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Health and home ownership: Findings for the case of Japan

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Health and Home Ownership: Findings for the Case of Japan

Toshiaki Aizawa and
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Abstract

The research objective of this paper is to test whether health conditions and health behavior are related to home ownership. This question has not yet been examined quantitatively in the existing literature. Our estimation results show that homeowners consistently report better health and less physical problems. The significance of home ownership remains even after controlling for financial assets and housing conditions. Furthermore, our estimations indicate that homeowners invest more in their future health by undergoing voluntarily medical screenings more frequently. Finally, our estimations suggest that home ownership is positively correlated with health care expenditure even when controlling for income, debt, and other financial assets and we could not reject the exogeneity of home ownership. Our empirical results thus provide evidence for the importance of home ownership for health.

JEL Classification: I12, I15

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1. INTRODUCTION

In a rapidly urbanizing Asia, housing policy is becoming a key concern for many governments in the region. Despite sustained economic growth, a large number of people in Asia, especially in South Asia and Southeast Asia, are still living in poor housing conditions. Many governments have therefore launched various programs to enhance access to affordable and adequate housing. Improved housing enhances human welfare in general and has particular benefits for health. A large body of empirical literature has established a clear link between poor housing conditions and poor health.¹ A link which has not been studied empirically is the relationship between home ownership and health. Several studies have shown home ownership to have a positive effect on social cohesion and the educational achievements of children.² However, we still lack quantitative evidence of the link between home ownership and health. This paper attempts to close this gap by providing evidence for the case of Japan.

Our study is based on data collected by the Keio Household Panel Survey (KHPS).³ This survey has been undertaken since 2004 and covers a wide range of socioeconomic data. In this paper, we benefit from this in-depth survey to study the link between home ownership and health. We find that homeowners report feeling healthier compared to renters, even after controlling for individual characteristics, such as income, as well as housing conditions. Our results further indicate that homeowners are more likely to undergo preventive care and to have higher health spending.

The structure of this paper is as follows: Section 2 briefly overviews relevant literature and Section 3 introduces a theoretical framework of health and home ownership. Section 4 introduces the KHPS data and the main variables used in our regression analyses. Section 5 presents the descriptive statistics of these variables and briefly discusses the differences in health conditions, medical expenditures, and financial status between home owners and renters. In Section 6, we explain the various methods used for our estimations. Section 7 presents the regression results and our interpretation. Section 8 states some limitations of the study before concluding.

2. BRIEF OVERVIEW OF THE LITERATURE

The relationship between home ownership and health has not yet been tested empirically. However, in the literature we find important guidance for approaching our research question.

First, a large body of literature has dealt with the link between the quality of housing and health outcomes. This relationship is particularly obvious in the case of developing countries. Poor housing conditions typically mean high levels of indoor air pollution as well as bad hydrothermal conditions (not ideal levels of humidity and temperature), which translate into high risks of developing a range of diseases. In addition, poor housing often lacks of fresh water supply and sanitary facilities. As a consequence, human health suffers on many fronts, with more frequent cases of respiratory diseases,

¹ See Thomson, Sellström, and Petticrew (2013) for a systematic review.

² DiPasquale and Glaeser (1999) on social cohesion; Haurin et al. (2001) on cognitive test scores of children of homeowners.

³ The KHPS data for this paper was provided by the Panel Data Research Center at Keio University.

hypothermia, and other physical and psychological problems. Poor sanitation also leads to a higher risk of contracting infectious diseases.

A number of studies have demonstrated quantitatively the link between poor housing and poor health in developing countries. For example, Nayar (1997) shows that in the case of India, improved sanitary facilities had a positive effect on health conditions. Another example is Wolff, Schroeder, and Young (2001) who find that improved housing conditions in Northern Malawi significantly reduced the burden of respiratory and gastrointestinal diseases and malaria among children under 5 years old. However, the link between poor housing and health is not limited to the context of developing countries. Many studies have demonstrated the link in advanced countries. As early as in 1975, Carp (1975) identified a positive relationship between the improvement of housing environments and high life satisfaction and morale in the United States (US). Martin, Platt, and Hunt (1987) show that for the case of Edinburgh, children living in damp houses had higher rates of respiratory symptoms and stress. Blackman and Harvey (2001) study the mental health conditions of residents. The authors find evidence of an improvement in mental health conditions after a neighborhood renewal in northeast England in the 1990s.⁴ Breysse et al. (2004) conclude that there is a positive relation between improved housing conditions and the health of children for the case of the US.⁵

Overall, we have strong evidence that improved housing conditions lead to improved health outcomes, irrespective of the stage of development. In an early stage of development, improved housing conditions seem to have a strong influence on both physical and mental well-being. In more advanced economies the benefits come mostly in terms of mental health.

Second, a rather small number of empirical papers have investigated the potential positive impact of home ownership on various socioeconomic indicators. For example, a number of studies have compared the educational achievements of children of homeowners and renters. Green and White (1996) found that children of homeowners are less likely to drop out of school. Haurin, Parcel, and Haurin (2001) discover a positive relationship between home ownership and the cognitive test scores of children as well as fewer behavioral problems compared to the children of renters. Another set of papers has studied the possibility of positive social externalities of home ownership. Most prominently, DiPasquale and Glaeser (1999) found a causal relationship between home ownership and a higher incentive to invest in local amenities and social capital, using an instrumental variables strategy and controlling for individual fixed effects. The authors attribute these higher incentives to the fact that home ownership creates barriers to mobility. Aaronson (2000) addresses the possibility that home ownership could be endogenous and uses a corresponding instrumental variable approach. However, the empirical results reject the hypothesis that home ownership does not have a positive effect on social investment.

For Japan, the relationship between housing conditions or home ownership and socioeconomic outcomes has not been tested yet. One study by Takano and Nakamura (2001) is, however, related, as it investigates the various health outcomes across Japanese cities due to differences in their health and health-related infrastructure, such as the number of hospitals per capita. The authors find that a

⁴ One of the earliest study on the link between housing conditions and mental health is Hopton and Hunt (1979) for the case of Scotland.

⁵ For more discussions on health and housing conditions, see Lowry (1990); Hopton and Hunt (1996); Iversen, Bach, and Lundqvist (1986); Carp (1977); Thomson, Petticrew, and Morrison (2001).

quarter of the variability in health conditions in Japan can be attributed to these differences between cities.

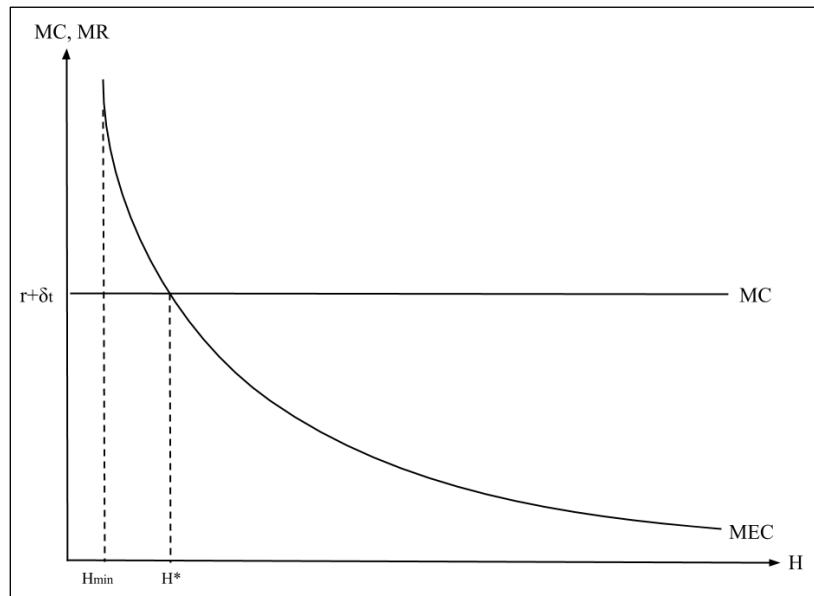
To our knowledge, this paper is the first attempt to estimate quantitatively the impact of home ownership on health. In the next section we present a simple theoretical model to conceptualize our main hypothesis.

3. ECONOMIC THEORY

The seminal model by Grossman (1972) illustrates the effects of schooling on the production of health and on the demand for health. Grossman argues that health can be viewed as one form of human capital and people invest in their health. The marginal cost for the investment in health is determined by two factors. First is the interest rate, r . Money spent on health investment could be used for savings instead, and therefore the interest rate can be interpreted as the marginal opportunity cost of the investment. Second, the depreciation rate of the health stock in every period is defined as δ_t . The depreciation of the health stock is assumed to increase as people become older.

In the Grossman (1972) model people choose their optimal investment in their health capital by equating the marginal return of the health stock investment to the price of investment, that is, $MR = r + \delta_t$, at every stage. Because of diminishing returns to scale, the marginal efficiency of investment curve (MEC) is downward sloping. The marginal cost for the investment, $r + \delta_t$, is assumed to be independent of the stock level of health, H_t but dependent on age, t , through the depreciation rate. As people become older, the depreciation rate becomes higher ($\delta_{j+1} > \delta_j, \forall j$) and their optimal health level becomes lower. Death comes when the optimal stock drops below a certain level, H_{min} . Figure 1 illustrates the downward sloping MEC curve as well as the optimal and minimum health stock.

Figure 1: The Optimal and Minimum Health Stock

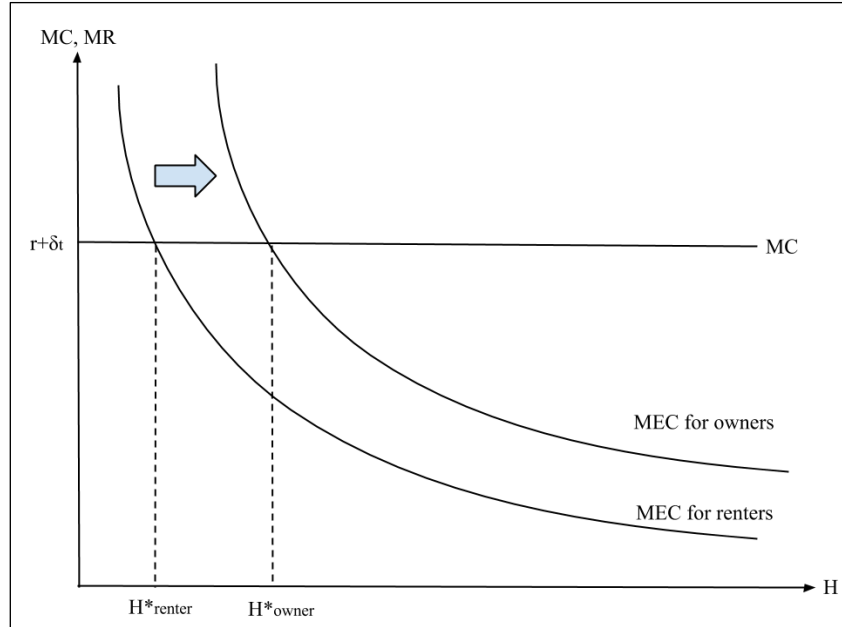


H = stock of health, MC = marginal cost, MR = marginal return, MEC = marginal efficiency of investment curve.

Source: Authors.

Grossman's model predicts that if education improves the efficiency with which health is produced, then more educated people demand a higher optimal stock of health. In Figure 2 the improvement of efficiency can be described as a shift of the MEC curve to the right. The new optimal stock of health is determined at the new point where the marginal return of the investment equals the marginal cost of the investment.

Figure 2 : Improvement of the Environment and the Health Stock



H = stock of health, MC = marginal cost, MR = marginal return, MEC = marginal efficiency of investment curve.

Source: Authors.

Following the same logic, we will extend the health investment model and analyze the effect of home ownership. We assume living in one's own house improves the environmental condition, E , in which health is produced from the fact that homeowners invest more in better social capital and local amenities (DiPasquale and Glaeser 1999) and enjoy external private benefits (Rossi and Weber 1996). According to Grossman (1972: 225), "the production function also depends on certain 'environmental variables.'" We therefore assume that the improvement of environmental conditions enhances the efficiency of health production. As for education in the original model, the improvement of environmental conditions shifts the MEC curve to the right. As a result, homeowners have higher demand for health: $H_{owner,t}^* > H_{renter,t}^*$.

Grossman (1972) shows that the percentage increase in the amount of health demanded for a one-unit increase in E can be expressed as:

$$\hat{H} = r_h \cdot \varepsilon \quad (1)$$

Where r_h is the percentage change in gross investment supplied to a consumer by a one-unit change in E , $r_h = \frac{\partial I}{\partial E} \frac{1}{I}$, and ε is the elasticity of the MEC schedule, $\varepsilon = -\frac{\partial \ln H_t}{\partial \ln(r+\delta_t)}$. Under the assumption that r_h is positive, \hat{H} becomes positive.

The improvement of environmental conditions thus increases the health stock demanded. However, it does not necessarily mean that homeowners spend more on health care. This is because their efficiency is now higher and thus the inputs necessary to achieve the optimal health stock are not necessarily higher than those

invested by renters. In other words, the efficiency gained by the environmental improvements enables homeowners to produce a certain level of health with fewer inputs.

Grossman (1972) also shows the percentage increase in the amount of medical expenditure as:

$$\hat{M} = r_h(\varepsilon - 1) \quad (2)$$

In short, equations (1) and (2) imply that improvement in environmental conditions increases the health stock demanded. However, whether improvement in environmental conditions leads to higher medical expenditure depends on ε . If and only if ε is larger than 1, will people spend more on health care services. For more details and derivations of equations (1) and (2), see Grossman (1972).

The purpose of our paper is to verify the prediction of Grossman's model: Do homeowners have a higher health stock? Do homeowners have higher medical expenditures compared to renters even when controlling for their income and financial assets?

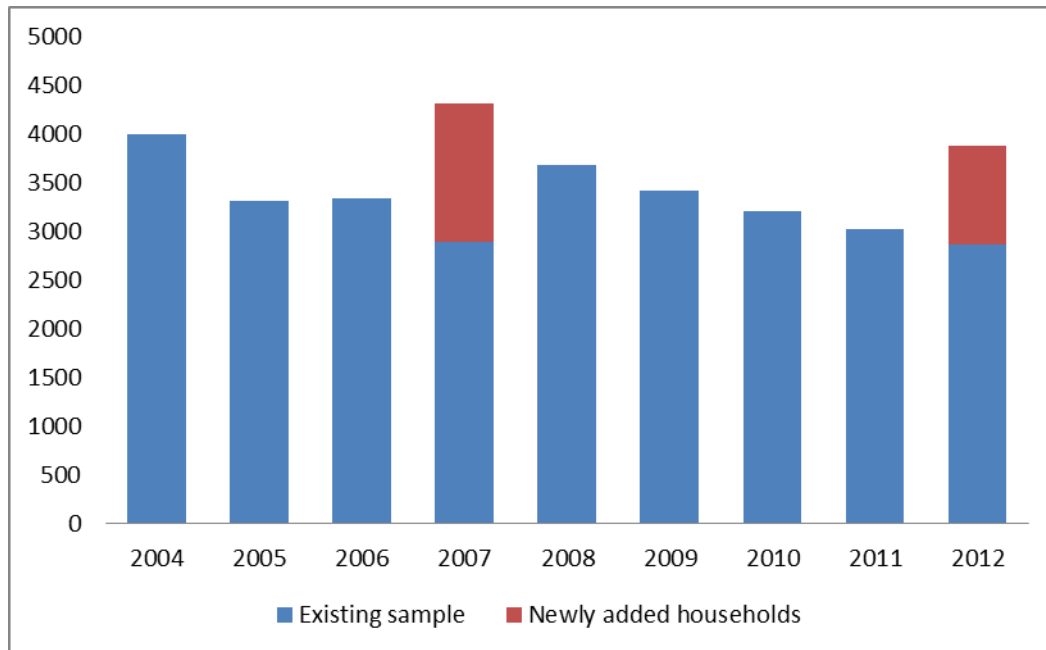
4. DATA DESCRIPTION

4.1 The Keio Household Panel Survey

The Keio Household Panel Survey (KHPS) is a longitudinal survey of private households in Japan providing not only demographic, occupational, and economic information, but also information about health, educational backgrounds, lifestyle, and housing. The KHPS is conducted by investigators using the Drop-Off Pick-Up (DOPU) Method, which means that a surveyor distributes a questionnaire to a survey respondent, then later visits the respondent again to collect the completed questionnaire. In principle, responses by spouses or other family members are not permitted.

The KHPS uses a two-stage stratified random sampling of people aged between 20 and 69 in 2004, and was first conducted in January 2004 covering 4,005 households, which represented 67.2% of the total population. In wave 2 in 2005, only 3,314 of the 4,005 individuals who were surveyed responded to the survey. The number of samples of the following wave 3 increased slightly to 3,342. However, in order to avoid a decrease in the sample size, in wave 4, 1,419 new households were added to the old cohort of the then 2,894 households. The number of surveys received in waves 5–8 was 3,691, 3,422, 3,207, and 3,030, respectively. In the ninth survey, again another 1,012 new households were added to the 2,865 existing ones. In total, the KHPS counts 29,770 observations. The changing composition of the KHPS is illustrated in Figure 3.

Figure 3: Keio Household Panel Survey Sample Size
(number of households)



Source: Authors, based on Keio Household Panel Survey.

4.2 Health-related Dependent Variables

4.2.1 Self-assessed Health

In the KHPS, the health status of a respondent can be inferred by the answer to the question: “How is your health normally?” The respondent can choose an answer to this question from five levels: good, pretty good, normal, not so good, and bad. In order to facilitate our analyses, we have transformed all five possible answers into a dichotomous variable for the self-assessed-health condition (*sah*). The variable *sah* is equal to 1 if the respondents’ health conditions are rated as “good” or “pretty good,” and *sah* becomes 0 if the health conditions are considered to be “not so good” or “bad.”

In addition to the more general question on health, the KHPS contains specific questions on the physical and psychological health conditions of the respondents. It asks the respondents how frequently they suffer from one of the following 12 health disorders: headaches, palpitations, digestive problems, back pain, becoming tired easily, catching colds easily, becoming irritated frequently, having difficulty sleeping, finding seeing people tiresome, losing concentration at work, being dissatisfied with life, and experiencing anxiety about the future. The answers of the respondents are restricted to four choices (1: often, 2: sometimes, 3: rarely, 4: never). In our research, we summarized their replies by building two new variables. First, a physical health condition index (labelled *physical*), which is defined from the aggregated value of the first six conditions related to physical health. When the aggregated value of all six answers exceeds 14, the index becomes unity, and 0 otherwise. Second, a psychological health condition index (labelled *mental*), which is defined in the same way by aggregating values of the other six conditions related to psychological health.

4.2.2 Medical Expenditure

In the KHPS, medical expenditure, *medexp*, is measured as the total household out-of-pocket expenditure on medicines, medical treatments, glasses, contact lenses, and so forth in the previous month. Medical expenditure can be interpreted as investment in good health. The medical expenditures are reported in thousand yen.

4.2.3 Screenings

The decision to undergo voluntary medical screenings (*fullscreen*, *cancerscreen*) is analyzed in this paper because it reflects respondents' attitudes toward preventive health care. A complete screening (*fullscreen*) is an optional multiphase medical examination that normally takes 1 or 2 days. Cancer screening (*cancerscreen*) is highly advised, but an optional examination. On the other hand, a periodic screening (*companyscreen*) is an annual examination that employees are required to undergo by companies or the government and that are financed by the latter.

4.3 Independent Variables

4.3.1 Housing Variables

The key explanatory variable in our paper is home ownership (*own*), which is equal to 1 if respondents have answered that they live in their own detached-house or condominium. We consider households to be homeowners who are living in their own house or condominium (but leasing their plot).

It can be conjectured that a homeowner is more likely to live in a home with a larger floor space and yard and these could have a positive effect on health conditions. In order to control for possible differences in housing conditions between homeowners and renters, we introduce several variables that capture the quality of housing:

- *spaceratio*: The floor space (m^2) per person in the household.
- *yardratio*: The yard size (m^2) per person in the household.
- *hage*: The age of the home.
- *seniorbarrier*: A dummy variable, which equals 1 if a respondent over 70 years of age is living in a house with some amenities for the elderly, such as handrails or low bathtub walls for easy access.

Furthermore, we control for the fact that the home is located in an urban area (large or middle-size city) or a rural area and construct a corresponding dummy variable (*urban*).

4.3.2 Sociodemographic Variables

In order to control for other socio-demographic characteristics, we introduce the following variables:

- *age*: The age of the respondent.
- *familysize*: The number of family members in the family of the respondent.
- *male*: A dummy variable that equals 1 if respondent is male and 0 otherwise.
- *married*: A dummy variable that equals 1 if respondent is married and 0 otherwise.
- *nsmoker*: A nonsmoker dummy, which can reflect the effect of smoking on

health. We expect that the nonsmoker dummy partly reflects an individual's time preferences. Sato and Onichi (2002) argued that among people with high time preferences the smoking rate was higher. It is said that time preferences play a vital role in determining an individual's health-related decisions (Fuchs 1982). For instance, an individual with high time preferences would be more likely to have an unhealthy lifestyle, which could influence their health condition. We expect the nonsmoking dummy captures both the direct effects caused by smoking and the indirect effects attributed to individual time preferences.

- *senior*: The variable, *senior*, is equal to 1 for individuals over the age of 70. We introduce this variable to control for the effect of the lower co-payment rates for elderly people in Japan. The co-payment rate for adults is currently 30%, but only 10% for people over 70. The co-payment rate covers outpatient and inpatient treatment, dental care, optical care, and pharmaceuticals.

4.3.3 Income Variables

The inclusion of information on financial status is important because it is well known from a number of previous studies that income levels significantly affect health and medical demand (Ettner 1996; Costa-Font, Gemmill, and Rubert 2009). Ishii (2011) confirmed that people in the lower-income group in Japan are significantly less likely to take up medical treatment, even when controlling for health conditions. We thus use the following variables to control for the financial status of the households:

- *inc*: Household's annual pre-tax income in the previous year (January–December). Any income from the sales of assets or private insurance receipts is not included. The amount of income is reported in units of ¥10,000.
- *borrow*: Balance of household's present borrowings, reported in units of ¥10,000.
- *saving*: The amount of deposits the household currently has. Deposits refer to the following types of items: postal savings, time deposits, installment savings, ordinary deposits, company deposits, gold investment accounts, medium-term government bond funds, etc. *Saving* includes foreign currency denominated deposits (yen equivalent) but excludes real estate such as housing and other real assets. The amount is reported in units of ¥10,000.
- *securities*: The amount of securities the household currently has. Securities refer to the following types of items: shares (market value), bonds (par value) and stock investment trusts (market value), corporate and public bond investment trusts (market value), loans in trust, and money in trust (par value), etc. Foreign currency denominated securities (yen equivalent) is also included in securities. The amount is reported in units of ¥10,000.
- *mortgage*: Mortgage dummy, which captures whether the household has a mortgage or not.

4.3.4 Other Socioeconomic Variables

Since previous studies showed that health conditions are strongly determined by socioeconomic status (e.g., van Doorslaer et al. [1997]; van der Pol [2011]), we need to

take into account the effect of socioeconomic status in our study. Kagamimori, Gaina, and Nasermoddelli (2009) and Murata et al. (2008) show the significant influence of socioeconomic status on health in the Japanese population. From numerous empirical studies, it is known that individual lifestyle is also influenced by socioeconomic status (Kenkel 1991; Vallejo-Torres and Morris 2010). Fukuda, Nakamura, and Takano (2005) argue that among people with low socioeconomic backgrounds, unhealthy lifestyles are more prevalent in Japan.

To capture the socioeconomic status, education level dummy variables (*edulevel* 1–3) are used:

- *edulevel1* is equal to 1 if the final education level is a compulsory education.
- *edulevel2* is equal to 1 if the final education level is high school graduation.
- *edulevel3* is equal to 1 if the final education level is university graduation or higher.

In Japan, it is compulsory for companies and municipal governments to make their staff undergo a periodic screening once a year, regardless of the size or scale of the organization. The expense for the screening is supposed to be more or less covered by the employers, but the coverage rate and scope often differ from company to company. Generally, large companies tend to fully cover costs, whereas smaller companies tend to only pay part of the costs.

People who choose to undergo additional complete screenings and cancer screenings must pay for them themselves, but large companies and government organizations usually offer workers generous financial incentives to undergo these optional health checkups. To take account of this financial incentive, we use a company size dummy variable, *largecompany*, which equals 1 if a respondent works for a company or government organization with over 500 working staff. We also consider that an employer might only pay the screening costs for fulltime employees and not for part-time workers. We therefore introduce two dummy variables capturing whether the employee is a fulltime worker (*fulltimeworker*) or a part-time worker (*parttimeworker*). Finally, since Japan has a universal health insurance system, insurance status variables, which are generally used as a partial measure of the socioeconomic status of US households, are not included in this paper.

5. DESCRIPTIVE STATISTICS

In this section we provide descriptive statistics of the main variables used in our paper. The definitions, means, and standard deviations of all variables are reported in Appendix, Table A.1. Appendix, Table A.2 presents the correlation matrix of the variables.

5.1 Home Ownership

The absolute number of homeowners and renters in the KHPS data is shown in Table 1. Figure 4 shows the evolution of the home ownership rate. The rate of home ownership in the KHPS is slightly higher than the rate reported in other national

surveys.⁶ This difference might be due to our definition of home ownership. Homeowners in this paper are defined as those who live in their own house or condominium, while the ownership rate is sometimes reported as the rate of “detached house” owners. Another reason could be that we count detached houses and condominiums with leased plots as owner-occupied houses. Nevertheless, we are concerned that the rate of home ownership in the KHPS sample households is higher than the rate in the whole Japanese population, which might lead to a selection bias in our estimation. Figure 4 also illustrates that the home ownership rates captured by the KHPS increased from 2004 to 2011 and dropped in 2012.

Table 1: Home Ownership versus Renting

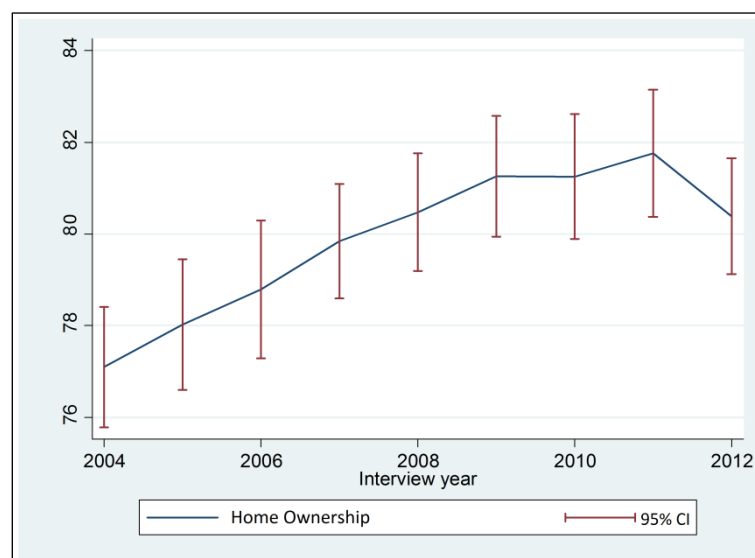
(number of respondents)

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Owner	911	712	603	803	711	630	592	544	748	6,254
Renter	3,040	2,528	2,240	3,181	2,931	2,732	2,566	2,439	3,066	24,723
Total	3,951	3,240	2,843	3,984	3,642	3,362	3,158	2,983	3,814	30,977

Source: Authors.

Figure 4: Rate of Home Ownership, 2004–2012

(%)



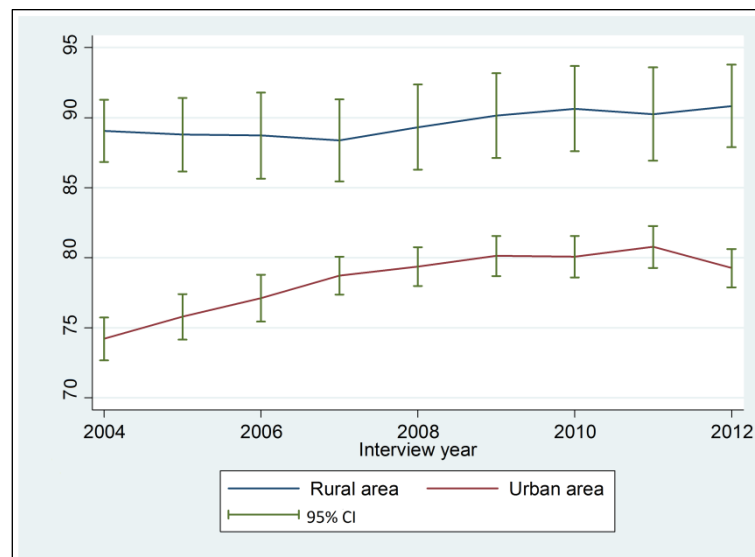
CI = confidence interval.

Source: Authors.

Figure 5 shows the transition of home ownership rate in the KHPS sample in urban areas and rural areas. The rate in rural areas has been consistently higher than in urban areas and the 95% confidence intervals have not overlapped through the period of the survey. This could be explained by the fact that land prices and housing prices in urban areas are generally higher and therefore more people live in rental houses.

⁶ *Social Indicators by Prefecture 2014* by Statistics Bureau, Ministry of Internal Affairs and Communication, for example, reported that the home ownership rate in Japan was 61.1% in 2008 and 61.2% in 2003.

Figure 5: Home Ownership by Area Type, 2004–2012
(%)



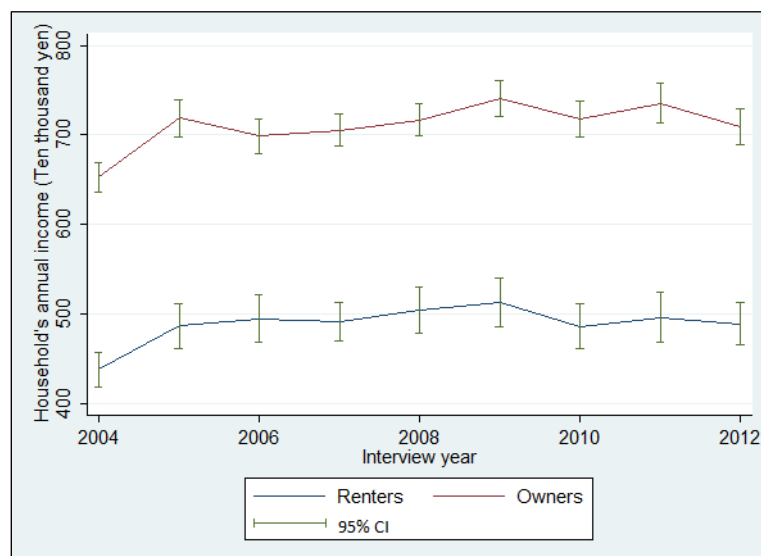
CI = confidence interval.

Source: Authors.

5.2 Financial Situation of Home Owners versus Renters

Figure 6 shows that the mean household income of homeowners is consistently higher than that of renters.

Figure 6: Household Income of Renters and Homeowners, 2004–2012
(¥10,000)



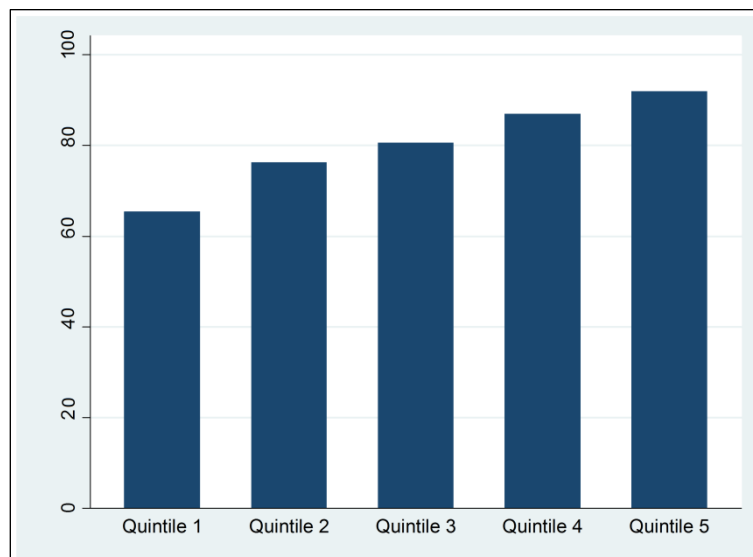
CI = confidence interval.

Source: Authors.

Home owners are highly likely to belong to a middle- or high-income group and Figure 7 illustrates that the home ownership rate in 2012 was higher at higher levels of income.

Figure 7: Mean of Home Ownership Rate by Quintiles of Income, 2012

(%)

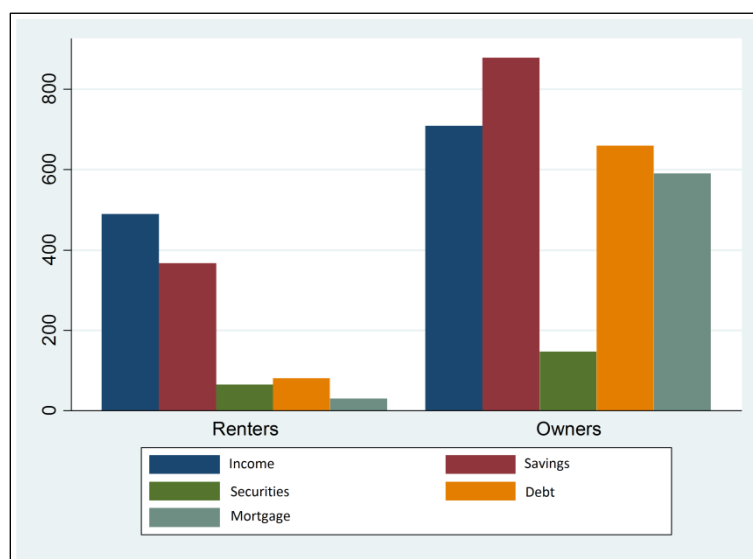


Source: Authors.

Figure 8 compares the income, savings, securities, debt, and mortgage of renters and homeowners for the year 2012. We observe that homeowners had the larger amount of income, savings, and securities, while at the same time they also had much larger amounts of debt, mostly composed of mortgages. Some renters also had mortgages, but this can be explained by the fact that some Japanese households rent an apartment in a city, while having a second residence in a rural area.

Figure 8: Financial Situation of Renters versus Homeowners, 2012

(¥10,000)



Source: Authors' calculations.

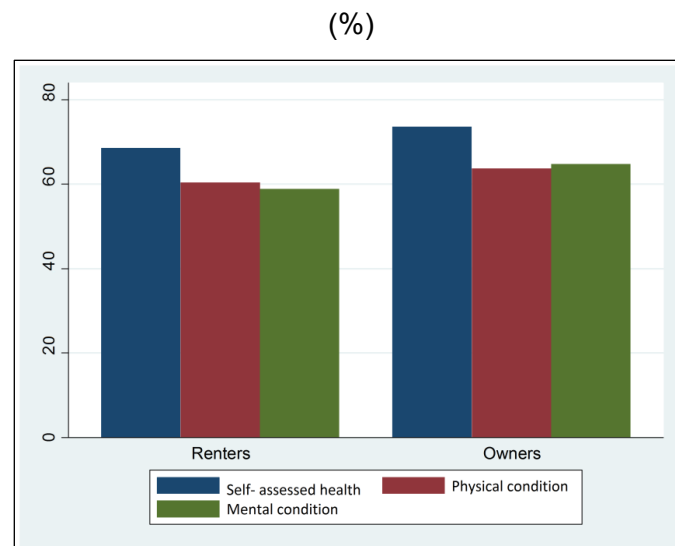
A word of caution might be in order for the data on savings and securities. In the data we observed a large number of missing values for both variables. In addition, a large number of respondents answered zero for both, which is difficult to imagine. Both problems could possibly cause a considerable measurement error and we need to be

careful in treating these variables (see Appendix, Figure A.1 for histograms of both variables).

5.3 Health of Home Owners versus Renters

Figures 9 and 10 show the proportion of respondents who answered that their health condition was good or pretty good. Those who own a house or condominium tend to consider themselves to have a better physical and mental health.

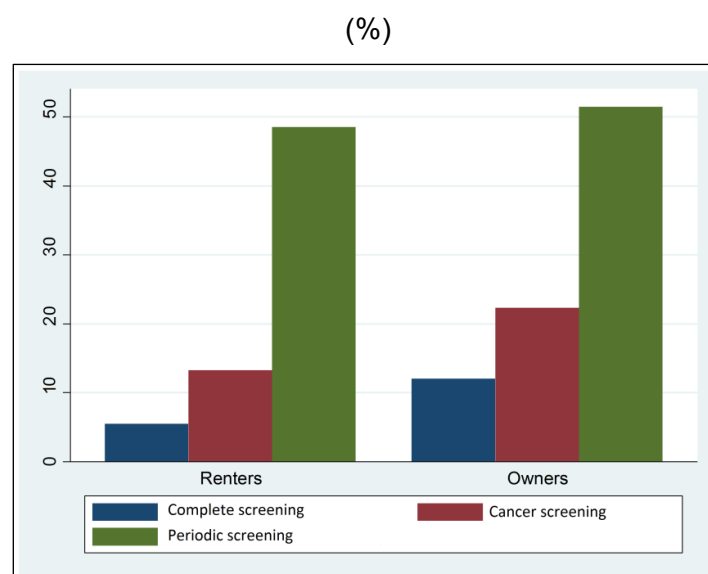
Figure 9: Self-Assessed Health of Home Owners versus Renters, 2012



Source: Authors' calculations.

Looking at Figure 10, we observe that the rates of undergoing medical screenings, especially complete and cancer screenings, are higher among homeowners, which suggests that homeowners are more likely to invest their time and money in their future health through medical checkups.

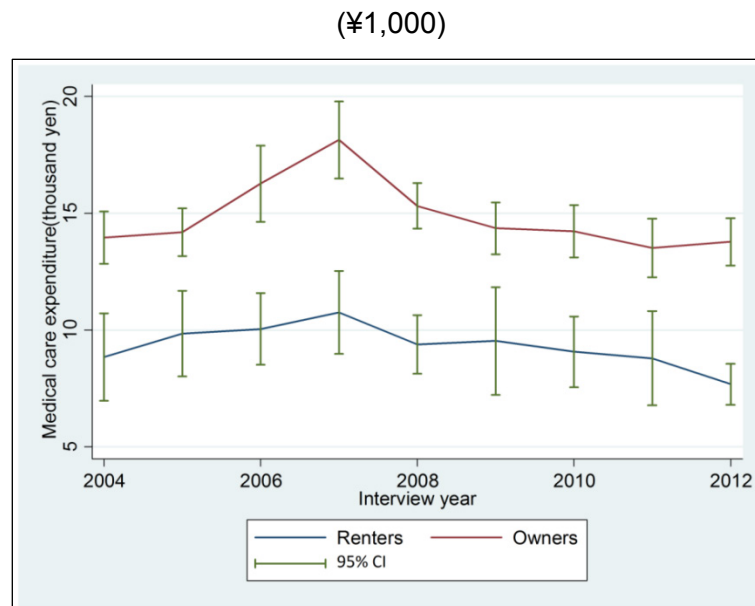
Figure 10: Medical Screenings of Renters versus Homeowners, 2012



Source: Authors' calculations.

Figure 11 shows the average medical expenditure (in units of ¥10,000) for renters and homeowners for the period 2004–2012. We observe that medical expenditure among homeowners was consistently higher than that of renters. (The 95% confidence intervals do not overlap in any period of the survey.) Medical expenditure in 2006 and 2007 among homeowners was higher than in other years. The reason could be a few outliers in both years. We found a few outliers of with values exceeding 700 (i.e., ¥7 million) in 2006 and 2007 and one respondent answered that they had spent ¥14.73 million in 2007. Although one respondent reported they spending of ¥10 million in 2011, no household spent more than ¥7 million in other years.

Figure 11: Medical Expenditure of Renters versus Homeowners, 2004–2012



CI = confidence interval.

Source: Authors.

Comparing self-assessed health, the percentage undergoing screenings and the medical expenditure of renters and homeowners do not necessarily mean that owning a house improves health or increases the demand for health care. The reason is that it is uncertain whether these correlations remain after controlling for other factors such as income levels, socioeconomic conditions, and demographic status. This paper is intended as an estimation of the quantitative impact of home ownership after taking account of other factors that would possibly affect individual health directly and indirectly.

6. ESTIMATION STRATEGY

Our main research objective is to quantify the impact of home ownership on health and medical demand. In order to single out the effect of home ownership, we will control for various housing-related variables.

In all our regressions we control for socioeconomic status, comprised of the important factors affecting individual lifestyle and health conditions, as it has been well documented in the literature (for example, van Doorslaer et al. [1997]; van der Pol [2011]; Kagamimori, Gaina, and Nasermoaddeli [2009]; and Murata et al. [2008]). The explanatory variables therefore include variables on individual demographic

information, financial situation (including mortgages), educational background, and other lifestyle related variables.

We estimate four different specifications for self-reported health conditions and the undergoing of health checkups (see Table 2). Firstly, we include the logarithmic amount of saving and securities as financial assets in the set of explanatory variables. Then we add housing condition variables to the first estimation. In the third and fourth estimations, we exclude the financial asset information from the first estimation and the second estimation. Reasons for the inclusion and exclusion of the financial assets are that they may suffer measurement errors, which generally hinder the derivation of consistent estimates of all variables. Another reason for the exclusion of some explanatory variables is to check the robustness of our estimation and see the change in the coefficient size of home ownership and its standard errors.

Table 2: Comparison of Estimation Strategies

	Financial assets		Housing conditions				
	Insaving	Insecurities	Inspacratio	Inyardratio	Indistance	hage	seniorbarrierfree
Specification 1	○	○					
Specification 2	○	○	○	○	○	○	○
Specification 3 (Result in the appendix)							
Specification 4 (Result in the appendix)			○	○	○	○	○

Source: Authors.

6.1 Estimation 1: Home Ownership and Self-assessed Health

The first objective of this paper is to test whether being a homeowner is positively related with self-assessed health (either in general or for specific health conditions). We estimate this relationship using a random effects probit estimator, because it is known that in panel data binary choice models a fixed effects probit model cannot be estimated consistently for fixed T (for details, see Verbeek [2012]). Using the random effects probit model, we assume that the independent variables are not correlated with individual time-invariant effects and home ownership is exogenous in our model. The equation that we will estimate takes the following form:

$$sah_{it} = \alpha + (Socio\ economic\ status)'_{it}\beta_1 + \gamma_1 urban_{it} + \gamma_2 own_{it} + (Financial\ assets)'_{it}\beta_2 + (Housing\ conditions)'_{it}\beta_3 + \varepsilon_{it}$$

where β_j ($j = 1, 2, 3$) is a vector of coefficients of each independent variable set and γ_k ($k = 1, 2$) is a coefficient of the urban dummy and the home ownership dummy.

6.2 Estimation 2: Home Ownership and Preventive Health Care

The second estimation is to test whether owning a home has any link with attitudes toward preventive health care. We use three types of medical checkup: complete screenings, cancer screenings, and periodic screenings.

The first two (complete and cancer screening) are voluntary examinations, whereas periodic screenings are mandatory examinations that workers are required to undergo annually. As for voluntary examinations, we are interested in the difference in the probability of undergoing cancer screenings and complete screenings between homeowners and renters. The choice of having these two screenings is basically up to the individual. Complete screenings are normally more expensive and people can

usually add in the cancer screening as an extra option. In this sense, the complete screening could more accurately reflect individual demand for preventive health care than the cancer screening. The effect on the probability of undergoing the mandatory screening is estimated for reference, because both homeowners and renters are expected to undergo the periodic checkup if they are employed. We therefore expect that for these compulsory check-ups to find no difference between homeowners and renters. As large firms often provide their staff some financial incentives to undergo voluntary checkups, we use the large company dummy, *largecompany*, in our estimation to control for this financial incentive scheme. The equation we will estimate takes the following form:

$$\text{Screenings}_{it} = \alpha + (\text{Socio economic status})'_{it}\beta_1 + \gamma_1 \text{urban}_{it} + \gamma_2 \text{own}_{it} \\ + (\text{Financial assets})'_{it}\beta_2 + (\text{Housing conditions})'_{it}\beta_3 + \varepsilon_{it}$$

where $\beta_j (j = 1, 2, 3)$ is a vector of coefficients of each independent variable set and $\gamma_k (k = 1, 2)$ is a coefficient of the urban dummy and the home ownership dummy.

6.3 Estimation 3: Home Ownership and Medical Expenditure

The third objective is to test whether home ownership is related to demand for medical care as measured by medical expenditure. We use the logarithmic amount of medical expenditure as the dependent variable.

For the first step, we exclude zero expenditure following recent empirical literature on medical expenditures in Japan (e.g., Ishii [2011]). Our objective is to test the hypothesis of whether home owners have higher health care expenditure, even after controlling for income, education level, financial situation, and other socio-demographic variables. The equation we will estimate takes the following form:

$$\ln(\text{medical expenditure})_{it} \\ = \alpha + (\text{Socio economic status})'_{it}\beta_1 + \gamma_1 \text{urban}_{it} + \gamma_2 \text{own}_{it} \\ + (\text{Financial assets})'_{it}\beta_2 + (\text{Housing conditions})'_{it}\beta_3 + \varepsilon_{it} , \\ \varepsilon_{it} = \alpha_i + u_{it}$$

where $\beta_j (j = 1, 2)$ is a vector of coefficients of each independent variable set and $\gamma_k (k = 1, 2)$ is a coefficient of the urban dummy and the home ownership dummy.

For comparison purposes, we first assume that ε_{it} are independent and perform a pooled OLS estimation with a cluster robust covariance estimator. To account for individual time invariant effects, we then estimate the equation using the fixed effects and the random effects estimators and compare the estimates with the Hausman test.

For the second step, we include zero medical expenditure in our estimations. The reason is that focusing attention only on households with positive health expenditure may cause a selection bias. Healthy people may not have undertaken any treatment and hence have no medical expenditure. To take account of the decision making that is possibly influenced by the current health condition, we introduce a two-equation model. Assuming that the decision to spend and the amount spent are not independent, we perform a bivariate sample-selection model proposed by Heckman (1979).

The advantage gained by the two equation model is that we can eliminate the selection bias due to the different decision making patterns between healthy people and unhealthy people. We define a dummy variable, *exp*, which becomes 1 if the respondent has spent money on medical services or goods, and 0 otherwise. We assume that the respondent's decision is influenced by their health condition, housing condition, educational background, financial situation, etc. To take account of the time

effect and the within-group correlations, we include year dummies in the explanatory variable sets and use a cluster robust covariance estimator.

$$\begin{aligned} \ln(\text{medical expenditure})_i^* &= \alpha + x'_{1i}\beta_1 + \varepsilon_{1i} \\ \exp_i^* &= \alpha + x'_{2i}\beta_2 + \varepsilon_{2i} \\ \ln(\text{medical expenditure})_i &= \ln(\text{medical expenditure})_i^*, \exp_i = 1 \quad \text{if } \exp_i^* > 0 \\ \ln(\text{medical expenditure})_i &= \text{Unobservable}, \exp_i = 0 \quad \text{if } \exp_i^* \leq 0 \end{aligned}$$

where

$$\begin{pmatrix} \varepsilon_{1i} \\ \varepsilon_{2i} \end{pmatrix} \sim \text{NID} \left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & 1 \end{pmatrix} \right) \quad \text{and}$$

β_j is a vector of coefficients of x_j , ($j = 1, 2$).

Finally, we would like to control for the possible endogeneity problem (as suggested by Aaronson [2000]). We do so by estimating the model using an instrumental variable method as suggested by Hausman and Taylor (1981). The Hausman-Taylor estimator assumes that some of the explanatory variables are correlated with the individual-level random effects, α_i . The Hausman-Taylor estimator is consistent and more efficient than that fixed effects estimator when the model is overidentified and the partition of the variables into endogenous and exogenous variables is correct. The advantage of the Hausman-Taylor estimation is that one does not have to find external valid instruments. Another advantage of the Hausman-Taylor estimator is that it allows us to estimate the effect of time-invariant variables, which are also of interest but cannot be estimated by the fixed effect model (Hausman and Taylor [1981]; Verbeek [2012]). The general equation for the Hausman-Taylor estimation takes the following form:

$$y_{it} = \alpha + x'_{1,it}\beta_1 + x'_{2,it}\beta_2 + w'_{1,it}\gamma_1 + \alpha_i + u_{it}$$

where the x variables are time variant and the w variables are time invariant. β_j ($j=1,2$) and γ_1 are vectors of coefficients. The variables $x'_{2,it}$ are assumed to be correlated with α_i but not with u_{it} .

For comparison, we perform a traditional IV/GMM estimation of the fixed-effects panel data model with the variable, *own*, which is potentially correlated with the error term. As excluded variables, we use the information on whether respondents live with their parents, and whether the house the respondents live in has a yard as well as the number of rooms per person in the house (*prntlive*, *yard*, *Inroomratio*). We test the orthogonality condition of the variable with the Hansen-Sargan J test and the GMM distance test.

The reason we use both the Hausman-Taylor estimator and the IV estimator to deal with the potential endogenous variable is two-fold. First is to check the robustness of the results and second is to see how the size of the coefficients and their significance levels change when the assumption of endogeneity changes. The instrumental variable estimation model assumes that a subset of the explanatory variables in the model is correlated with the idiosyncratic error, u_{it} , while the Hausman-Taylor estimation model assumes that the regressors are correlated with the individual effects, α_i .

7. ESTIMATION RESULTS

7.1 Estimation 1: Home Ownership and Self-assessed Health

The results of estimation 1 are summarized in Table 3. Firstly, for the self-assessed overall health (columns 1 and 2), we find that homeowners are significantly more likely to feel healthy than renters, even after controlling for housing conditions (column 2). The significance of home ownership remains for the case in which financial assets are excluded from the set of explanatory variables (results are listed in the Appendix).

Most of the other explanatory variables carry the expected signs. Age has a significant negative impact, which is consistent with our expectations of aging and health-assessed health. Sex and family size do not show significance, but those who are married tend to report better health.

Workers (full-time and part-time), students and non-smokers are significantly more likely to report better health. Furthermore, our results confirm that higher educational achievements are linked with better health. More educated people tend to feel healthier, although the size of the average marginal effects of *edulevel2* and *edulevel3* are very close. The significant link between education level and health is consistent with previous studies (Grossman 1972; Kenkel 1991; Berger and Leigh 1989). Berger and Leigh (1989), for instance, found that individuals with higher levels of schooling were healthier than those with lower levels of schooling.

Income and securities do not show significant effects on overall health conditions, but savings do. Debt and mortgage have no significant effect. It is difficult to explain why only savings influence health condition among the variables controlling for financial status.

Living in an urban area shows a negative association with health, which could be explained by the urban lifestyle. People living in rural areas feel healthier probably because they are less subject to the stress-related factors of the urban lifestyle, such as air pollution, overcrowded places, etc.

Table 3: Estimation Results for Self-Assessed Health (Random Effects Probit Estimation, Average Marginal Effects)

	(1) Sah	(2) Sah with housing conditions	(3) Physical health	(4) Physical health with housing conditions	(5) Mental health	(6) Mental health with housing conditions
age	-0.0636*** (0.00473)	-0.0549*** (0.00596)	0.0000216 (0.00250)	0.00132 (0.00288)	-0.00279 (0.00243)	-0.00212 (0.00275)
senior	-0.387*** (0.143)	-0.218 (0.263)	-0.0119 (0.0803)	-0.0907 (0.126)	0.0250 (0.0793)	-0.134 (0.122)
male	0.104 (0.114)	0.0750 (0.139)	0.748*** (0.0643)	0.771*** (0.0710)	0.457*** (0.0619)	0.448*** (0.0674)
married	0.698*** (0.119)	0.733*** (0.151)	-0.112* (0.0635)	-0.192*** (0.0722)	0.169*** (0.0612)	0.149** (0.0692)
familysize	0.0447 (0.0319)	0.0769 (0.0472)	0.00227 (0.0170)	-0.0117 (0.0226)	-0.0308* (0.0166)	-0.0358 (0.0219)
fulltimeworker	0.678*** (0.0922)	0.780*** (0.115)	-0.0751 (0.0533)	-0.0792 (0.0588)	0.0547 (0.0518)	0.0204 (0.0568)
parttimeworker	0.458*** (0.103)	0.482*** (0.124)	0.0167 (0.0583)	0.0498 (0.0645)	0.124** (0.0575)	0.100 (0.0633)
student	1.478*** (0.402)	1.471*** (0.475)	0.368 (0.231)	0.228 (0.264)	0.430** (0.211)	0.562** (0.246)
nsmoker	0.339*** (0.0901)	0.163 (0.116)	0.243*** (0.0547)	0.243*** (0.0604)	0.224*** (0.0534)	0.252*** (0.0583)
edulevel2	0.869*** (0.197)	1.206*** (0.279)	0.0879 (0.0984)	0.189* (0.111)	0.0144 (0.0957)	0.0893 (0.106)
edulevel3	0.856*** (0.205)	1.373*** (0.285)	0.168 (0.104)	0.283** (0.117)	0.0104 (0.101)	0.0808 (0.112)
lninc	0.0260 (0.0445)	-0.0156 (0.0522)	0.0523** (0.0265)	0.0485* (0.0295)	0.0812*** (0.0262)	0.0891*** (0.0291)
lnborrow	-0.0213 (0.0137)	-0.0132 (0.0166)	-0.0230*** (0.00785)	-0.0233*** (0.00867)	-0.0298*** (0.00773)	-0.0242*** (0.00853)
mortgage	0.0714 (0.111)	0.00101 (0.140)	-0.0138 (0.0636)	-0.00307 (0.0727)	0.114* (0.0624)	0.0694 (0.0710)
own	0.237** (0.117)	0.407** (0.165)	0.135** (0.0642)	0.149* (0.0811)	0.0595 (0.0630)	0.0424 (0.0791)
urban	-0.540*** (0.136)	-0.376** (0.177)	-0.0469 (0.0732)	-0.0543 (0.0834)	-0.107 (0.0712)	-0.0804 (0.0803)
lnsaving	0.0621*** (0.0146)	0.0580*** (0.0181)	0.0338*** (0.00816)	0.0234*** (0.00904)	0.0393*** (0.00796)	0.0389*** (0.00877)
lnsecurities	0.0138 (0.0166)	0.0280 (0.0194)	0.00401 (0.00904)	0.0101 (0.00970)	0.0155* (0.00885)	0.0109 (0.00938)
lnspaceratio		-0.00134 (0.110)		-0.0552 (0.0526)		-0.0705 (0.0511)
lnyardratio		-0.0341 (0.0424)		0.0398* (0.0205)		0.0499** (0.0196)
lndistance		-0.00374 (0.0602)		0.00495 (0.0299)		-0.0236 (0.0287)
hage		-0.00559 (0.00395)		0.000317 (0.00195)		-0.00126 (0.00185)
seniorbarrierfree		-0.266 (0.330)		0.0826 (0.158)		0.276* (0.154)
N	15,640	11,520	18,937	16,098	19,050	16,189

Notes: Standard errors are in parentheses. Random effects probit estimation. Assets: ln(saving), ln(securities). * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$. Source: Authors.

Broadly speaking, young married people living in their own houses in the countryside tend to report better health conditions. Well-educated nonsmokers are also likely to be healthier.

As for physical and mental health (columns 3–6), the results show that home ownership only affects physical health. The coefficient is smaller compared to overall self-assessed health and its significance level becomes lower once we control for housing conditions. Income, savings, and borrowing affect both physical and mental health. The mortgage dummy is not significant for either health condition.

Surprisingly, men reported better physical and mental conditions although we could not find a significant effect on their self-assessed health. Married people tend to have better mental conditions. As for the case of self-assessed health, we found that not smoking improved one's physical and mental health. Although the urban dummy showed significance for self-assessed health, it was not significant for physical or mental health. In contrast to self-assessed health, people living in a house with a large yard are more likely to feel psychologically healthy.

7.2 Estimation 2: Home Ownership and Preventive Health Care

The estimation results for screenings are summarized in Table 4. Firstly, when we do not control for housing condition (column 1), the result shows that homeowners are more likely to have a complete medical checkup than renters (column 1). However, home ownership does not show significance once we include housing condition variables (column 2). Home ownership shows significance for cancer screening (columns 3 and 4), but only when we do not control for assets (see Appendix). As expected, we do not find a significant result for the case of the periodic checkup (columns 5 and 6).

The other estimation results hold interesting information. Age shows significance for the complete screening and the cancer screening. Older people care more about their health, probably because their likelihood to become sick is generally higher. The insignificant result for the periodic screening can be explained by the fact that older people are not required to have a periodic screening anymore because they do not work or are self-employed after their retirement.

Men are significantly more likely to undergo the complete screening and the periodic screening than women. On the contrary, the sign of the male dummy for the cancer screening is negative, which means that women tend to undergo the cancer screening more. The reason for this could be that women are particularly concerned about female-specific cancers.

The marital status dummy is also significant only for the full screening and the cancer screening. Married respondents may have been influenced by their partners to have these screenings.

Both full-time workers and part-time workers are more likely to have the periodic screening. The most likely explanation for this significance is that the periodic screening may be compulsory at the company or government office where the respondent is working. The difference in the size of the marginal effect between full-time workers and part-time workers requires further explanation. The difference can be attributed to the fact that part-time workers are usually not required to take the periodic checkup unless they work over a certain number of hours per week or month.

The company size dummy is significant for the periodic screening and the complete screening as expected. Some large companies in Japan fully cover the cost of the

periodic checkup and partly support the cost of the complete medical screening. These financial incentives may account for the significance of the company size dummy. All these factors explain why full-time workers at a large company or a government organization are more likely to have these two optional screenings.

Non-smokers are significantly more likely to take the complete screening and the periodical screening. This can be partly explained by the finding by Sato and Onichi (2002) that the smoking rate in Japan is higher among people with a high time discount rate. From this view point, we could say nonsmokers tend to value their future more and get more preventive screenings. Interestingly, the nonsmoker dummy shows the opposite sign for the cancer screening. This might be because smokers are more concerned about cancers caused by smoking. Warnings of cancer risks displayed on all Japanese cigarette packets might make smokers more aware of the risks of smoking, causing them to have cancer screenings more frequently than nonsmokers.

Education levels show significant positive effects on the decision to undergo a complete screening, which implies that more educated people are more willing to undergo them. This result is consistent with the evidence in the United States provided by Fletchen and Frisvold (2009) that higher education is associated with an increase in the likelihood of using several types of preventive care. The average marginal effects of the education level dummies are relatively large in our estimation. Only the highest educational level dummy shows significance for cancer screening.

The urban dummy is significant only for the full screening in column 1. Further studies might need to investigate whether residents in rural areas have more limited access to screening compared to urban dwellers. Finally, debt and mortgage amounts do not affect the incentive to have a complete medical examination.

Table 4: Estimation Results for Preventive Health Care (Random Effects Probit Estimation, Average Marginal Effects)

	(1) Complete screening	(2) Complete screening with housing conditions	(3) Cancer screening	(4) Cancer screening with housing conditions	(5) Periodic screening	(6) Periodic screening with housing conditions
age	0.0308*** (0.00419)	0.0305*** (0.00477)	0.0308*** (0.00262)	0.0284*** (0.00293)	0.00324 (0.00232)	0.00178 (0.00265)
senior	-0.417*** (0.123)	-0.482** (0.226)	0.0694 (0.0719)	0.129 (0.112)	0.0107 (0.0712)	0.0873 (0.112)
male	0.439*** (0.0998)	0.516*** (0.110)	-1.220*** (0.0663)	-1.192*** (0.0719)	0.330*** (0.0587)	0.309*** (0.0642)
married	0.527*** (0.112)	0.464*** (0.124)	0.158** (0.0644)	0.188*** (0.0719)	-0.0254 (0.0587)	0.00383 (0.0665)
familysize	-0.0326 (0.0259)	-0.00368 (0.0348)	-0.0178 (0.0171)	-0.0235 (0.0224)	-0.0663*** (0.0158)	-0.0729*** (0.0211)
fulltimeworker	0.203** (0.0881)	0.242** (0.0970)	-0.320*** (0.0526)	-0.354*** (0.0575)	0.840*** (0.0506)	0.812*** (0.0554)
parttimeworker	-0.00887 (0.102)	0.0384 (0.111)	-0.201*** (0.0556)	-0.188*** (0.0605)	0.320*** (0.0558)	0.265*** (0.0609)
largecompany	0.526*** (0.0742)	0.486*** (0.0798)	-0.00684 (0.0557)	-0.00590 (0.0601)	0.481*** (0.0476)	0.480*** (0.0514)
student	-0.592 (0.669)	-0.608 (0.698)	-0.251 (0.319)	-0.374 (0.348)	-0.399** (0.200)	-0.372* (0.223)
nsmoker	0.188** (0.0842)	0.215** (0.0920)	-0.113** (0.0536)	-0.114* (0.0586)	0.165*** (0.0505)	0.174*** (0.0553)
edulevel2	0.432*** (0.166)	0.814*** (0.207)	0.0794 (0.0884)	0.0890 (0.0986)	0.190** (0.0904)	0.170* (0.101)
edulevel3	0.906*** (0.174)	1.264*** (0.215)	0.333*** (0.0951)	0.320*** (0.105)	0.0853 (0.0960)	0.0581 (0.107)
lninc	0.445*** (0.0547)	0.481*** (0.0602)	0.0611** (0.0291)	0.0446 (0.0316)	0.138*** (0.0257)	0.110*** (0.0285)
lnborrow	-0.00524 (0.0129)	-0.0127 (0.0141)	0.0126 (0.00870)	0.00830 (0.00955)	0.00448 (0.00743)	0.00384 (0.00817)
mortgage	0.145 (0.0990)	0.158 (0.112)	-0.125* (0.0669)	-0.176** (0.0756)	-0.0280 (0.0593)	-0.0438 (0.0675)
own	0.292*** (0.111)	0.162 (0.135)	0.0993 (0.0665)	0.0644 (0.0820)	0.0804 (0.0608)	0.0978 (0.0771)
urban	-0.236** (0.106)	-0.121 (0.121)	-0.0371 (0.0683)	-0.0561 (0.0769)	-0.0705 (0.0672)	-0.0584 (0.0761)
lnsaving	0.0478*** (0.0136)	0.0395*** (0.0151)	0.0466*** (0.00883)	0.0438*** (0.00975)	0.0373*** (0.00765)	0.0391*** (0.00844)
lnsecurities	0.0304** (0.0122)	0.0327** (0.0132)	0.00201 (0.00847)	0.00130 (0.00898)	-0.0110 (0.00824)	-0.00996 (0.00877)
lnspaceratio		0.111 (0.0821)		0.0301 (0.0511)		-0.0765 (0.0490)
lnyardratio		0.0264 (0.0304)		0.0449** (0.0185)		0.0222 (0.0187)
lndistance		0.0491 (0.0454)		0.000406 (0.0280)		0.0568** (0.0275)
hage		-0.00615** (0.00310)		-0.00497*** (0.00186)		-0.00187 (0.00182)
seniorbarrierfree		0.110 (0.265)		-0.0801 (0.137)		-0.0217 (0.138)
N	19,556	16,573	19,556	16,573	19,556	16,573

Notes: Standard errors are in parentheses. Random effects probit estimation. Assets: ln(saving), ln(securities).
 * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$. Source: Authors.

7.3 Estimation 3: Home Ownership and Medical Expenditure

When we assume home ownership is exogenous, home ownership shows a positive significant effect on medical expenditure in the pooled OLS, the fixed effects, and the random effects estimation models (columns 1–3 in Table 5). Applying the Hausman test, under the assumption that home ownership is not endogenous and the model is correctly specified, we conclude that the fixed effects estimates are preferable ($p < 0.01$) to the random effects estimates.

Our estimations indicate a quadratic relationship between age and medical care expenditure, which implies that the older a person becomes, the more he/she spends on health care. The negative and significant sign of the senior dummy is surprising because it is generally thought that older people tend to have high medical demand and therefore higher medical expenditure. However, this apparently counterintuitive result could be attributable to the low co-payment rate system in Japan for people who are over 70 years old. Thanks to the low co-payment system, the financial burden of high medical costs that are specific to older people seems to have been mitigated. The educational level dummies and the urban dummy do not show significance in all specifications of the model. The nonsmoking dummy shows a negative sign but is statistically insignificant.

The significance of the variable, *familysize*, can be attributable to the way medical expenditure was reported in the KHPS. In the survey, respondents were asked the amount they spent on medical services and goods as a household unit, not as an individual unit. In other words, the significant effect of the family size variable shows that aggregated medical expenditure becomes higher as the number of family members increases.

Income is positively correlated with medical expenditure at the 1% significance level. This result is consistent with previous studies showing that the elasticity of health care expenditure with respect to income is positive. Costa-Font, Gemmill, and Rubert (2009), for example, estimate the income elasticity of health care demand by meta-regression analysis and conclude that income elasticity ranges from 0.4 to 0.8.

The saving variable shows significance in the pooled OLS model and the random effects estimation model, but is insignificant in the fixed effects estimation model. The amount of securities and debt is insignificant in every model. The mortgage dummy shows a negative significant effect in the pooled OLS and the random effects model, but does not show a significant effect in the fixed effects estimation model.

Home ownership still shows significance in the Heckman model (column 4). We reject the independence of the decision to spend and the amount spent between healthy people and unhealthy people ($p < 0.01$), which means that healthy people are more likely not to spend on medical services and goods, but, among those who spend, home owners have significantly higher medical expenditure.

Next, we assume that home ownership is endogenous and correlated with individual time-invariant effects. In the Hausman-Taylor estimation model (column 5), the significance levels of all the variables are very similar to those of the fixed effect estimation model. The Hausman-Taylor estimates clarify that education levels and sex, which were excluded in the fixed effects estimates because they do not change across time, do not affect medical expenditure. The Hausman-Taylor estimator is both consistent and more efficient than the fixed effects estimator if the partition of the variables into exogenous and endogenous variables is correct, but if it is not, the consistency of the Hausman-Taylor estimator cannot be guaranteed. We tested for this by the Hausman test comparing both estimates and rejected the null that both

estimators are identical at the 1% level. This implies that the fixed effects estimator is preferable to the Hausman-Taylor estimator.

Finally, we treat the endogeneity of home ownership with an IV/GMM estimation of the fixed effects panel data model (column 6). The instrumental variable regression shows a significant effect of ownership, and the coefficient size is larger than in the previous five estimations. As we include three instrumental variables, the model is over-identified and we confirm that these instruments are valid and not weak. The F-values of the first-stage estimations to test whether the instrumental variables are relevant are 1468.59 ($p < 0.01$) and 1518.56 ($p < 0.01$) when we include and exclude asset variables, respectively, which assures that our instrumental variables are not weak. When we include the financial assets variables, the p-values of the Hansen-Sargan J test and the GMM distance test become 0.47 and 0.79, respectively. When we exclude financial assets variables, the p-values of the Hansen-Sargan J test and the GMM distance test are 0.67 and 0.38, respectively. These results show the Hansen-Sargan J test and the GMM distance test fail to reject the exogeneity of home ownership even at the 10% level.

Table 5: Estimation Results for Medical Expenditure

	(1) Medical expenditure Pool	(2) Medical expenditure FE	(3) Medical expenditure RE	(4) Medical expenditure Heckman	(5) Medical expenditure HT	(6) Medical expenditure IV
age	-0.0291*** (0.00618)	-0.0370*** (0.0127)	-0.0277*** (0.00571)	-0.0210** (0.00919)	-0.0350*** (0.00834)	-0.0466*** (0.0147)
agesq	0.000374*** (0.0000650)	0.000271** (0.000124)	0.000347*** (0.0000595)	0.000286*** (0.0000964)	0.000409*** (0.0000847)	0.000357** (0.000142)
senior	-0.236*** (0.0442)	-0.125*** (0.0445)	-0.212*** (0.0362)	-0.195*** (0.0684)	-0.213*** (0.0388)	-0.152*** (0.0502)
male	0.0260 (0.0238)		0.0380* (0.0219)	0.0138 (0.0339)	0.0344 (0.0265)	
married	0.00148 (0.0290)	0.273*** (0.0609)	0.0279 (0.0242)	-0.0287 (0.0417)	0.0628** (0.0292)	0.279*** (0.0816)
familysize	0.0416*** (0.00719)	0.0394*** (0.0119)	0.0463*** (0.00650)	0.0217** (0.0107)	0.0455*** (0.00766)	0.0304** (0.0150)
fulltimeworker	-0.0134 (0.0242)	-0.0358 (0.0319)	-0.0213 (0.0213)	0.0155 (0.0345)	-0.0201 (0.0232)	-0.00908 (0.0388)
parttimeworker	-0.0358 (0.0265)	-0.0359 (0.0317)	-0.0378 (0.0241)	-0.0317 (0.0389)	-0.0339 (0.0253)	-0.00805 (0.0370)
student	0.0420 (0.0999)	-0.107 (0.121)	-0.0140 (0.0862)	0.145 (0.152)	-0.0400 (0.0917)	-0.191 (0.150)
nsmoker	-0.0333 (0.0204)	-0.0547 (0.0381)	-0.0283 (0.0189)	-0.0526* (0.0292)	-0.0322 (0.0219)	-0.0968** (0.0414)
edulevel2	-0.0201 (0.0354)		-0.0297 (0.0330)	0.0104 (0.0537)	-0.0431 (0.0417)	
edulevel3	-0.0420 (0.0372)		-0.0477 (0.0353)	-0.0404 (0.0551)	-0.0638 (0.0442)	
lninc	0.144*** (0.0156)	0.0468*** (0.0163)	0.106*** (0.0118)	0.136*** (0.0228)	0.0840*** (0.0133)	0.0383* (0.0200)
lnborrow	-0.00312 (0.00356)	-0.00751* (0.00414)	-0.00430 (0.00326)	-0.00362 (0.00526)	-0.00511 (0.00337)	-0.00844* (0.00476)
mortgage	-0.0754*** (0.0268)	-0.0466 (0.0369)	-0.0744*** (0.0250)	-0.0896** (0.0392)	-0.0535* (0.0285)	-0.0756 (0.0481)
own	0.197*** (0.0273)	0.159*** (0.0507)	0.200*** (0.0246)	0.157*** (0.0391)	0.165*** (0.0465)	0.268** (0.127)
urban	-0.00257 (0.0268)	0.0989* (0.0566)	-0.00245 (0.0253)	0.0271 (0.0416)	-0.00303 (0.0301)	0.1000 (0.0658)
lnsaving	-0.0119*** (0.00352)	0.000883 (0.00493)	-0.00777** (0.00325)	-0.0210*** (0.00525)	-0.00449 (0.00354)	0.000362 (0.00564)
Insecurities	0.00662* (0.00400)	0.00290 (0.00526)	0.00600* (0.00342)	0.00586 (0.00549)	0.00634* (0.00376)	0.00324 (0.00614)
N	20503	20503	20503	11349	20503	15518

FE = fixed effects estimation; HT = Hausman-Taylor estimation; IV = instrumental variable fixed effects estimation; pool = pooled OLS with cluster robust standard errors; RE = random effects estimation.

Note: Standard errors are in parentheses.

Assets: ln(saving), ln(securities)

* = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$

Source: Authors.

8. CONCLUSION AND LIMITATIONS

The research objective of this paper has been to test whether health and home ownership are correlated. Our estimation results show that homeowners consistently report better self-reported health, including less physical problems. The significance of home ownership remained even after controlling for financial assets and housing conditions. Furthermore, our estimations suggest that home ownership is positively correlated with health care expenditure, even when controlling for income, debt, and other financial assets. We could not reject the exogeneity of home ownership.

Following Grossman (1972), we illustrate our empirical results in a simple modelling framework. In our model, we find that people who live in a better environment have a higher demand for health. However, in Grossman's model, the higher demand for health does not translate necessarily into higher spending on health care, because these individuals also enjoy higher levels of health. Our empirical results suggest that home ownership may indeed increase the demand for better health and also translate into higher spending on medical services and goods.

Our paper makes an important contribution to the existing literature, as the link between home ownership and health has not yet been examined quantitatively. Our empirical results underline the importance of home ownership for health. However, several caveats are in order.

First, in our study we are unable to uncover the cause of better self-reported health. One might suspect that owning a home might provide higher incentives to keep the house well maintained and thus the inhabitants might enjoy better housing conditions, eventually resulting in better health. However, even when controlling for housing conditions, the positive effect of home ownership remains stable. We are thus unable to uncover the reason why homeownership has a positive effect on perceived health conditions.

The second limitation is that we do not have data on actual health outcomes, but only on self-reported health. Differences in self-reported health conditions across the population could be a possible problem. Lindeboom and van Doorslaer (2004) refer to the problem of differences in health reporting across subgroups in Canada. They find "evidence of index shifting and cut-point shifting for age and gender, but not for income, education or language" (p.1083). If this is happening in the Japanese population as well for home ownership, the measurement error of the self-assessed health condition from the "true" health condition could have biased the results.

Furthermore, the possibility of a selection bias from non-response cannot be denied. Nicoletti and Peracchi (2005) provide a taxonomy of reasons for non-response, namely: demographic events, such as death; movements out of the scope of the survey, such as institutionalization or emigration; refusals to respond at subsequent waves; absence of the person at the address; and other types of non-contact. Among these five categories, the second point and the fourth point seem crucial for our research. If people living in a rental house can more easily move out, as a result they may be more likely to drop out of the survey than homeowners—a selection bias may have happened and this could have led to inconsistent estimators. One indication of a possible selection bias in our study is the rise of the home ownership rate in the period covered by the KHPS (see Figure 4).

Despite these limitations, our study provides strong empirical evidence that homeownership is any important determinant of health. Future studies might look at the causal relationship between the two. It also needs to be noted that our results do not

imply that housing conditions are not important for health. Improving housing conditions is still a key issue in most Asian countries for improving health outcomes. For example, as Krieger and Higgins (2002) emphasize there is growing importance of public health action in the creation of healthier homes. However, the importance of home ownership for other socioeconomic outcomes is not yet well understood. We hope that our empirical investigation has shed new light into this debate.

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APPENDIX

Table A.1: Definitions and Descriptive Statistics

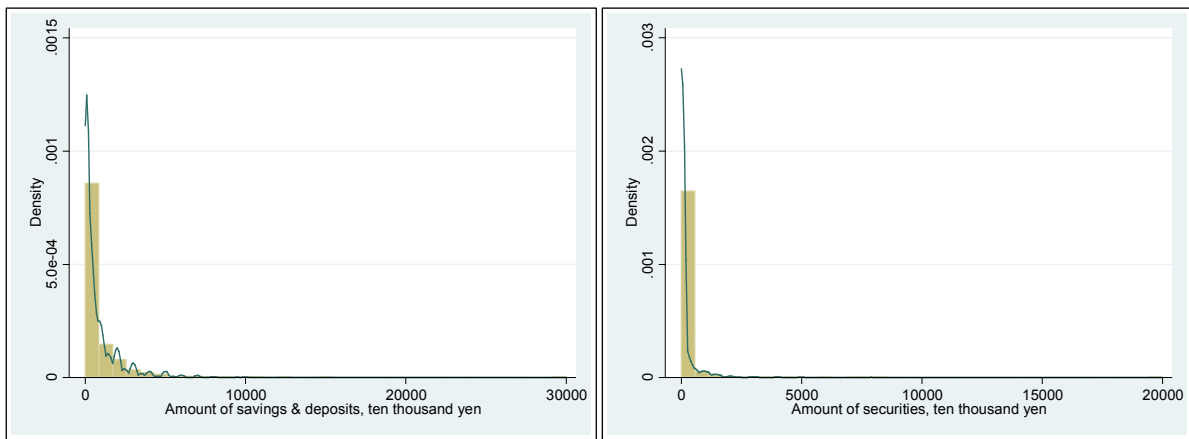
Variable Name	Definition	All			Owner			Renter		
		count	mean	sd	count	mean	sd	count	mean	sd
age	Age	3814	51.87284	13.7536	3066	53.32551	13.37158	748	45.91845	13.70291
senior	1 if over 70	3814	.1116938	.3150306	3066	.1232877	.3288208	748	.0641711	.2452215
male	1 if male	3814	.4819088	.4997381	3066	.4761905	.4995143	748	.5053476	.5003059
married	1 if married	3814	.7587834	.4278775	3066	.7925636	.4055369	748	.6203209	.4856317
familysize	Number of family members living together	3814	3.286576	1.45928	3066	3.432485	1.453636	748	2.688503	1.324479
fulltimeworker	1 if working full-time	3814	.5718406	.4948769	3066	.5541422	.4971411	748	.644385	.4790195
parttimeworker	1 if working part-time	3814	.1339801	.3406756	3066	.1448141	.3519707	748	.0895722	.285759
largecompany	1 if working for a large company(over 500 employees) or public office	3769	.200849	.4006885	3028	.2007926	.4006594	741	.2010796	.4010782
student	1 if student	3814	.0091767	.0953671	3066	.0094586	.09681	748	.0080214	.089262
edulevel1	1 if final education level is compulsory education level	3814	.0786576	.2692389	3066	.0737117	.2613437	748	.0989305	.2987684
edulevel2	1 if final education level is high school level	3814	.4680126	.4990412	3066	.4748858	.4994503	748	.4398396	.4966997
edulevel3	1 if final education level is university level or more	3814	.4462507	.4971678	3066	.444227	.4969607	748	.4545455	.4982628
nsmoker	1 if non-smoker	3800	.5347368	.4988575	3055	.5558101	.4969568	745	.4483221	.4976563
inc	Household's annual income (¥10,000)	3476	665.3743	498.3881	2786	709.0686	525.6453	690	488.9507	311.507
mortgage	1 if having a mortgage	3790	.3118734	.4633195	3047	.3813587	.4858001	743	.0269179	.1619525
ammortgage	Total amount of the unpaid balance of the loan (¥10,000)	3698	477.3905	1098.724	2952	590.1999	1197.98	746	30.99196	236.3869
borrow	Total borrowings (¥10,000)	3717	544.396	1459.342	2978	659.3687	1601.101	739	81.08254	337.9304
saving	Amount of savings and deposits (¥10,000)	3635	776.0171	1379.446	2906	878.5513	1376.361	729	367.2867	1315.349
securities	Amount of securities (¥10,000)	3683	131.2639	613.8291	2954	147.5342	551.9027	729	65.33471	815.2919
own	1 if owning a house or condominium	3814	.8038804	.3971121	3066	1	0	748	0	0
urban	1 if living in a city	3814	.9027268	.2963683	3066	.8900848	.312835	748	.9545455	.2084383
rural	1 if living in a town or village	3814	.0972732	.2963683	3066	.1099152	.312835	748	.0454545	.2084383
spaceratio	Floor space (m ²) per person	3362	42.24126	41.43105	2709	45.92508	40.5936	653	26.9588	41.40251
yardratio	Yard size (m ²) per person	3650	15.39595	41.2823	2904	19.18128	45.47854	746	.6605563	3.819632
hage	Age of house/apartment	3501	24.12539	15.11336	2843	24.18431	15.47279	658	23.87082	13.45832
distance	Time-distance to the nearest station/bus stop (minutes)	3680	10.0856	9.191125	2971	10.23258	9.4759	709	9.469676	7.862932
seniorbarrierfree	1 if person over 70 lives in the house with amenities for the elderly	3671	.0645601	.2457814	2968	.074124	.2620167	703	.0241821	.1537235
roomratio	Number of rooms per person	3660	1.96748	1.1945	2966	2.063551	1.225704	694	1.556898	.9473393
yard	1 if having a yard	3629	.5428493	.4982292	2892	.6614799	.4732882	737	.0773406	.2673125
prntlive	1 if living with parents	3814	.5702674	.4951028	3066	.5838226	.4930041	748	.5147059	.5001181
sah	1 if excellent or good health	2041	.7261146	.4460601	1621	.7365824	.4406229	420	.6857143	.4647844
physical	1 if physically fine	3642	.6367381	.4810054	2926	.6483254	.4775746	716	.5893855	.4922893
mental	1 if psychologically fine	3653	.6307145	.4826774	2935	.637138	.4809074	718	.6044568	.4893079
fullscreen	1 if undertaken a multiphase health screening	3814	.1074987	.3097868	3066	.1203523	.3254261	748	.0548128	.2277669
cancerscreen	1 if undertaken a cancer screening	3814	.2052963	.4039709	3066	.223092	.4163874	748	.1323529	.3391008
companyscreening	1 if undertaken a company or municipal screening	3814	.5089145	.4999861	3066	.5146771	.4998661	748	.4852941	.5001181
medexp	Medical care expenditure (¥1,000)	3639	12.56142	25.65424	2909	13.78584	27.90892	730	7.682192	12.14398
medexp2	Positive medical expenditure	2915	15.6813	27.79781	2409	16.64716	29.88291	506	11.083	13.23351

m² = square meter, sd = standard deviation. Source: Authors.

Table A.2: Correlation Matrix (All Samples)

	age	agesq	senior	male	married	familysize	fulltime worker	parttime worker	largecom pany	student	nsmoker	edulevel 2	edulevel 3	lninc	lnborro w	mortgag e	own	urban	lnsavin g	lnsecurit ies	lnspacera tio	lnyardra tio	lndistan ce	hage	seniorbar rierfree	sah	physical	mental	fullscre en	cancers reen	compan yscreen	lnmedex p
age	1																															
agesq	0.9909	1																														
senior	0.4858	0.5524	1																													
male	0.0452	0.048	0.0361	1																												
married	0.2085	0.1704	0.0098	0.0647	1																											
familysize	-0.2409	-0.268	-0.18	-0.0189	0.3134	1																										
fulltimeworker	-0.2629	-0.2855	-0.2457	0.4523	-0.103	0.0607	1																									
parttimeworker	-0.0093	-0.0194	-0.0344	-0.3471	0.0848	0.0805	-0.4957	1																								
largecompany	-0.1774	-0.1915	-0.1275	0.1325	0.011	0.0316	0.2795	-0.0129	1																							
student	-0.1647	-0.1308	-0.0211	0.0235	-0.1717	-0.0126	-0.112	0.0872	-0.0142	1																						
nsmoker	0.0037	0.0128	0.0352	-0.4745	-0.0402	-0.0149	-0.2555	0.1691	-0.031	0.0441	1																					
edulevel2	0.1503	0.1434	0.0497	-0.0658	0.0561	0.0192	-0.0514	0.038	-0.0861	-0.0834	-0.0582	1																				
edulevel3	-0.2748	-0.2757	-0.1372	0.0685	-0.0429	0.0194	0.1073	-0.018	0.1456	0.0956	0.0522	-0.8716	1																			
lninc	-0.0674	-0.0928	-0.1127	0.0422	0.2726	0.3058	0.1586	0.0245	0.1768	-0.0449	0.0318	-0.096	0.1781	1																		
lnborrow	-0.1898	-0.2249	-0.1684	0.0356	0.2061	0.2443	0.1249	0.0638	0.1178	-0.0324	-0.0628	-0.0033	0.0518	0.2068	1																	
mortgage	-0.1833	-0.215	-0.1478	0.0173	0.2121	0.2626	0.1016	0.0685	0.134	-0.0207	-0.0133	-0.0314	0.0725	0.2258	0.7829	1																
own	0.2584	0.245	0.0856	-0.0044	0.1614	0.224	-0.0764	0.052	-0.0253	-0.0102	0.0838	0.0221	-0.0192	0.2257	0.2338	0.3431	1															
urban	-0.0311	-0.0286	-0.0086	0.0172	-0.0575	-0.0863	-0.0028	-0.0124	0.0241	0.0152	-0.0262	-0.0507	0.0575	-0.0218	0.0029	0.019	-0.074	1														
lnsavin	0.2562	0.2473	0.0913	-0.0164	0.1937	-0.0423	-0.0926	0.0046	0.045	-0.0657	0.1208	-0.0845	0.1156	0.2596	-0.1805	-0.0945	0.1969	-0.0178	1													
lnsecurities	0.2424	0.2369	0.085	0.0256	0.1176	-0.0775	-0.1186	0.0204	0.0457	-0.0309	0.0697	-0.0866	0.1203	0.1561	-0.1196	-0.0857	0.143	0.0375	0.3907	1												
lnspacratio	0.3658	0.3789	0.1985	0.0139	-0.1326	-0.4438	-0.068	-0.0367	-0.0783	0.0022	0.0684	0.0199	-0.0354	-0.007	-0.0888	-0.0743	0.3509	-0.0571	0.2005	0.1795	1											
lnyardratio	0.3073	0.3089	0.1415	0.0096	0.0592	-0.0362	-0.0857	0.0015	-0.0391	0.0078	0.0743	0.0173	-0.0234	0.1086	-0.0355	-0.0251	0.4067	-0.1599	0.219	0.1909	0.4651	1										
lndistance	-0.0357	-0.0351	-0.0191	-0.0168	-0.0077	0.0571	-0.0249	0.036	-0.0073	0.0264	0.0115	-0.0013	-0.0002	0.0198	0.021	0.0357	0.0298	-0.0789	0.0318	0.0204	-0.0146	0.0795	1									
hage	0.3374	0.3499	0.1818	-0.0129	-0.1255	-0.1183	-0.0969	-0.0297	-0.1321	-0.0199	0.0189	0.079	-0.1323	-0.1444	-0.3353	-0.4102	0.0232	-0.0023	0.0387	0.0383	0.1081	0.1523	-0.0243	1								
seniorbarrierfree	0.3684	0.4182	0.7626	0.0041	0.0013	-0.1471	-0.1897	-0.0231	-0.0993	-0.0137	0.0381	0.0549	-0.1126	-0.0707	-0.1248	-0.1047	0.0717	0.0038	0.0805	0.0906	0.1794	0.0938	-0.0396	0.0658	1							
sah	-0.1608	-0.1629	-0.109	0.0217	0.0441	0.0831	0.1333	0.0445	0.0571	0.0231	0.0102	-0.0319	0.1117	0.1269	0.0528	0.0633	0.0112	-0.0075	0.0632	-0.0029	-0.046	-0.0299	0.0044	-0.0973	-0.073	1						
physical	0.0119	0.0195	0.0075	0.1067	-0.0034	-0.0158	0.0654	-0.0185	0.0332	0.0306	0.0158	-0.0416	0.0715	0.0646	-0.0313	-0.019	0.0441	-0.0175	0.073	0.0328	0.0433	0.0421	-0.0009	-0.0016	0.0152	0.4696	1					
mental	0.0095	0.0168	0.0336	0.0803	0.0476	-0.01	0.0397	0.0132	0.0404	0.0223	0.0241	-0.0287	0.0536	0.0924	-0.0355	-0.0174	0.0312	-0.0137	0.1124	0.0473	0.0378	0.0514	0.0029	-0.0232	0.0335	0.395	0.4299	1				
fullscreen	0.0676	0.051	-0.0115	0.1186	0.0993	0.0053	0.095	-0.0433	0.1284	-0.0214	-0.0157	-0.0729	0.1032	0.1756	0.0244	0.0493	0.0761	-0.017	0.1382	0.1345	0.0686	0.0766	0.0101	-0.045	-0.0002	0.0273	0.0131	0.0371	1			
cancerscreen	0.1567	0.1561	0.0876	-0.2228	0.0438	-0.0478	-0.2038	0.0656	-0.0672	-0.038	0.115	-0.0039	-0.0086	0.0152	-0.0646	-0.0536	0.0615	-0.0154	0.1345	0.09	0.0861	0.0855	-0.0138	0.0402	0.0683	-0.0514	-0.035	-0.0147	0.0116	1		
companyscreen	-0.0283	-0.0331	-0.0262	0.1302	0.0054	0.0012	0.235	-0.0709	0.1841	-0.0364	-0.0244	-0.0018	0.0254	0.0847	0.03	0.0388	0.0221	-0.0105	0.0772	0.0006	-0.0053	0.0231	0.0378	-0.0271	-0.0137	0.0619	0.0437	0.0254	-0.2804	-0.0111	1	
lnmedexp	0.1609	0.1615	0.0665	-0.0014	0.1176	0.0921	-0.0615	-0.0083	-0.0212	-0.0227	0.0151	0.0055	-0.0175	0.156	-0.0274	-0.015	0.1568	-0.0125	0.1166	0.1143	0.0715	0.112	-0.0168	0.0667	0.0583	-0.1434	-0.0717	-0.0671	0.0614	0.0871	0.0006	1

Source: Authors.

Figure A.1: Histogram of Savings and Securities, 2012

Source: Authors.

Table A.3: Estimation Results for Self-Assessed Health (Random Effects Probit Estimation, without Financial Assets, Average Marginal Effects)

	(1) Sah	(2) Physical health	(3) Mental health	(4) Sah with housing conditions	(5) Physical health with housing conditions	(6) Mental health with housing conditions
age	-0.0627*** (0.00459)	0.00129 (0.00242)	-0.000466 (0.00236)	-0.0518*** (0.00589)	0.00319 (0.00279)	0.000314 (0.00268)
senior	-0.392*** (0.139)	0.0303 (0.0779)	0.0149 (0.0773)	-0.202 (0.264)	-0.0365 (0.122)	-0.141 (0.119)
male	0.125 (0.112)	0.765*** (0.0634)	0.464*** (0.0611)	0.0931 (0.140)	0.787*** (0.0700)	0.452*** (0.0665)
married	0.748*** (0.116)	-0.0916 (0.0623)	0.186*** (0.0603)	0.767*** (0.151)	-0.179** (0.0708)	0.171** (0.0680)
familysize	0.0204 (0.0311)	-0.00376 (0.0166)	-0.0353** (0.0163)	0.0535 (0.0471)	-0.0114 (0.0221)	-0.0386* (0.0215)
fulltimeworker	0.700*** (0.0905)	-0.0764 (0.0521)	0.0386 (0.0508)	0.773*** (0.114)	-0.0769 (0.0575)	0.0128 (0.0557)
parttimeworker	0.490*** (0.101)	0.0143 (0.0569)	0.135** (0.0563)	0.499*** (0.122)	0.0550 (0.0630)	0.128** (0.0620)
student	1.402*** (0.394)	0.349 (0.222)	0.362* (0.203)	1.459*** (0.485)	0.257 (0.255)	0.500** (0.236)
nsmoker	0.381*** (0.0881)	0.267*** (0.0537)	0.221*** (0.0525)	0.184 (0.117)	0.263*** (0.0593)	0.250*** (0.0574)
edulevel2	0.849*** (0.194)	0.130 (0.0963)	0.0561 (0.0939)	1.165*** (0.286)	0.223** (0.108)	0.120 (0.104)
edulevel3	0.891*** (0.200)	0.245** (0.101)	0.102 (0.0987)	1.400*** (0.290)	0.350*** (0.114)	0.151 (0.109)
lninc	0.0484 (0.0431)	0.0733*** (0.0253)	0.108*** (0.0251)	0.00879 (0.0514)	0.0615** (0.0282)	0.119*** (0.0280)
lnborrow	-0.0259* (0.0134)	-0.0266*** (0.00767)	-0.0343*** (0.00755)	-0.0186 (0.0164)	-0.0260*** (0.00847)	-0.0288*** (0.00833)
mortgage	0.0707 (0.109)	-0.00606 (0.0625)	0.106* (0.0614)	-0.0323 (0.139)	-0.00284 (0.0714)	0.0584 (0.0698)
own	0.282** (0.114)	0.167*** (0.0628)	0.0939 (0.0618)	0.482*** (0.165)	0.175** (0.0799)	0.0654 (0.0779)
urban	-0.551*** (0.132)	-0.0640 (0.0715)	-0.0947 (0.0697)	-0.335* (0.176)	-0.0923 (0.0814)	-0.0697 (0.0785)
lnspaceratio				-0.0284 (0.110)	-0.0459 (0.0519)	-0.0689 (0.0504)
lnyardratio				-0.0327 (0.0426)	0.0338* (0.0201)	0.0516*** (0.0193)
lndistance				0.0150 (0.0602)	0.00458 (0.0295)	-0.0170 (0.0283)
hage				-0.0106*** (0.00391)	-0.000448 (0.00190)	-0.00175 (0.00182)
seniorbarrierfree				-0.375 (0.335)	0.0408 (0.153)	0.269* (0.150)
N	16420	19630	19732	11936	16635	16718

Notes: Standard errors are in parentheses. Random effects probit estimation.

Assets: ln(saving), ln(securities)

* = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$

Source: Authors.

Table A.4: Estimation Results for Preventive Health Care (Random Effects Probit Estimation, without Financial Assets, Average Marginal Effects)

	(1) Complete screening	(2) Cancer screening	(3) Periodic screening	(4) Complete screening with housing conditions	(5) Cancer screening with housing conditions	(6) Periodic screening with housing conditions
age	0.0332*** (0.00407)	0.0328*** (0.00256)	0.00455** (0.00225)	0.0324*** (0.00463)	0.0302*** (0.00286)	0.00289 (0.00258)
senior	-0.414*** (0.121)	0.0957 (0.0702)	0.00475 (0.0691)	-0.495** (0.224)	0.147 (0.110)	0.103 (0.109)
male	0.429*** (0.0983)	-1.222*** (0.0657)	0.344*** (0.0580)	0.522*** (0.108)	-1.196*** (0.0715)	0.324*** (0.0637)
married	0.593*** (0.110)	0.203*** (0.0636)	0.00238 (0.0577)	0.511*** (0.122)	0.226*** (0.0710)	0.0393 (0.0655)
familysize	-0.0497* (0.0255)	-0.0264 (0.0169)	-0.0644*** (0.0155)	-0.0182 (0.0343)	-0.0245 (0.0222)	-0.0660*** (0.0208)
fulltimeworker	0.195** (0.0865)	-0.342*** (0.0516)	0.838*** (0.0496)	0.232** (0.0954)	-0.367*** (0.0564)	0.808*** (0.0545)
parttimeworker	-0.00730 (0.0999)	-0.229*** (0.0545)	0.325*** (0.0545)	0.0613 (0.109)	-0.216*** (0.0595)	0.264*** (0.0596)
largecompany	0.548*** (0.0731)	-0.000450 (0.0553)	0.474*** (0.0470)	0.499*** (0.0790)	-0.00248 (0.0596)	0.475*** (0.0509)
student	-0.663 (0.655)	-0.322 (0.317)	-0.373* (0.191)	-0.689 (0.687)	-0.441 (0.346)	-0.338 (0.213)
nsmoker	0.184** (0.0831)	-0.0986* (0.0530)	0.188*** (0.0497)	0.216** (0.0908)	-0.106* (0.0581)	0.205*** (0.0547)
edulevel2	0.469*** (0.163)	0.131 (0.0870)	0.184** (0.0887)	0.868*** (0.204)	0.117 (0.0970)	0.153 (0.0997)
edulevel3	0.983*** (0.170)	0.407*** (0.0928)	0.100 (0.0934)	1.355*** (0.211)	0.367*** (0.103)	0.0641 (0.105)
lninc	0.494*** (0.0533)	0.0912*** (0.0286)	0.162*** (0.0250)	0.527*** (0.0587)	0.0760** (0.0311)	0.136*** (0.0278)
lnborrow	-0.00923 (0.0126)	0.00860 (0.00848)	0.000237 (0.00726)	-0.0167 (0.0138)	0.00480 (0.00931)	0.000239 (0.00802)
mortgage	0.102 (0.0969)	-0.148** (0.0659)	-0.0279 (0.0583)	0.122 (0.110)	-0.205*** (0.0746)	-0.0527 (0.0666)
own	0.369*** (0.109)	0.161** (0.0654)	0.107* (0.0596)	0.227* (0.133)	0.108 (0.0812)	0.110 (0.0762)
urban	-0.206* (0.105)	-0.0305 (0.0675)	-0.0465 (0.0662)	-0.0911 (0.120)	-0.0546 (0.0757)	-0.0309 (0.0749)
lnspaceratio				0.109 (0.0810)	0.0473 (0.0506)	-0.0572 (0.0485)
lnyardratio				0.0366 (0.0299)	0.0457** (0.0183)	0.0236 (0.0185)
lndistance				0.0532 (0.0448)	-0.00663 (0.0279)	0.0575** (0.0273)
hage				-0.00654** (0.00306)	-0.00537*** (0.00184)	-0.00176 (0.00179)
seniorbarrierfree				0.110 (0.263)	-0.0666 (0.133)	-0.0646 (0.134)
N	20283	20283	20283	17136	17136	17136

Notes: Standard errors are in parentheses. Random effects probit estimation.

Assets: ln(saving), ln(securities)

* = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$

Source: Authors.

Table A.5: Estimation Results for Medical Expenditure (without Financial Assets)

	(1) Medical expenditure Pool without assets	(2) Medical expenditure FE without assets	(3) Medical expenditure RE without assets	(4) Medical expenditure Heckman without assets	(5) Medical expenditure HT without assets	(6) Medical expenditure IV without assets
age	-0.0286*** (0.00607)	-0.0328*** (0.0124)	-0.0265*** (0.00558)	-0.0207** (0.00908)	-0.0297*** (0.00819)	-0.0417*** (0.0142)
agesq	0.000366*** (0.0000637)	0.000239** (0.000121)	0.000333*** (0.0000581)	0.000278*** (0.0000949)	0.000355*** (0.0000833)	0.000319** (0.000137)
senior	-0.233*** (0.0428)	-0.125*** (0.0430)	-0.208*** (0.0352)	-0.194*** (0.0665)	-0.202*** (0.0377)	-0.149*** (0.0480)
male	0.0314 (0.0233)		0.0413* (0.0214)	0.0246 (0.0336)	0.0389 (0.0259)	
married	-0.000293 (0.0284)	0.249*** (0.0595)	0.0262 (0.0237)	-0.0454 (0.0414)	0.0578** (0.0284)	0.252*** (0.0794)
familysize	0.0428*** (0.00696)	0.0385*** (0.0116)	0.0462*** (0.00635)	0.0259** (0.0105)	0.0440*** (0.00746)	0.0299** (0.0146)
fulltimeworker	-0.0144 (0.0237)	-0.0408 (0.0310)	-0.0266 (0.0208)	0.00845 (0.0341)	-0.0269 (0.0226)	-0.0230 (0.0377)
parttimeworker	-0.0391 (0.0261)	-0.0534* (0.0309)	-0.0473** (0.0235)	-0.0338 (0.0384)	-0.0468* (0.0247)	-0.0319 (0.0360)
student	0.0168 (0.0932)	-0.110 (0.116)	-0.0323 (0.0820)	0.113 (0.143)	-0.0461 (0.0874)	-0.199 (0.143)
nsmoker	-0.0364* (0.0199)	-0.0597 (0.0367)	-0.0301 (0.0184)	-0.0619** (0.0288)	-0.0330 (0.0213)	-0.108*** (0.0397)
edulevel2	-0.0201 (0.0346)		-0.0260 (0.0323)	0.00963 (0.0530)	-0.0351 (0.0405)	
edulevel3	-0.0455 (0.0361)		-0.0489 (0.0341)	-0.0472 (0.0541)	-0.0580 (0.0427)	
lninc	0.137*** (0.0146)	0.0606*** (0.0158)	0.106*** (0.0113)	0.117*** (0.0212)	0.0917*** (0.0128)	0.0532*** (0.0198)
lnborrow	-0.00189 (0.00347)	-0.00699* (0.00402)	-0.00407 (0.00317)	-0.00145 (0.00510)	-0.00503 (0.00328)	-0.00773* (0.00460)
mortgage	-0.0709*** (0.0261)	-0.0407 (0.0359)	-0.0675*** (0.0245)	-0.0849** (0.0385)	-0.0547** (0.0279)	-0.0758 (0.0467)
own	0.182*** (0.0266)	0.146*** (0.0495)	0.187*** (0.0240)	0.148*** (0.0384)	0.174*** (0.0459)	0.264** (0.124)
urban	-0.000297 (0.0260)	0.0857 (0.0540)	0.00231 (0.0247)	0.0369 (0.0407)	0.00415 (0.0293)	0.0624 (0.0630)
N	21429	21429	21429	11735	21429	16269

Pool: pooled OLS with cluster robust standard errors; FE= fixed effects estimation; RE = random effects estimation; HT = Hausman-Taylor estimation; IV = instrumental variable fixed effects estimation;

Notes: Standard errors are in parentheses.

assets: ln(saving), ln(securities)

* = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$

Source: Authors.