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Health and Home Ownership: Findings for the Case of Japan

Toshiaki Aizawa and
Matthias Helble

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Toshiaki Aizawa is a research associate at the Asian Development Bank Institute (ADBI).
Matthias Helble is a research fellow at ADBI.

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Please contact the authors for information about this paper.

Email:

Toshiaki Aizawa: taizawa@adbi.org

Matthias Helble: mhelble@adbi.org

Asian Development Bank Institute
Kasumigaseki Building 8F
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500

Fax: +81-3-3593-5571

URL: www.adbi.org

E-mail: info@adbi.org

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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 fewer physical and mental problems. The significance of home ownership remains even when controlling for 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. Our empirical results thus provide evidence for the importance of home ownership for health.

JEL Classification: I12, I15

Contents

1.	Introduction.....	3
2.	Brief Overview of the Literature.....	3
3.	Economic Theory.....	5
4.	Data Description	7
4.1	The Keio Household Panel Survey	7
4.2	Health-related Dependent Variables	8
4.3	Independent Variables	9
5.	Descriptive Statistics.....	12
5.1	Home Ownership	12
5.2	Financial Situation of Homeowners versus Renters	13
5.3	Health of Homeowners versus Renters.....	15
6.	Estimation strategy	17
6.1	Estimation 1: Home Ownership and Self-assessed Health.....	17
6.2	Estimation 2: Home Ownership and Preventive Health Care	17
6.3	Estimation 3: Home Ownership and Medical Expenditure	18
7.	Estimation results	20
7.1	Estimation 1: Home Ownership and Self-assessed Health.....	20
7.2	Estimation 2: Home Ownership and Preventive Health Care	22
7.3	Estimation 3: Home Ownership and Medical Expenditure	25
8.	Conclusions and Limitations	27
	References	29

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 homeowners 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 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). We dichotomize⁶ the choices and define 12 dummy variables for each of the 12 health disorders (1: good condition, 0: bad condition).

We additionally introduce two new variables. The first is a physical health condition index (ranging from 0 to 6), which is defined from the aggregated values of the first six good condition dummies related to physical health. The second is a psychological health condition index (ranging from 0 to 6), which is defined in the same way by aggregating the other six good condition dummies related to psychological health.

⁶ “Often” and “sometimes” are considered to be bad conditions and “rarely” and “never” are considered to be good conditions.

4.2.2 Medical Expenditure

In the KHPS, medical expenditure 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. Medical expenditure is reported in thousands of yen.

4.2.3 Screenings

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

4.3 Independent Variables

4.3.1 Housing Variables

The key explanatory variable in our paper is home ownership, 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 amenities for the elderly 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:

- *Handrail for the elderly*: A dummy variable that equals 1 if a respondent over 70 years of age is living in a house with handrails.
- *Bath for the elderly*: A dummy variable that equals 1 if a respondent over 70 years of age is living in a house with a special bath for the elderly.
- *Floor step for the elderly*: A dummy variable that equals 1 if a respondent over 70 years of age is living in a house without steps.
- *Passage for the elderly*: A dummy variable that equals 1 if a respondent over 70 years of age is living in a house with a passage wide enough for a wheelchair.
- *Entrance for the elderly*: A dummy variable that equals 1 if a respondent over 70 years of age is living in a house with a wide entrance enough for a wheelchair.
- *Age of house/apartment*: The age of the home.
- *Squared age of house/apartment*: The squared age of the home.
- *ln(Distance)*: Number of minutes to the nearest station on foot.

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 sociodemographic characteristics, we introduce the following variables:

- *Age*: The age of the respondent.
- *Family size*: 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.
- *Nonsmoker*: A nonsmoker dummy that equals 1 if respondent is a nonsmoker and 0 otherwise.
- 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.
- *Age over 70*: A variable that 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:

- *Income*: The 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.
- *Debt*: The balance of the household's present borrowings, reported in units of ¥10,000.
- *Savings*: 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. Savings include foreign currency denominated deposits (yen equivalent) but exclude 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 Naseri-moadeli (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 are used:

- *Secondary education*: A dummy variable that is equal to 1 if the final education level is high school graduation.
- *Tertiary education*: A dummy variable that 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 these financial incentives, we use a company size dummy variable (*Large company*) that 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 (*Full-time worker*) or a part-time worker (*Part-time worker*). 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. A student dummy that equals 1 if a respondent is a student is also defined.

5. DESCRIPTIVE STATISTICS

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. 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.

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

CI = confidence interval.

Source: Authors.

5.2 Financial Situation of Homeowners 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.

Homeowners 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.

5.3 Health of Homeowners versus Renters

Figures 9 and 10 show the sample means for the self-assessed health, physical health, and mental health of renters and owners. Those who own a house or condominium tend to enjoy slightly better health and consider themselves to have a better physical and mental health.

Figure 9: Health of Homeowners 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 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 monthly medical expenditure (in units of ¥1,000) for renters and homeowners for responses during the period 2004–2012.⁷ We observe that the medical expenditure of homeowners was consistently higher than that of renters. (The 95% confidence intervals do not overlap in any period of the survey.) Medical expenditure during 2006 and 2007 among homeowners was higher than in other years. The reason could be due to outliers in both years. We found a few outliers with values exceeding 700 (i.e., ¥700,000) in 2006 and 2007 and one respondent answered that they had spent ¥1,473,000 in 2007. Although one respondent reported spending ¥1,000,000 in 2011, no household spent more than ¥700,000 in any other year.

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

(¥1,000)

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.

⁷ The survey asked for the amount of medical expenditures in the month prior to the interview.

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.

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). To control for the possible endogeneity problem, as suggested by Aaronson (2000), we perform a traditional instrumental variable (IV)/generalized method of moments (GMM) estimation of the panel data with the variable *Ownership*, which is potentially correlated with the error term. As excluded variables, we use the information on whether respondents live with their parents, the size of the yard per person in the house, and the number of rooms per person in the house. The random effects estimator is used because we are interested in the effects of gender and educational background, which are time invariant and thus cannot be estimated in the fixed effects model.

The equation that we will estimate takes the following form:

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

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

Finally we add the interaction terms of the ownership dummy, and the male and the urban dummy as explanatory variables to capture the specific effects of home ownership found only for men and for urban areas.

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 (*Large company*), in our estimation to control for such financial incentive schemes.

The equation we will estimate takes the following form:

$$\begin{aligned} Screenings_{it} = & \alpha + \gamma_1 Ownership_{it} + (Socio\ economic\ status)_{it}'\beta_1 + \gamma_2 Urban_{it} \\ & + (Financial\ assets)_{it}'\beta_2 + (Housing\ conditions)_{it}'\beta_3 + \varepsilon_{it} \end{aligned}$$

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

As before, we add the interaction terms of the ownership dummy and the male and the urban dummy as explanatory variables to capture the specific effects of home ownership found only for men and for urban areas.

6.3 Estimation 3: Home Ownership and Medical Expenditure

The third objective is to test whether home ownership is related to demand for medical goods and services as measured by medical expenditure. We use the logarithmic amount of medical expenditure per family member as the dependent variable.

Our objective is to test the hypothesis of whether homeowners have higher health care expenditure, even after controlling for income, education level, financial situation, and other sociodemographic variables. The equation we will estimate takes the following form:

$$\begin{aligned} \ln(medical\ expenditure)_{it} &= \alpha + \gamma_1 Ownership_{it} + (Socio\ economic\ status)_{it}'\beta_1 + \gamma_2 Urban_{it} \\ &+ (Financial\ assets)_{it}'\beta_2 + (Housing\ conditions)_{it}'\beta_3 + \varepsilon_{it}, \\ \varepsilon_{it} &= \alpha_i + u_{it} \end{aligned}$$

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

In this estimation, we include zero medical expenditure. The reason is that focusing attention only on households with positive health expenditure may cause a selection bias. For the first step, we perform the random effects estimation under the assumption that home ownership is exogenous. However, healthy people may not have undertaken any treatment or bought any medical goods 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.

$$\ln(\text{medical expenditure})_i^* = \alpha + x'_{1i}\beta_1 + \varepsilon_{1i}$$

$$exp_i^* = \alpha + x'_{2i}\beta_2 + \varepsilon_{2i}$$

$$\ln(\text{medical expenditure})_i = \ln(\text{medical expenditure})_i^*, exp_i = 1 \quad \text{if } exp_i^* > 0$$

$$\ln(\text{medical expenditure})_i = \text{Unobservable}, exp_i = 0 \quad \text{if } exp_i^* \leq 0$$

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 the coefficients of x_j , ($j = 1, 2$).

Next, we control for possible endogeneity of home ownership, 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 advantage of the Hausman-Taylor estimation is that one does not have to find external valid instruments (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 random-effects panel data model with the variable *Ownership*, which is potentially correlated with the error term. 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 .

We finally add the interaction terms of the ownership dummy and the male and the urban dummy as explanatory variables to capture the specific effects of home ownership found only for men and for urban areas.

7. ESTIMATION RESULTS

7.1 Estimation 1: Home Ownership and Self-assessed Health

As we include three instrumental variables for the IV/GMM estimation, the model is over-identified and we confirm that these instruments are valid and not weak. The F-value of the first-stage estimations to test whether the instrumental variables are relevant are 4675.90 ($p < 0.01$), which assures that our instrumental variables are not weak. The results of estimation 1 are summarized in Table 2. Firstly, for self-assessed overall health (column 1), we find that homeowners are significantly more likely to feel healthy than renters, even when controlling for housing conditions.

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 self-assessed health. Men tend to report better health than women. Family size does not show significance, but those who are married tend to report better health.

Workers (full-time and part-time), students and nonsmokers are significantly more likely to report better health. Furthermore, our results do not show that higher educational achievements are linked with better health. Although a significant link between education level and health has been found in previous studies (Grossman 1972; Kenkel 1991; Berger and Leigh 1989), we are unable to find significance in our estimation. Income and securities do not show significant effects on overall health conditions, but savings do. Debt and mortgage have negative significant effects. It is difficult to explain why only savings positively influences 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 2: Estimation Results for Self-Assessed Health (Random Effects Probit Estimation, Average Marginal Effects)

	(1) SAH IV	(2) Physical health IV	(3) Mental health IV	(4) SAH IV	(5) Physical health IV	(6) Mental health IV
Ownership	0.170*** (0.0594)	0.315*** (0.118)	0.296** (0.131)	1.369*** (0.513)	1.351 (1.223)	2.694*** (1.330)
Age	-0.0200*** (0.00599)	-0.0463*** (0.0122)	-0.0830*** (0.0134)	-0.0218*** (0.00606)	-0.0470*** (0.0122)	-0.0841*** (0.0136)
Age squared	0.0000211 (0.0000628)	0.000476*** (0.000126)	0.000797*** (0.000138)	0.0000406 (0.0000629)	0.000486*** (0.000126)	0.000806*** (0.000140)
Age over 70	-0.0529 (0.0430)	-0.157* (0.0828)	-0.286*** (0.0922)	-0.0559 (0.0432)	-0.159* (0.0829)	-0.289*** (0.0926)
Male	0.0707*** (0.0254)	0.657*** (0.0518)	0.484*** (0.0563)	0.145** (0.0713)	0.755*** (0.143)	0.764*** (0.157)
Married	0.158*** (0.0272)	-0.0650 (0.0541)	0.240*** (0.0593)	0.158*** (0.0275)	-0.0666 (0.0547)	0.241*** (0.0606)
Family size	0.00861 (0.00757)	-0.0119 (0.0150)	-0.0328** (0.0165)	0.00806 (0.00773)	-0.0116 (0.0156)	-0.0345** (0.0173)
Full-time worker	0.161*** (0.0210)	-0.00706 (0.0422)	0.106** (0.0466)	0.159*** (0.0211)	-0.00871 (0.0423)	0.0999** (0.0469)
Part-time worker	0.0891*** (0.0228)	0.0468 (0.0458)	0.150*** (0.0507)	0.0835*** (0.0230)	0.0411 (0.0461)	0.133*** (0.0513)
Student	0.238*** (0.0725)	0.541*** (0.169)	0.448** (0.186)	0.244*** (0.0728)	0.558*** (0.168)	0.479** (0.187)
Nonsmoker	0.156*** (0.0201)	0.192*** (0.0441)	0.254*** (0.0483)	0.154*** (0.0205)	0.192*** (0.0445)	0.250*** (0.0493)
Secondary education	0.0493 (0.0409)	0.154* (0.0831)	0.0286 (0.0902)	0.0608 (0.0409)	0.165** (0.0831)	0.0472 (0.0917)
Tertiary education	0.0416 (0.0434)	0.206** (0.0878)	0.00583 (0.0953)	0.0565 (0.0434)	0.219** (0.0876)	0.0299 (0.0967)
ln(Income)	-0.0128 (0.0106)	0.0383* (0.0213)	0.0902*** (0.0235)	-0.0141 (0.0108)	0.0388* (0.0213)	0.0888*** (0.0237)
ln(Debt)	-0.00713** (0.00295)	-0.0151** (0.00615)	-0.0281*** (0.00679)	-0.00638** (0.00296)	-0.0140** (0.00620)	-0.0256*** (0.00686)
Mortgage	-0.0643** (0.0287)	-0.0999* (0.0589)	0.0202 (0.0652)	-0.0636** (0.0290)	-0.0969 (0.0611)	0.0168 (0.0676)
Urban	-0.107*** (0.0282)	-0.0498 (0.0592)	-0.0530 (0.0646)	0.984** (0.402)	0.884 (0.986)	2.037* (1.072)
ln(Savings)	0.0119*** (0.00316)	0.0112* (0.00652)	0.0297*** (0.00718)	0.0119*** (0.00318)	0.0112* (0.00658)	0.0293*** (0.00727)
ln(Securities)	0.00408 (0.00351)	0.00266 (0.00688)	0.00944 (0.00761)	0.00425 (0.00352)	0.00294 (0.00689)	0.00972 (0.00766)
Ownership*Male				-0.105 (0.0887)	-0.132 (0.177)	-0.372* (0.194)
Ownership*Urban				-1.249*** (0.455)	-1.061 (1.108)	-2.373** (1.204)
Observations	20,781	14,473	14,560	20,781	14,473	14,560

IV = instrumental variable random effects estimator, SAH = self-assessed health.

Note: Standard errors are in parentheses. Housing characteristics and quality are controlled for.

Random effects estimator.

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

Source: Authors.

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

As for physical and mental health (columns 2 and 3), the results show that home ownership positively affects both physical and mental health. Income and savings positively affect both physical and mental health at the 10% level, while borrowing negatively affects physical and mental health at the 1% level. The mortgage dummy is not significant for mental health.

Interestingly, men reported better self-assessed health as well as physical and mental conditions. Married people tend to have better mental health conditions. For 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 either physical or mental health.

Columns 4–6 show the estimation results including the interaction terms. For self-assessed health (column 4), homeowners in urban regions suffer from slightly worse health compared to homeowners in rural areas, *ceteris paribus*, but they still enjoy better health than renters. Interestingly, on the other hand, the results show that renters in urban areas report better health compared to renters in rural areas, because the urban dummy turns positive and is significant. For physical health, we find insignificance of ownership and of the interaction terms, but reject the null that they are jointly insignificant ($p < 0.00$). For mental health, we find that ownership has the strongest influence on health for people living in rural regions. Although homeowners in urban areas have smaller health benefits of ownership than those in rural regions, their health conditions are found to be better than those of tenants both in urban and rural areas. Male homeowners on average tend to report fewer mental problems than female owners and renters, other things being equal. Male tenants are less healthy psychologically than homeowners, but are more likely to feel healthy mentally than female tenants.

7.2 Estimation 2: Home Ownership and Preventive Health Care

The estimations results for screenings are summarized in Table 3. The results show that homeowners are more likely to have a complete medical checkup and cancer screening than renters (columns 1 and 2). As expected, we do not find a significant result for the case of the periodic checkup (column 3).

The other estimation results hold interesting information. Age shows significance for the complete 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 is 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. Nonsmokers 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 viewpoint, 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, although it is not statistically significant. 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.

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. Only the highest educational level dummy shows significance for cancer screening.

The results show that the amount of debt does not affect the incentives to undergo these screenings, but having a mortgage negatively affects the incentive to undergo a cancer-specific examination. Savings as well as income show significant correlations for all three screenings, and securities shows significance only for a complete medical checkup. These facts imply that preventive health care is a normal good and its demand is sensitive to the financial situation of the respondent.

The interaction terms in columns 4–6 hold interesting information. For a complete screening, ownership and its interaction terms do not show significance but we reject the null hypothesis that they are jointly insignificant at the 5% level. For a cancer examination, owners in urban areas have a slightly lower incentive to have the examination than those in rural areas, but they are more likely to undergo it than renters in urban and rural areas. Female homeowners are most likely to choose the examination, followed by male homeowners, other things being equal. Male tenants are the least likely to undergo cancer screenings. Finally home ownership and its interaction terms do not have significant effects on periodic screening as we expected and we fail to reject the hypothesis that they are jointly insignificant at the 5% level. This is mainly because the periodic screening is mostly compulsory regardless of ownership status.

Table 3: Estimation Results for Preventive Health Care (Random Effects Probit Estimation, Average Marginal Effects)

	(1) Complete screening IV	(2) Cancer screening IV	(3) Periodic screening IV	(4) Complete screening IV	(5) Cancer screening IV	(6) Periodic screening IV
Ownership	0.0476 (0.0210)	0.0662 [*] (0.0254)	0.0364 (0.0343)	0.335 (0.212)	0.558 [*] (0.257)	0.319 (0.344)
Age	0.0186 ^{***} (0.00213)	0.00375 (0.00259)	-0.00245 (0.00348)	0.0184 ^{***} (0.00215)	0.00319 (0.00264)	-0.00281 (0.00350)
Age squared	-0.000173 ^{***} (0.0000221)	-0.00000754 (0.0000270)	0.0000290 (0.0000362)	-0.000171 ^{***} (0.0000222)	-0.00000223 (0.0000273)	0.0000324 (0.0000361)
Age over 70	0.0180 (0.0150)	0.0428 ^{**} (0.0198)	0.0151 (0.0252)	0.0181 (0.0151)	0.0423 ^{**} (0.0200)	0.0149 (0.0252)
Male	0.0477 ^{***} (0.00876)	-0.155 ^{***} (0.00993)	0.0671 ^{***} (0.0140)	0.0579 ^{**} (0.0246)	-0.109 ^{***} (0.0278)	0.138 ^{***} (0.0390)
Married	0.0282 ^{***} (0.00937)	0.0261 ^{**} (0.0110)	0.0160 (0.0152)	0.0282 ^{***} (0.00951)	0.0277 ^{**} (0.0113)	0.0175 (0.0153)
Family size	-0.00492 [*] (0.00265)	-0.00703 ^{**} (0.00323)	-0.0157 ^{***} (0.00434)	-0.00522 [*] (0.00276)	-0.00808 ^{**} (0.00338)	-0.0160 ^{***} (0.00449)
Full-time worker	0.00688 (0.00774)	-0.0690 ^{***} (0.00979)	0.200 ^{***} (0.0128)	0.00624 (0.00777)	-0.0690 ^{***} (0.00991)	0.199 ^{***} (0.0128)
Part-time worker	-0.00976 (0.00850)	-0.0403 ^{***} (0.0111)	0.0723 ^{***} (0.0142)	-0.0111 (0.00860)	-0.0437 ^{***} (0.0113)	0.0697 ^{***} (0.0143)
Large company	0.0505 ^{***} (0.00714)	-0.00129 (0.00902)	0.120 ^{***} (0.0118)	0.0506 ^{***} (0.00718)	-0.000699 (0.00915)	0.121 ^{***} (0.0118)
Student	0.0559 [*] (0.0303)	-0.0519 (0.0385)	-0.0739 (0.0501)	0.0605 ^{**} (0.0303)	-0.0445 (0.0389)	-0.0712 (0.0500)
Nonsmoker	0.0170 ^{**} (0.00763)	-0.0119 (0.00891)	0.0443 ^{***} (0.0123)	0.0175 ^{**} (0.00773)	-0.0135 (0.00915)	0.0418 ^{***} (0.0124)
Secondary education	0.0289 ^{**} (0.0138)	0.0135 (0.0153)	0.0440 ^{**} (0.0220)	0.0315 ^{**} (0.0139)	0.0167 (0.0156)	0.0451 ^{**} (0.0219)
Tertiary education	0.0676 ^{***} (0.0147)	0.0364 ^{**} (0.0163)	0.0183 (0.0234)	0.0709 ^{***} (0.0147)	0.0416 ^{**} (0.0166)	0.0206 (0.0232)
ln(Income)	0.0234 ^{***} (0.00382)	0.0117 ^{**} (0.00497)	0.0275 ^{***} (0.00638)	0.0232 ^{***} (0.00385)	0.0110 ^{**} (0.00504)	0.0272 ^{***} (0.00640)
ln(Debt)	-0.00172 (0.00111)	0.000169 (0.00148)	0.000475 (0.00187)	-0.00147 (0.00112)	0.000551 (0.00150)	0.000705 (0.00188)
Mortgage	0.000140 (0.0106)	-0.0379 ^{***} (0.0138)	-0.0123 (0.0177)	-0.000392 (0.0110)	-0.0415 ^{***} (0.0142)	-0.0137 (0.0181)
Urban	-0.0165 (0.0102)	-0.00435 (0.0121)	-0.00283 (0.0166)	0.249 (0.171)	0.423 ^{**} (0.210)	0.216 (0.278)
ln(Savings)	0.00316 ^{***} (0.00117)	0.00514 ^{***} (0.00149)	0.00762 ^{***} (0.00194)	0.00311 ^{***} (0.00118)	0.00481 ^{***} (0.00152)	0.00752 ^{***} (0.00196)
ln(Securities)	0.00385 ^{***} (0.00123)	0.000380 (0.00155)	-0.00245 (0.00204)	0.00385 ^{***} (0.00124)	0.000266 (0.00157)	-0.00248 (0.00204)
Ownership*Male				-0.0144 (0.0304)	-0.0632 [*] (0.0347)	-0.0928 [*] (0.0484)
Ownership*Urban				-0.301 (0.192)	-0.482 ^{**} (0.235)	-0.248 (0.312)
Observations	14,928	14,928	14,928	14,928	14,928	14,928

IV = instrumental variable random effects estimator.

Note: Standard errors are in parentheses. Housing characteristics and quality are controlled for.

Random effects estimator.

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

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 random effects estimation model (column 1 in Table 4).

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.

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. Our estimated income elasticity is much smaller than theirs, which might be due to the different econometric specifications resulting from circumstances specific to Japan. Determining the reasons for this difference is beyond the scope of this paper. The savings and securities variables show positive significance, while the mortgage dummy is negatively significant.

Home ownership still shows significance in the Heckman model (column 2). We reject the independence of the decision to spend and the amount spent between healthy people and unhealthy people ($p < 0.05$), which means that healthy people are more likely not to spend on medical services and goods, but, among those who spend, homeowners 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 3), the significance levels of all the variables are very similar to those of the random effects estimation model.

Next, we treat the endogeneity of home ownership with an IV/GMM estimation of the random effects panel data model (column 4). The instrumental variable regression shows a significant effect of ownership, and the coefficient size is larger than in the previous three estimations.

Column 5 shows the results including the interaction terms. The results show that homeowners in rural regions have the largest expenditure, followed by owners in urban areas, *ceteris paribus*. Renters in urban neighborhoods spend more than those in rural districts. Female owners have higher spending compared to male owners. Male tenants, who on average spend less than male and female owners, have higher expenditure than female tenants.

Table 4: Estimation Results for Medical Expenditure

	(1)	(2)	(3)	(4)	(5)
	Medical expenditure	Medical expenditure	Medical expenditure	Medical expenditure	Medical expenditure
	RE	Heckman	HT	IV	IV
Ownership	0.213*** (0.0222)	0.0937*** (0.0213)	0.199*** (0.0384)	0.403*** (0.0533)	2.006*** (0.474)
Age	-0.0315*** (0.00516)	-0.0198*** (0.00488)	-0.0423*** (0.00731)	-0.0318*** (0.00539)	-0.0345*** (0.00551)
Age squared	0.000417*** (0.0000539)	0.000272*** (0.0000516)	0.000515*** (0.0000748)	0.000404*** (0.0000569)	0.000432*** (0.0000574)
Age over 70	-0.192*** (0.0407)	-0.169*** (0.0464)	-0.207*** (0.0427)	-0.195*** (0.0441)	-0.202*** (0.0446)
Male	-0.00261 (0.0201)	0.0110 (0.0195)	-0.0106 (0.0248)	-0.00214 (0.0209)	0.150*** (0.0576)
Married	0.0570*** (0.0220)	-0.106*** (0.0235)	0.0899*** (0.0262)	0.0726*** (0.0236)	0.0765*** (0.0242)
Family size	-0.111*** (0.00588)	-0.178*** (0.00576)	-0.113*** (0.00684)	-0.123*** (0.00690)	-0.125*** (0.00718)
Full-time worker	-0.0740*** (0.0189)	-0.00685 (0.0194)	-0.0701*** (0.0204)	-0.0736*** (0.0203)	-0.0769*** (0.0206)
Part-time worker	-0.0699*** (0.0212)	-0.0279 (0.0209)	-0.0660*** (0.0221)	-0.0696*** (0.0230)	-0.0818*** (0.0235)
Student	-0.119* (0.0698)	0.0167 (0.0787)	-0.163** (0.0749)	-0.154** (0.0732)	-0.145* (0.0742)
Nonsmoker	0.00272 (0.0171)	-0.0308* (0.0166)	-0.00767 (0.0197)	-0.0103 (0.0181)	-0.0142 (0.0186)
Secondary education	0.0343 (0.0310)	-0.00387 (0.0285)	0.0107 (0.0398)	0.0293 (0.0324)	0.0412 (0.0328)
Tertiary education	0.0371 (0.0331)	-0.0246 (0.0301)	0.00916 (0.0422)	0.0318 (0.0345)	0.0477 (0.0350)
ln(Income)	0.0955*** (0.00975)	0.0742*** (0.0124)	0.0781*** (0.0107)	0.0904*** (0.0106)	0.0880*** (0.0109)
ln(Debt)	0.00115 (0.00281)	0.00255 (0.00286)	0.000800 (0.00289)	0.000819 (0.00303)	0.00171 (0.00308)
Mortgage	-0.0559** (0.0229)	-0.0453** (0.0218)	-0.0450* (0.0255)	-0.115*** (0.0286)	-0.112*** (0.0287)
Urban	0.0239 (0.0233)	-0.0102 (0.0209)	0.0208 (0.0277)	0.0412* (0.0248)	1.466*** (0.379)
ln(Savings)	0.00982*** (0.00284)	-0.00683** (0.00275)	0.0100*** (0.00307)	0.00524* (0.00312)	0.00532* (0.00317)
ln(Securities)	0.0104*** (0.00311)	0.00696** (0.00321)	0.0106*** (0.00338)	0.00994*** (0.00333)	0.0100*** (0.00338)
Ownership*Male					-0.209*** (0.0720)
Ownership*Urban					-1.624*** (0.427)
Observations	24,166	23,973	24,166	20,513	20,513

IV = instrumental variable random effects estimator, Heckman = Heckman two equation model, HT = Hausman-Taylor estimator, RE = random effects estimator.

Note: Standard errors are in parentheses. Housing characteristics and quality are controlled for.

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

Source: Authors.

8. CONCLUSIONS 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 and have fewer physical and mental problems. Furthermore, our estimations suggest that home ownership is positively correlated with health care expenditure, even when controlling for income, debt, and other financial assets.

Following Grossman (1972), we illustrate our empirical results in a simple modeling 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. Randomized control trials seem the best way to identify causal relations, but randomized control trials for the effect of homeownership have never been conducted in Japan and would be difficult to initiate due to the related costs and ethical concerns. 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, a positive effect of home ownership was found even when controlling for housing characteristics. We are thus unable to uncover the reasons why home ownership has a positive effect on perceived health conditions. Housing conditions have multidimensional aspects that are often difficult to quantify or observe, and it is possible some of these aspects were not taken into account in our analysis. If the unknown conditions, found particularly in owner-occupied housing, considerably influence health, our estimates may have suffered from omitted variable bias.

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.

Despite these limitations, our study provides strong empirical evidence that home ownership is an 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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