-0.001	0.000	0.053	0.000	0.000	0.151	0.000	0.000	0.694
RT4									
Age	-0.010	0.000	0.000	-0.010	0.000	0.000	-0.008	0.000	0.000
Income	-0.054	0.002	0.000	-0.043	0.002	0.000	-0.034	0.002	0.000
Family size	-0.010	0.001	0.000	-0.011	0.001	0.000	-0.012	0.001	0.000
Saving	-0.002	0.001	0.050	-0.013	0.001	0.000	-0.010	0.001	0.000
No. of workers	0.003	0.002	0.209	-0.001	0.002	0.571	-0.001	0.002	0.763
Gender	-0.004	0.004	0.300	-0.005	0.003	0.048	-0.002	0.002	0.358
Metro	-0.007	0.002	0.003	-0.009	0.002	0.000	-0.007	0.002	0.000
RT5									
Age	-0.004	0.000	0.000	-0.005	0.000	0.000	-0.003	0.000	0.000
Income	-0.005	0.001	0.000	-0.003	0.001	0.012	-0.004	0.001	0.000
Family size	-0.008	0.000	0.000	-0.010	0.000	0.000	-0.009	0.000	0.000
Saving	-0.001	0.000	0.144	-0.001	0.000	0.002	-0.001	0.000	0.000
No. of workers	-0.004	0.001	0.001	-0.003	0.001	0.014	-0.001	0.001	0.126
Gender	-0.012	0.002	0.000	-0.006	0.002	0.001	-0.006	0.001	0.000
Metro	0.016	0.001	0.000	0.023	0.001	0.000	0.012	0.001	0.000
RT6									
Age	-0.015	0.000	0.000	-0.011	0.000	0.000	-0.007	0.000	0.000
Income	0.024	0.003	0.000	0.020	0.002	0.000	0.018	0.001	0.000
Family size	0.000	0.001	0.711	0.000	0.000	0.505	-0.002	0.000	0.000
Saving	-0.001	0.001	0.141	-0.001	0.001	0.112	0.000	0.001	0.719
No. of workers	-0.052	0.003	0.000	-0.034	0.002	0.000	-0.020	0.001	0.000
Gender	-0.025	0.006	0.000	-0.019	0.003	0.000	-0.012	0.002	0.000
Metro	0.010	0.002	0.000	0.004	0.001	0.003	0.000	0.001	0.894
RT7									
Age	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Income	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Family size	0.000	0.000	0.000	-0.001	0.000	0.000	-0.001	0.000	0.000
Saving	0.000	0.000	0.045	0.000	0.000	0.000	0.000	0.000	0.000
No. of workers	0.000	0.000	0.026	-0.001	0.000	0.000	-0.001	0.000	0.000
Gender	0.000	0.000	0.887	0.000	0.000	0.003	0.000	0.000	0.038
Metro	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000

Note: See Table 4.

Table 6: Owing or renting a house

	Coef 1994	Std Err	p-value	Coef 1999	Std Err	p-value	Coef 2004	Std Err	p-value
Probit estimation									
Age	-0.256	0.005	0.000	-0.202	0.004	0.000	-0.189	0.004	0.000
Income	-0.504	0.021	0.000	-0.394	0.017	0.000	-0.361	0.018	0.000
Family size	-0.271	0.008	0.000	-0.233	0.007	0.000	-0.241	0.008	0.000
Saving	-0.031	0.006	0.000	-0.186	0.007	0.000	-0.194	0.007	0.000
No. of workers	-0.261	0.020	0.000	-0.213	0.017	0.000	-0.165	0.019	0.000
Gender	-0.126	0.035	0.000	-0.027	0.026	0.287	-0.005	0.025	0.849
Metro	0.149	0.019	0.000	0.184	0.015	0.000	0.126	0.016	0.000
Mortgage rate	0.474	0.012	0.000	0.581	0.016	0.000	0.496	0.018	0.000
Occupation									
2. Employees in the public sector	0.020	0.024	0.409	0.003	0.020	0.884	0.064	0.022	0.004
3. Merchants	-0.145	0.027	0.000	-0.068	0.027	0.011	0.037	0.029	0.193
4. Owners of private companies	-0.248	0.097	0.010	-0.328	0.031	0.000	-0.223	0.033	0.000
5. Employees in agricultural forestry industries and fisheries	-1.415	0.140	0.000	-0.056	0.088	0.523	-0.071	0.091	0.437
6. Owners of corporations	-0.220	0.060	0.000	-1.391	0.105	0.000	-1.066	0.099	0.000
7. Self employed	-0.385	0.086	0.000	-0.143	0.056	0.010	-0.071	0.063	0.256
8. Other occupations	-0.458	0.245	0.062	-0.109	0.072	0.128	0.070	0.071	0.323
9. No work	0.032	0.108	0.767	-0.128	0.076	0.094	-0.169	0.089	0.059
10. Family business	-0.337	0.044	0.000	-0.313	0.031	0.000	-0.187	0.032	0.000
Constant	1.958	0.050	0.000	1.398	0.040	0.000	1.178	0.042	0.000
Marginal effect									
Age	-0.071	0.001	0.000	-0.053	0.001	0.000	-0.043	0.001	0.000
Income	-0.140	0.006	0.000	-0.102	0.004	0.000	-0.081	0.004	0.000
Family size	-0.075	0.002	0.000	-0.060	0.002	0.000	-0.054	0.002	0.000
Saving	-0.009	0.002	0.000	-0.048	0.002	0.000	-0.044	0.002	0.000
No. of workers	-0.072	0.005	0.000	-0.055	0.005	0.000	-0.037	0.004	0.000
Gender	-0.035	0.010	0.000	-0.007	0.007	0.287	-0.001	0.006	0.849
Metro	0.041	0.005	0.000	0.048	0.004	0.000	0.028	0.004	0.000
Mortgage rate	0.131	0.004	0.000	0.151	0.004	0.000	0.112	0.004	0.000
Occupation									
2. Employees in the public sector	0.006	0.007	0.408	0.001	0.006	0.884	0.016	0.006	0.004
3. Merchants	-0.042	0.008	0.000	-0.020	0.008	0.010	0.009	0.007	0.196
4. Owners of private companies	-0.069	0.024	0.004	-0.084	0.008	0.000	-0.049	0.007	0.000
5. Employees in agricultural forestry industries and fisheries	-0.218	0.008	0.000	-0.016	0.025	0.514	-0.017	0.021	0.421
6. Owners of corporations	-0.062	0.016	0.000	-0.205	0.006	0.000	-0.143	0.006	0.000
7. Self employed	-0.101	0.019	0.000	-0.040	0.015	0.007	-0.017	0.014	0.242
8. Other occupations	-0.116	0.049	0.018	-0.031	0.020	0.112	0.018	0.019	0.338
9. No work	0.010	0.034	0.769	-0.036	0.020	0.078	-0.038	0.018	0.039
10. Family business	-0.090	0.011	0.000	-0.081	0.008	0.000	-0.042	0.007	0.000

Note: The dependent variable is binary and equal to "0" for homeowners and "1" for borrowers.

Table 7: The determinants of the size of residence

	Mean	Std. Dev.	MCSE	Median	95% confidence interval	
Standard linear model						
Age	0.166	0.001	0.000	0.166	0.163	0.169
Age2	-0.007	0.000	0.000	-0.007	-0.007	-0.006
Income	0.139	0.003	0.000	0.139	0.134	0.144
Family size	0.112	0.001	0.000	0.112	0.110	0.114
Saving	0.047	0.001	0.000	0.047	0.045	0.049
No. of workers	0.044	0.003	0.000	0.043	0.038	0.049
Gender	-0.020	0.004	0.000	-0.020	-0.029	-0.012
Metro	-0.221	0.002	0.000	-0.221	-0.225	-0.216
Constant	5.818	0.004	0.001	5.819	5.810	5.826
sigma2	0.196	0.001	0.000	0.196	0.194	0.197
Hierarchical model						
Age	0.167	0.002	0.000	0.167	0.163	0.172
Age2	-0.007	0.000	0.000	-0.007	-0.007	-0.007
Income	0.137	0.003	0.000	0.137	0.131	0.142
Family size	0.115	0.001	0.000	0.115	0.113	0.117
Saving	0.048	0.001	0.000	0.048	0.046	0.050
No. of workers	0.042	0.003	0.000	0.042	0.037	0.048
Gender	-0.021	0.005	0.000	-0.021	-0.030	-0.012
Metro	-0.219	0.003	0.000	-0.219	-0.224	-0.214
Constant	5.871	0.059	0.010	5.862	5.779	5.998
1994	-0.114	0.058	0.010	-0.105	-0.244	-0.024
1999	-0.060	0.058	0.010	-0.050	-0.188	0.030
2004	-0.022	0.058	0.010	-0.012	-0.151	0.068
U0:sigma2	0.044	0.186	0.004	0.017	0.003	0.222
sigma2	0.195	0.001	0.000	0.195	0.193	0.196

Note: The dependent variable is residential size, and the MCSE is the Monte Carlo standard error. Estimated by the Gibbs sampling method.

Table 8: Difference-in-differences

	Coef.	Std. Err.	p-value	Coef.	Std. Err.	p-value	Coef.	Std. Err.	p-value
1994 → 2004	AG>5	Robust		AG>6			AG>7		
AG	0.319	0.006	0.000	0.318	0.006	0.000	0.338	0.007	0.000
Time	0.192	0.006	0.000	0.183	0.005	0.000	0.193	0.004	0.000
AG*Time	0.004	0.007	0.561	0.008	0.007	0.284	-0.044	0.008	0.000
Metro	-0.232	0.004	0.000	-0.234	0.004	0.000	-0.232	0.004	0.000
Gender	-0.016	0.007	0.017	0.001	0.007	0.896	-0.002	0.007	0.738
Family size	0.119	0.002	0.000	0.119	0.002	0.000	0.110	0.002	0.000
Income	0.158	0.004	0.000	0.179	0.004	0.000	0.179	0.004	0.000
Saving	0.050	0.001	0.000	0.052	0.001	0.000	0.060	0.001	0.000
No. of workers	0.044	0.004	0.000	0.068	0.004	0.000	0.085	0.004	0.000
Constant	6.291	0.009	0.000	6.325	0.008	0.000	6.383	0.008	0.000
	AG>8			AG>9			AG>10		
AG	0.356	0.007	0.000	0.331	0.009	0.000	0.302	0.013	0.000
Time	0.195	0.004	0.000	0.182	0.004	0.000	0.167	0.004	0.000
AG*Time	-0.098	0.009	0.000	-0.109	0.012	0.000	-0.138	0.018	0.000
Metro	-0.233	0.004	0.000	-0.237	0.004	0.000	-0.240	0.004	0.000
Gender	-0.011	0.007	0.121	-0.023	0.007	0.001	-0.033	0.007	0.000
Family size	0.099	0.002	0.000	0.090	0.002	0.000	0.084	0.002	0.000
Income	0.176	0.004	0.000	0.165	0.004	0.000	0.156	0.004	0.000
Saving	0.067	0.001	0.000	0.072	0.001	0.000	0.074	0.001	0.000
No. of workers	0.089	0.004	0.000	0.084	0.004	0.000	0.077	0.004	0.000
Constant	6.448	0.008	0.000	6.519	0.008	0.000	6.572	0.007	0.000
1994 → 1999	AG>5			AG>6			AG>7		
AG	0.323	0.006	0.000	0.328	0.006	0.000	0.352	0.007	0.000
Time	0.096	0.006	0.000	0.093	0.005	0.000	0.096	0.004	0.000
AG*Time	0.026	0.007	0.000	0.029	0.007	0.000	0.018	0.008	0.021
Metro	-0.240	0.004	0.000	-0.241	0.004	0.000	-0.238	0.004	0.000
Gender	-0.017	0.007	0.016	0.008	0.007	0.265	0.027	0.007	0.000
Family size	0.126	0.002	0.000	0.131	0.002	0.000	0.122	0.002	0.000
Income	0.146	0.004	0.000	0.174	0.004	0.000	0.206	0.004	0.000
Saving	0.057	0.002	0.000	0.056	0.002	0.000	0.058	0.002	0.000
No. of workers	0.037	0.004	0.000	0.057	0.004	0.000	0.091	0.004	0.000
Constant	6.271	0.009	0.000	6.289	0.008	0.000	6.332	0.008	0.000
	AG>8			AG>9			AG>10		
AG	0.377	0.007	0.000	0.353	0.009	0.000	0.321	0.013	0.000
Time	0.108	0.004	0.000	0.106	0.004	0.000	0.099	0.004	0.000
AG*Time	-0.033	0.009	0.000	-0.050	0.011	0.000	-0.062	0.016	0.000
Metro	-0.240	0.004	0.000	-0.246	0.004	0.000	-0.252	0.004	0.000
Gender	0.022	0.007	0.003	0.002	0.007	0.756	-0.011	0.008	0.145
Family size	0.110	0.002	0.000	0.098	0.002	0.000	0.091	0.002	0.000
Income	0.205	0.004	0.000	0.187	0.004	0.000	0.170	0.004	0.000
Saving	0.067	0.002	0.000	0.076	0.002	0.000	0.082	0.002	0.000
No. of workers	0.107	0.004	0.000	0.103	0.004	0.000	0.093	0.004	0.000
Constant	6.396	0.008	0.000	6.477	0.008	0.000	6.540	0.007	0.000

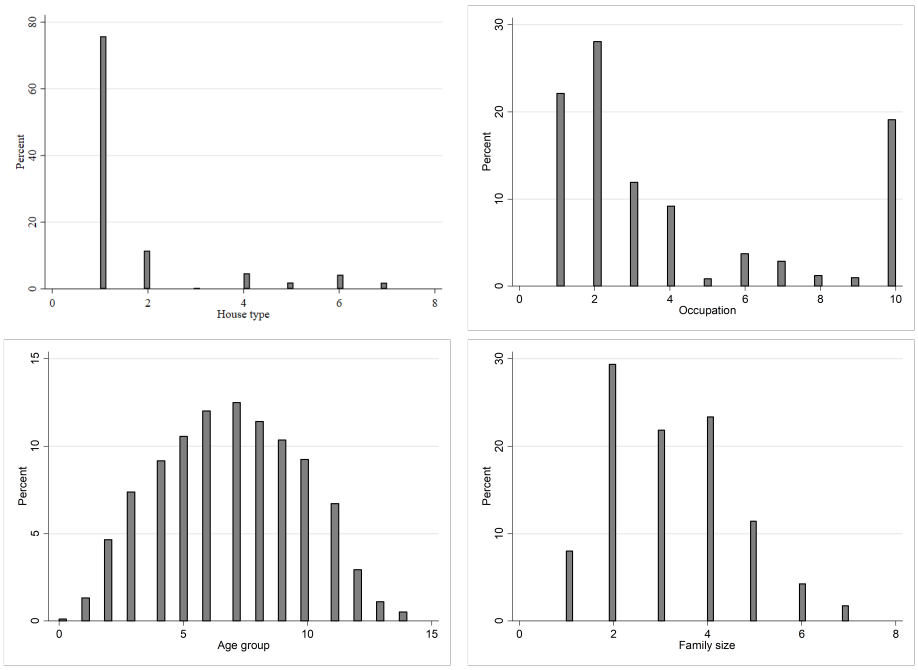
Note: The difference-in-differences estimation results for 1994 & 2004 and 1994 & 1999. The heading, AG>5, indicates the treatment group (elder people), and the control group is AG≤5 (younger people) in this example. The robust standard error (Std. Err.) is reported.

Table 9: Difference-in-differences (Metro vs. Non metropolitan areas)

1994 → 2004	Coef.	Std. Err.	p-value	Coef.	Std. Err.	p-value	Coef.	Std. Err.	p-value
1) Metro	AG>5			AG>6			AG>7		
AG	0.319	0.009	0.000	0.326	0.010	0.000	0.359	0.011	0.000
Time	0.201	0.009	0.000	0.194	0.007	0.000	0.210	0.007	0.000
AG*Time	0.025	0.012	0.034	0.032	0.012	0.007	-0.026	0.013	0.046
Gender	0.014	0.011	0.233	0.034	0.012	0.003	0.033	0.012	0.004
Family size	0.147	0.003	0.000	0.152	0.003	0.000	0.145	0.003	0.000
Income	0.176	0.006	0.000	0.197	0.006	0.000	0.196	0.006	0.000
Saving	0.049	0.002	0.000	0.051	0.002	0.000	0.061	0.002	0.000
No. of workers	0.004	0.006	0.507	0.025	0.006	0.000	0.047	0.006	0.000
Constant	5.970	0.014	0.000	5.984	0.013	0.000	6.029	0.013	0.000
	AG>8			AG>9			AG>10		
AG	0.397	0.012	0.000	0.384	0.015	0.000	0.381	0.022	0.000
Time	0.216	0.006	0.000	0.205	0.006	0.000	0.190	0.006	0.000
AG*Time	-0.103	0.015	0.000	-0.130	0.020	0.000	-0.176	0.032	0.000
Gender	0.024	0.012	0.047	0.015	0.012	0.208	0.005	0.012	0.656
Family size	0.133	0.003	0.000	0.122	0.003	0.000	0.114	0.003	0.000
Income	0.194	0.006	0.000	0.183	0.006	0.000	0.175	0.006	0.000
Saving	0.069	0.002	0.000	0.075	0.002	0.000	0.078	0.002	0.000
No. of workers	0.057	0.006	0.000	0.054	0.006	0.000	0.047	0.006	0.000
Constant	6.097	0.013	0.000	6.169	0.012	0.000	6.224	0.012	0.000
2) Non-metro	AG>5			AG>6			AG>7		
AG	0.315	0.008	0.000	0.311	0.008	0.000	0.325	0.008	0.000
Time	0.183	0.007	0.000	0.174	0.006	0.000	0.181	0.006	0.000
AG*Time	-0.004	0.010	0.649	-0.003	0.009	0.726	-0.053	0.010	0.000
Gender	-0.033	0.008	0.000	-0.018	0.008	0.036	-0.023	0.009	0.008
Family size	0.101	0.002	0.000	0.099	0.002	0.000	0.088	0.002	0.000
Income	0.145	0.005	0.000	0.164	0.005	0.000	0.166	0.005	0.000
Saving	0.050	0.002	0.000	0.052	0.002	0.000	0.060	0.002	0.000
No. of workers	0.075	0.005	0.000	0.102	0.005	0.000	0.115	0.005	0.000
Constant	6.346	0.011	0.000	6.389	0.010	0.000	6.454	0.010	0.000
	AG>8			AG>9			AG>10		
AG	0.331	0.009	0.000	0.297	0.011	0.000	0.253	0.016	0.000
Time	0.181	0.005	0.000	0.166	0.005	0.000	0.151	0.005	0.000
AG*Time	-0.094	0.011	0.000	-0.094	0.014	0.000	-0.114	0.022	0.000
Gender	-0.031	0.009	0.000	-0.046	0.009	0.000	-0.055	0.009	0.000
Family size	0.079	0.002	0.000	0.071	0.002	0.000	0.065	0.002	0.000
Income	0.162	0.005	0.000	0.151	0.005	0.000	0.141	0.005	0.000
Saving	0.065	0.002	0.000	0.069	0.002	0.000	0.072	0.002	0.000
No. of workers	0.116	0.005	0.000	0.109	0.005	0.000	0.101	0.005	0.000
Constant	6.518	0.009	0.000	6.586	0.009	0.000	6.636	0.009	0.000

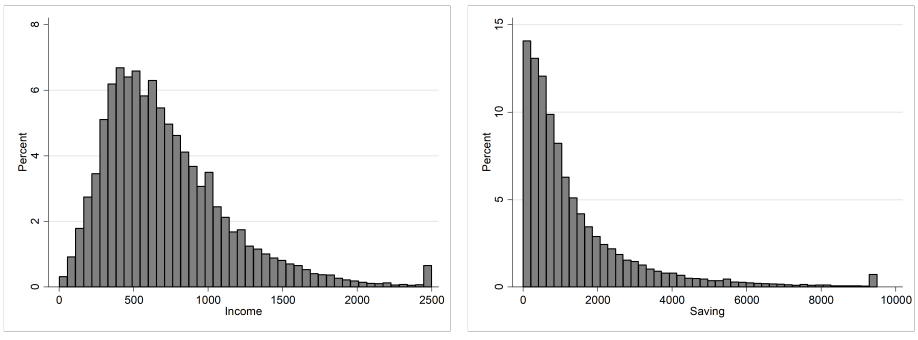
Note: The difference-in-differences estimation results for 1994 & 2004 and 1994 & 1999. The heading, AG>5, indicates the treatment group (elder people), and the control group is AG≤5 (younger people) in this example. The robust standard error (Std. Err.) is reported.

Figure 1: Histogram of key variables



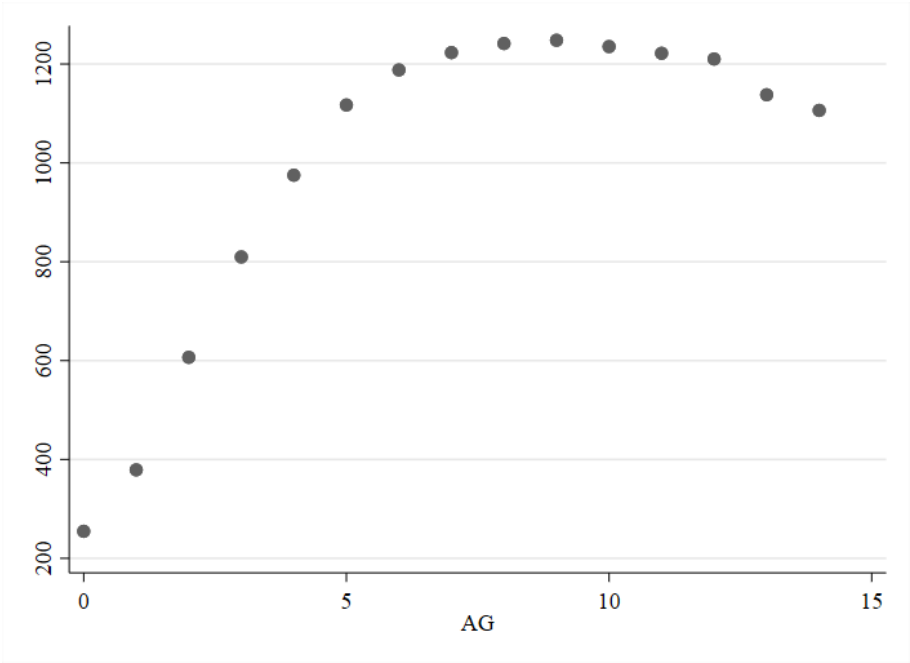
Note: Statistics based on the 1999 survey.

Figure 2: Histogram of income and saving



Note: Statistics based on 1999.

Figure 3: Average residential size



Note: The average dwelling size of each age group based on all three year observations.

Figure 4: MCMC results

Figure 5: MCMC results, Continued