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Dissatisfaction with dwelling environments in an aging society:
An empirical analysis of the Kanto area in Japan[*]

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Abstract

We conducted a questionnaire survey in the Kanto area regarding people's dissatisfaction with various aspects of their dwelling environment.   Dissatisfaction with access to transportation, shopping and medical facilities are important reasons for moving house.   Probit model estimation implies that economic wealth   improves satisfaction with transportation, shopping and medical facilities, but it does not reduce dissatisfaction with living costs whereas aging increases not only the satisfaction with transportation, shopping and medical facilities, but also with living costs and family and acquaintances.   The results also imply that Japan's aging population does not present crucial problems for housing in the Kanto area.

Keywords: moving, dissatisfaction, dwelling environment

JEL classification: R23, R21, D12

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1. Introduction

In developed countries, few people live in the same house all of their life. Most people move several times during their life for reasons such as entering university, getting a job, illness, aging and so on. This can be either intended or unintended. In particular, the decline in physical strength associated with aging can make the present dwelling environment inappropriate, requiring a move to a new dwelling. If the effects of aging occur rapidly, the supply of suitable housing for the aged may not meet the demand, causing costs to increase. Japan's aging population is likely to cause a large increase in dwelling changes in the near future. Additionally, some East Asian countries such as South Korea, Taiwan and China (People's Republic of China) are likely to experience similar trends.

In response to this trend, we should examine the desired future movements of Japan's aging population. However, few studies have examined this issue. Of these, Seko (2001) found that size of house, income and coresidence with parent or parents are significant factors that affect moving. Zorn (1988) and Henderson and Ioannides (1989) investigated the relationships between types of dwellings and moving. In addition, Seko and Sumita (2007a, 2007b) considered the effects of the reforms of the law and tax system on tenure choice behaviors[3]. These studies paid attention only to the kind of housing type that people move to. They did not investigate the reason why people moved or what type of dissatisfaction with the current dwelling environment makes people move. Furthermore, none of these studies investigated the effects of aging on moving.

The aim of this paper is to investigate the determinants of households' dissatisfaction with their dwelling environments and what kinds of dwellings they wish to move to. This will clarify the current types of dwelling environment dissatisfaction. Furthermore, we can propose some suggestions regarding residential forms/structures, residential development and town planning in Japan's aging society.

We conducted a questionnaire survey in the Kanto area to examine people's dwelling

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[3] Boehm (1981) and Horioka (1988) also investigated tenure choice behaviors.

environment dissatisfaction if they want to move or satisfaction if they do not want to move. Respondents range in age from 20 to 70 years old because it is difficult to identify people who have made provisions for old age and when people move to their final home. Therefore, instead of asking people whether or not they moved, we ask whether or not they want to move to make provision for their old age and their satisfaction or dissatisfaction with their current dwelling environment.

The paper proceeds as follows. In Section 2, we review the previous studies on elderly migration and mobility. In Section 3, we describe the questionnaire survey used in this study and analyze the survey results. We then apply Probit analyses to the dissatisfaction indexes in Section 4. Section 5 concludes and discusses directions for future research.

2. Literature survey

In this paper, we investigate households' dissatisfaction with their current dwelling environment through their desire to either move or not move. This is related to housing demand, tenure choice and mobility or moving of households. Of course, housing demand or tenure choice has been investigated by many authors. Boehm (1981), Ioannides (1987) and Zorn (1988) investigated household mobility, household moves, or both. In considering the reasons for moving, Clark and Onaka's (1983) classification is useful. They classify moving into three types: forced, adjustment and induced. They also point out the three reasons for moving by adjustment: housing, neighbor and accessibility. Our approach in this paper concerns the three reasons for this type of moving. However, some researchers such as Winger (1963) examine upgrading as the reason for moving by adjustment. Morrow-Jones and Wenning (2005) also consider this type of moving, calling it the "housing ladder." Some other researchers analyze moving from a lifecycle point of view, *e.g.*, Clark and Huang (2003), Clarke and Onaka (1985), Kendig (1984), Nelson (2008) and Quigley (1985). Studies on moving and health condition or diseases of the elderly could be regarded as this type of approach, *e.g.*, Clark and White (1990), Engelhardt and Greenhalgh-Stanley

(2010), Longino et al (1991), Litwak and Longino (1987), Painter and Lee (2009) and Seko (2001).

From a tenure choice point of view, the types of houses or dwelling environment that households prefer are important. Boehm (1984), Kiel (1994), Palmquist (1984), Seko and Sumita (2007a), Börsh-Supan, Heiss and Seko (2001), Tiwari and Hasegawa (2004) and Seko, Sumita and Naoi (2010) investigated the characteristics of housing and dwelling environments. On the other hand, moving is costly as Edin and Englund (1991) pointed out. Clark and White (1990) also found that fiscal conditions were an important determinant of intra-urban moving for the elderly. Seko and Sumita (2007a, 2007b) examined revisions to the law or tax system as other contributors to the cost of moving. If the fixed cost of moving is not negligible, households do not move when their dissatisfaction level is below the threshold point that balances the cost for moving and the utility gain from moving or new housing. Most previous studies focused on the chosen housing or dwelling environment. They did not investigate whether households were satisfied with the housing or dwelling environment prior to moving. Some studies that analyzed the role of health conditions or diseases in elderly people moving, however, could be thought of as exceptions. For example, Litwak and Longino (1987) and Longino et al (1991) analyzed the second move by the residents' health condition changed. Following these discussions, in the following sections, we aim to investigate whether or not households are satisfied with the dwelling environment that they live in, according to their level of dissatisfaction and desire to move in the future.

3. Aggregated statistics of questionnaire survey

In this study, we conducted a questionnaire survey named "Survey of Dwelling Environment" in the Kanto area by mail. The targeted sample is called the "Master Sample," which was originally gathered by Chuo Chosa-sha using a two-step random sampling from the Basic Resident Registers for the Kanto area by the Ministry of Internal Affairs and Communications. The Kanto area (Figure 1), including the Tokyo Metropolitan area and Kanagawa, Saitama, Gunma, Tochigi, Chiba and Ibaragi prefectures, is located in central Japan and accounts for about one third

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of the national population.　Its area is about 32,400 km² and its population density is about 1,300 persons per 1 km².　We selected 2,000 people from the Master Sample randomly, and sent questionnaires by mail in February 2009.　We received 1,118 responses.　A summary of the questionnaire results is shown in the Appendix.

In Table 1, we aggregate the results of the 860 valid survey responses, which had no missing observations for any of the potential independent variables for the Probit analyses in the next section.　Table 1 shows a summary of the reasons to either want to move or not want to move. In Table 1, only 23.1% of households want to move.　Among the households who wish to move, the most common reason given is "Close to public transportation" (55.7%), while "Close to shops" and "Close to medical facilities" are equal second (54.6%), followed by "Excellent natural surroundings" (39.3%), "Living costs are low" (38.2%), "Good security" (37.7%) and "Close to family members" (33.3%). The other reasons were selected by less than 30% of the households. For households not wishing to move, the most common reason was "House is comfortable" (59.3%), followed by "Close to public transportation" (56.9%) and "Close to shops" (54.4%).　These three reasons were selected by over 50% of the households.　Furthermore, "Close to medical facilities" (39.7%), "Old acquaintances or friends living in the neighborhood" (34.7%), and "No money to spare for moving" (33.2%) were also commonly selected, while the remaining reasons were selected by less than 30% of the households.　We assume that "House is comfortable" is equivalent to there being no reason to move and if we discard this from the list, "Close to public transportation" becomes the most common reason not to move.

Now we summarize these results.　One of the most important reasons as to whether or not people want to move is their access to public transportation.　Cheaper shopping and whether or not people live close to medical facilities are also important reasons.　Both "Living costs are low" and "No money to spare for moving" mean that people want to move to places where living costs are lower.　In the next section, we categorize these reasons into seven dissatisfaction indexes.

4. Probit model estimation

We first propose a modified Probit model to analyze the dissatisfaction indexes in Section 4.1. An explanation of the dissatisfaction indexes is provided in Section 4.2 and the possible explanatory variables and their construction are discussed in Section 4.3. In Section 4.4, we discuss the estimation results.

4.1 Model of dissatisfaction

We next introduce a latent index of dissatisfaction containing J reasons $(y(j)^*, j = 1, 2, \ldots J)$ and a linear regression model for jth $y(j)_i^*$ reason of ith person:

$$y(j)_i^* = x_i{}' \beta + \varepsilon_i.$$

This index is a latent variable that cannot be observed directly. Next, we consider the relationships between this index and the observed variables. When a household wants to move in the future, $Mv_i = 1$, and selects one of the reasons for moving by jth reason, $Ra1\_j_i = 1$, we assume that the introduced dissatisfaction index is larger than a certain threshold d:

$$y(j)_i^* = x_i{}' \beta + \varepsilon_i > d,$$

where β is a vector of coefficients for the vector of explanatory variables (x_i) and d is assumed to be positive. If the household wishes to move in the future, $Mv_i = 1$, but does not select the jth reason for moving, $Ra1\_j_i = 0$, we assume that the introduced dissatisfaction index is less than or equal to the threshold:

$$y(j)_i^* = x_i{}' \beta + \varepsilon_i \leq d.$$

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On the other hand, when a household does not wish to move in the future, $Mv_i = 0$, and selects jth reason not for moving, $Ra2\_j_i = 1$, we assume that the introduced dissatisfaction index is less than or equal to zero:

$$y(j)_i^* = x_i{'}\beta + \varepsilon_i \leq 0.$$

When the household does not wish to move in the future: $Mv_i = 0$, but does not select the jth reason not for moving, $Ra2\_j_i = 0$, we assume that the introduced dissatisfaction index is larger than zero:

$$y(j)_i^* = x_i{'}\beta + \varepsilon_i > 0.$$

These assumptions imply the following about each household's decision making as follows. First, each household decides whether it chooses "Wish to move" ($Mv_i = 1$) or "Do not wish to move" ($Mv_i = 0$), considering levels of all the dissatisfaction indexes ($y(j)^*, j = 1,2, \dots, J$) simultaneously and synthetically. Second, when the household decided to select the item "Wish to move in the future," they pick up one or some reasons for moving of which dissatisfaction levels exceed a certain level d. When the household decided to select the item "Do not wish to move in the future," they pick up one or some reasons of which dissatisfaction levels are below zero. In the latter case, the assumption that the threshold of the selection is set to zero is simply because of the identification of the model. If we want to change this level from zero, we should make an additional assumption on d.

If the reasons for moving when $Mv_i = 1$ and for not moving when $Mv_i = 0$ can be classified into the same categories, for example "Close to shops", we create a new observed dissatisfaction index $y(j)_i$ as follows:

$$y(j)_i = 1 \quad if \quad Ra1_i = 1 \quad or \quad Ra2_i = 0,$$

$$y(j)_i = 0 \quad if \quad Ra1_i = 0 \quad or \quad Ra2_i = 1,$$

and we can then rewrite the model as follows:

$$y(j)_i = 1 \quad if \quad y(j)_i^* = -\mathrm{d} * \mathrm{Mv}_i + x_i{}'\beta + \varepsilon_i > 0,$$

$$y(j)_i = 0 \quad if \quad y(j)_i^* = -\mathrm{d} * \mathrm{Mv}_i + x_i{}'\beta + \varepsilon_i \leq 0,$$

where Mv_i is assumed to be a nonstochastic variable or this observational rule is constructed in a conditional situation after Mv_i is observed. In Figure 2, we explain the relationships between $y(j)^*$, $Ra1_j$ and $Ra2_j$. Hence, this observation rule favors a Probit model when the distribution of the error term ε_i is standard normal. We can estimate this model with explanatory variables for dissatisfaction and a dummy variable for "Wish to move" (Mv_i).

4.2 Dissatisfaction indexes

In constructing the Probit model in the preceding subsection, we need to ask the reasons for "Wish to move" and "Do not wish to move, with the same list of the reasons. However, as we investigated the reasons in Section 3, in our questionnaire survey, we do not ask the reasons for moving and not for moving with the same list. Furthermore, the reasons for "Wish to move" and those for "Do not wish to move" are not also mutually paired. We need to couple the reasons for "Wish to move" and "Do not wish to move." In this paper, we partially aggregate the reasons and construct dissatisfaction indexes for moving wish. To construct the dissatisfaction indexes, we categorize the reasons into seven indexes: "Transportation", "Living Cost", "Nature", "Shopping", "Medical", "Safety" and "Family & Acquaintances". We assume that "Comfortable housing" means that there is no reason to move, so we do not include this reason in the categorization. The construction of the indexes is as follows.

Transportation: The dummy variable of this dissatisfaction index $y(1)$ is constructed using "Close to public transportation" in AQ12-1 and "Close to public transportation" in AQ12-2. When "Close to public transportation" in AQ12-1 is selected or "Close to public transportation" in AQ12-2 is not selected, we set $y(1) = 1$, otherwise $y(1) = 0$.

Living Cost: The dummy variable of this dissatisfaction index $y(2)$ is constructed using "Living costs are low" in AQ12-1 and "No spare money for moving" in AQ12-2. When "Living costs are low" in AQ12-1 is selected or "No spare money for moving" in AQ12-2 is not selected, we set $y(2) = 1$, otherwise $y(2) = 0$.

Nature: The dummy variable of this dissatisfaction index $y(3)$ is constructed using "Excellent natural surroundings" in AQ12-1 and "Excellent natural surroundings" in AQ12-2. When "Excellent natural surroundings" in AQ12-1 is selected or "Excellent natural surroundings" in AQ12-2 is not selected, we set $y(3) = 1$ and $y(3) = 0$ otherwise.

Shopping: The dummy variable of this dissatisfaction index $y(4)$ is constructed using "Close to shops" in AQ12-1 and "Close to shops" in AQ12-2. When "Close to shops" in AQ12-1 is selected or "Close to shops" in AQ12-2 is not selected, we set $y(4) = 1$, otherwise $y(4) = 0$.

Medical: The dummy variable of this dissatisfaction index $y(5)$ is constructed using "Close to medical facilities" in AQ12-1 and "Close to medical facilities" in AQ12-2. When "Close to medical facilities" in AQ12-1 is selected or "Close to medical facilities" in AQ12-2 is not selected, we set $y(5) = 1$, otherwise $y(5) = 0$.

Safety: The dummy variable of this dissatisfaction index $y(6)$ is constructed using "Good security"

and "Fewer natural disasters" in AQ12-1 and "Good security" in AQ12-2.   When "Good security" or "Fewer natural disasters" or both in AQ12-1 are selected or "Good security" in AQ12-2 is not selected, we set $y(6) = 1$, otherwise $y(6) = 0$.

Family & Acquaintances: The dummy variable of this dissatisfaction index $y(7)$ is constructed using "Close to family members" and "To live with family members" in AQ12-1 and "Children are living in the neighborhood," "Old acquaintances or friends are living in the neighborhood," and "Living with family members" in AQ12-2.   Based on the reasons in AQ12-1, when the "Close to family members" or "To live with family members" or both are selected, we set $y(7) = 1$, otherwise $y(7) = 0$.   As for the reasons in AQ12-2, when one or more of the following three reasons "Children are living in the neighborhood," "Old acquaintances or friends are living in the neighborhood," and "Living with family members" is selected, we set $y(7) = 0$, otherwise $y(7) = 1$.

In Table 2, the dissatisfaction indexes and their descriptive statistics are presented.   The means of all the variables are between 0.45 and 0.7, so there is no variable with extreme choice results. These indexes also relate to the Clark and Onaka's (1983) classification of reasons for moving, in that "Transportation" and "Shopping" correspond to accessibility, and "Living Cost", "Nature", "Medical", "Safety" and "Family & Acquaintances" correspond to neighbors.

4.3 Possible explanatory variables

Next, we consider the candidates for the explanatory variables in the dissatisfaction function.   First, according to Section 4.1, we adopt the dummy variable for wish for move or not (Mv), which is constructed using the answer to questionnaire Q12.   Summary statistics of this variable are shown in Table 1.   Other candidates can be divided into three broad categories according to the question items in the questionnaire (see Appendix).

The first category contains variables that represent household characteristics.   The

number of household members of each age group (N0–N7) is calculated using the answers to SQ1 and SQ2. Additionally, we construct this variable for households consisting only of aged people: DN6 and DN7 are the number of household members for the age groups 60–70 years and 70 years and over. This type of approach to dealing with the number of household members for each age group as explanatory variables is similar to that of Mankiw and Wiel (1989) and Ohtake and Shintani (1996). These studies decomposed housing demand into that of various age groups. However, we add other explanatory variables in addition to the number of household members in each age group. The age of the respondents (Age) from SQ1 and total household income (Income) from SQ4 are constructed as the midpoint value of each category and the dummy variables Duage and Duincome are introduced for open-ended categories: "70 or over" in SQ1 and "over 10 million yen" in SQ4. These dummy variables are adjusted to prevent statistical bias by replacing the open-ended categories with fixed values: "70 or over" in SQ1 is replaced by 75 and "over 10 million yen" in SQ4 is replaced by 1250.

The second category contains variables that represent the characteristics of housing. We first construct a variable for floor space (Floor) from the answer to Q2 by using its midpoint value for each category and adding a dummy variable for "over 150 m^2" (Dufloor) in a similar manner to respondent's age and household's total income. Additionally, dummy variables for housing type: "Detached house" (House1) and "Renting apartment built of wood" (House3), constructed by Q1, where tenement house and apartment or condominium are set to be a reference type. We add two dummy variables for "Owning land and house or apartment" (Dum1) and "Renting land and house or apartment" (Dum2), which are constructed using AQ1-1. Then, we estimate housing costs per 1 m^2 for all three cases: "Owning land and house or apartment" (Price1), "Renting land and house or apartment" (Price2) and "Renting land and have built a house on it" (Price3) using fixed property tax (Estate taxes) payment (SQ5) and annual housing rent payment (SQ6×12) divided by the floor space (Floor) according to the type of ownership of land and house (AQ2). This category of the explanatory variables is related to "Housing" in the Clark and Onaka (1983) classification of reasons

for moving.

The third category contains variables that represent the dwelling environment, which are length of time at the current address, "10 to 20 years" and "over 20 years" (Year1 and Year2) constructed using the answer to Q3, and commuting and commuting time (Commt2 and Commtt) constructed using the answers to Q4 and AQ4–2. Additionally, for the variable for commuting time, we add a dummy variable Ducommtt for the case in which commuting time is "over 120 minutes" as we introduced the dummy variables Duage for age, Duincome for income and Dufloor for floor space cases.

A list of all the candidate explanatory variables except Mv is shown in Table 3 and summary statistics for them are given in Table 4. In the estimation process, we use the squared values of the candidate explanatory variables except for the dummy variables. The total number of questionnaires without missing observations for the candidate explanatory variables is 860.

4.4 Empirical results

We select a model by minimizing Akaike's information criteria because, in the estimation results with all independent variables, many variables have insignificant coefficients, which may cause inefficient estimation. The results of the estimation are shown in Table 5.

Transportation: First, in the model selection process, the coefficient of Mv is positive and statistically significant, although it is assumed to be negative in Section 4.1, so we remove this variable from the equation. The proportion of correct predictions of this estimated equation is 0.603, which is high compared with the sample mean of 0.458. Families with children below the age of 20 years old often have a high level of dissatisfaction with transportation. However, family members aged 40–49 or 60 or over are relatively satisfied with the availability of transportation. When family income increases, the level of dissatisfaction decreases. When the family resides in a detached house, their level of dissatisfaction is high, but when housing costs are high, their level of

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dissatisfaction is low. When the family rents land and builds a house on it, housing costs increase their level of dissatisfaction.

Living Cost: The proportion of correct predictions for this estimated equation is 0.672, which is high compared with the sample mean of 0.607. When family members are aged in their 20s, they do not have a high degree of dissatisfaction with living costs. As family income or floor space increases, their level of dissatisfaction with living costs increases.

Nature: The proportion of correct predictions for this estimated equation is 0.719, which is high compared with the sample mean of 0.672. When family members are aged in their 30s, 40s or 60s, they have a high level of dissatisfaction with the natural environment. When the family rents land and house or land and builds a house on it, housing costs increase the level of dissatisfaction.

Shopping: In the model selection process, the coefficient of Mv is estimated to be positive and statistically significant, although it is assumed to be negative in Section 4.1, therefore we remove this variable from the equation. The proportion of correct predictions for this estimated equation is 0.579, which is high compared with the sample mean of 0.476. When family income increases, their level of dissatisfaction with shopping decreases. When a family rents land and a house, their level of dissatisfaction is lower. When a family rents land and a house or land and builds a house on it, housing costs increase the level of dissatisfaction. When the respondent does not commute, their dissatisfaction is low.

Medical: The proportion of correct predictions for this estimated equation is 0.619, which is not high compared with the sample mean of 0.590. When we apply a test for difference in means, we cannot reject the hypothesis that the estimated equation has equal prediction power as a prediction with the simple mean at the 5% significance level, whereas we can reject this hypothesis at the 10%

significance level.   As age increases, the level of dissatisfaction with medical facilities increases.

When family income increases, their level of dissatisfaction decreases.   When a family rents land

and a house, their level of dissatisfaction is lower.

Safety: The proportion of correct predictions for this estimated equation is 0.731, which is high

compared with the sample mean of 0.698.   When a family has children below the age of 10 years

old, they have a high level of dissatisfaction with safety.   On the other hand, family members over

60 years old do not have a high level of dissatisfaction with safety.   When the family resides in a

detached house and housing costs are high, their dissatisfaction is higher.

Family & Acquaintances: The proportion of correct predictions for this estimated equation is 0.643,

which is high compared with the sample mean of 0.489.   When family members are over 40 years

old, their level of dissatisfaction with family and acquaintances is low.   When the family resides in

a detached house, their level of dissatisfaction is high, but when housing costs are high, their level of

dissatisfaction is low.   Floor space makes the level of dissatisfaction lower.

From an independent variable point of view, we can summarize the results as follows.

Families with small children are relatively satisfied with transportation but not satisfied with safety.

Families with members in their 30s or 40s are not satisfied with their natural surroundings, but are

satisfied with transportation, shopping and family and acquaintances.   As respondents' age

increases, their level of dissatisfaction with medical facilities increases.   As families' income

increases, their level of dissatisfaction with transportation, shopping and medical facilities decreases

but their level of dissatisfaction with living costs increases.   When a family rents land and a house

or owns a relatively high priced house, they are satisfied with the shopping.

To summarize these findings, wealth is associated with a high level of satisfaction with

transportation, shopping and medical facilities, but the level of dissatisfaction with living costs is

high.   On the other hand, as aging increases not only the satisfaction with the change in the living environment, shopping, medical facilities, but also that of family and acquaintances.

5. Conclusion

In this paper, we conducted a questionnaire survey in the Kanto area to examine people's wish to move and level of dissatisfaction with their dwelling environment.   From a simple aggregation of the survey results, one of the most important reasons why people want to move or not is related to their level of dissatisfaction with access to transportation.   To make shopping cheaper and to live close to medical facilities are also important reasons to move.

From the estimation results of a Probit model for each dissatisfaction equation, economic wealth (high income or high-valued housing) improves satisfaction with transportation, shopping and medical facilities, but it does not reduce dissatisfaction with living costs.   On the other hand, aging increases not only the level of satisfaction with transportation, shopping and medical facilities, but also with living costs and family and acquaintances.   This means that wealth makes a family move more quickly to more preferable areas, but such areas increase the level of dissatisfaction with living costs, but aging makes a family move to more preferable areas slowly and increase satisfaction with living costs and family and acquaintances.

The questionnaire survey and regression results imply that Japan's rapidly aging population is unlikely to create severe housing problems in the Kanto area because aging of household members does not seem to cause any type of dissatisfaction except with medical facilities. However, because access to transportation and shopping are important factors in deciding to move, town planning should focus on ease of transportation.   The so-called "compact city" is a solution to this problem and this may also reduce dissatisfaction with medical facilities.   Of course, unanticipated changes caused by a society's aging may create dissatisfaction with the dwelling environment in the future.   The impact of Japan's aging population should be monitored.

In our questionnaire survey, we do not have information about the neighborhood where

the respondents live, so we could not investigate neighborhood effects on the decision to move in the future. These neighborhood effects have been investigated by many researchers and from several aspects. van Ham et al (2013) survey this effect. Such neighborhood effects on people's moving should be investigated in the future. Finally, it is important to note the questionnaire survey used in this paper was conducted before the Great East Japan Earthquake occurred. This massive disaster affected people's attitude toward their dwelling environment including safety, so we might reconsider the robustness of our empirical results after the earthquake occurred.

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Table 1 Descriptive statistics of reason to move

Reasons to move	Questionnaire	Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Wish for moving (Mv) = 1 otherwise = 0	Q12	x44	860	0.21279	0.40952	0	1
Reasons to move	AQ12-1						
1. Close to public transportation		x45	183	0.55738	0.49806	0	1
2. Cheap living cost		x46	183	0.38251	0.48733	0	1
3. Excellent natural surroundings		x47	183	0.39344	0.48985	0	1
4. Close to shops		x48	183	0.54645	0.4992	0	1
5. Close to medical facilities		x49	183	0.54645	0.4992	0	1
6. Good security		x50	183	0.37705	0.48598	0	1
7. Fewer natural disasters		x51	183	0.27322	0.44684	0	1
8. Close to family members		x52	183	0.33333	0.4727	0	1
9. To live with family members		x53	183	0.065574	0.24821	0	1
10. House with 24 hour care service		x54	183	0.15847	0.36618	0	1
11. Nursing home or care house		x55	183	0.18033	0.38552	0	1
12. Other reasons		x56	183	0.092896	0.29108	0	1
Reasons not to move	AQ12-2						
1. Close to transportation		x57	677	0.56869	0.49563	0	1
2. Close to medical facilities		x58	677	0.39734	0.48971	0	1
3. Close to shops		x59	677	0.54357	0.49847	0	1
4. Children are living in the neighborhood		x60	677	0.14771	0.35508	0	1
5. House is comfortable		x61	677	0.5938	0.49149	0	1
6. Old acquaintances or friends are living in the neighborhood		x62	677	0.34712	0.47641	0	1
7. Living with family members		x63	677	0.1226	0.32822	0	1
8. Good security		x64	677	0.22304	0.41659	0	1
9. Excellent natural surroundings		x65	677	0.25258	0.43482	0	1
10. No money to spare for moving		x66	677	0.33235	0.4714	0	1
11. No place that we can move to		x67	677	0.24963	0.43312	0	1
12. Other reasons		x68	677	0.070901	0.25685	0	1

Table 2 Dissatisfaction indices for moving and descriptive statistics

Dissatisfaction index	Definition by the variables in Table 1	Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Transportation	x45+(1−x57)	y(1)	860	0.45814	0.49853	0	1
Living Cost	x46+(1−x66)	y(2)	860	0.60698	0.48871	0	1
Nature	x47+(1−x65)	y(3)	860	0.67209	0.46972	0	1
Shopping	x48+(1−x59)	y(4)	860	0.47558	0.49969	0	1
Medical	x49+(1−x58)	y(5)	860	0.59070	0.49199	0	1
Safety	Max(x50,x51)+(1−x64)	y(6)	860	0.69767	0.45953	0	1
Family & Acquaintances	Max(x52,x53)+(1−Max(x60,x62,x63))	y(7)	860	0.48953	0.50018	0	1

Table 3 Explanatory variables

Variable	Description
N0–N7	Number of family members for xx years old: N0: under 10 years old, N1: 10–19 years old, N2: 20–29 years old, N3: 30–39 years old, N4: 40–49 years old, N5: 50–59 years old, N6: 60–69 years old, N7: over 70 years old
DN6 & DN7	Number of elderly in elderly families SN6: 60–69-year-old elderly persons in elderly household, SN7: over 70-year-old elderly persons in elderly household
Age	Age of respondent (SQ1 for Age) Age = 25 if Age = 20s, Age = 35 if Age = 30s , Age = 45 if Age = 40s Age = 55 if Age = 50s, Age = 65 if Age = 60s, Age = 75 if Age = 70 or over
Duage	Dummy variable for age of respondents = 70 over Duage = 1 if Age = 70 or over & Duage = 0 otherwise
Income	Total family income Income = 100 if SQ4 = 1, Income = 300 if SQ4 = 2 Income = 500 if SQ4 = 3, Income = 700 if SQ4 = 4 Income = 900 if SQ4 = 5, Income = 1250 if SQ4 = 6 Income = 0 otherwise
Duincome	Dummy variable for total family income > 10 million yean Duincome = 1 if SQ4 = 6 & Duincome = 0 otherwise
Floor	Floor space per dwelling Floor = 15 if Q2 = 1, Floor = 40 if Q2 = 2, Floor = 60 if Q2 = 3, Floor = 85 if Q2 = 4, Floor = 125 if Q2 = 5, Floor = 175 if Q2 = 6 Floor = 0 otherwise
Dufloor	Dummy variable for floor space > 150 m^2 Dufloor = 1 if Q2 = 6 & Dufloor = 0 otherwise
House1	Dummy variable for detached house House1 = 1 if Q1 = 1 & House1 = 0 otherwise
House3	Dummy variable for renting apartment house built of wood House3 = 1 if Q1 = 3 & House3 = 0 otherwise
Dum1	Dummy variable for owning land and house or apartment Dum1 = 1 if AQ1-1 = 3 & Dum1 = 0 otherwise

Table 3 Explanatory variables: continued

Variable	Description
Price1	Estate tax per floor space (per 1 m^2) for owning land and house or apartment Price1 = Etax / Floor where Etax = 0.5 if SQ5 = 1, Etax = 2 if SQ5 = 2 Etax = 4 if SQ5 = 3, Etax = 7.5 if SQ5 = 4 Etax = 12.5 if SQ5 = 5, Etax = 17.5 if SQ5 = 6 Etax = 0 otherwise
Dum2	Dummy variable for renting land and house or apartment Dum2 = 1 if AQ1-1 = 1 & Dum2 = 0 otherwise
Price2	Housing rent per floor space (per 1 m^2) for renting land and house or apartment Price2 = Rent * 12 / Floor where Rent = 0.5 if SQ6 = 1, Rent = 2 if SQ6 = 2 Rent = 4 if SQ6 = 3, Rent = 7.5 if SQ6 = 4 Rent = 12.5 if SQ6 = 5, Rent = 17.5 if SQ6 = 6 Rent = 0 otherwise
Price3	Estate tax plus housing rent per floor space (per 1 m^2) for renting land and have built a house on it Price3 = (Etax + Rent * 12) / Floor
Year1	Dummy variable for living over 10 years under 20 years Year1 = 1 if Q3 = 5 & Year1 = 0 otherwise
Year2	Dummy variables for living over 20 years Year2 = 1 if Q3 = 6 & Year2 = 0 otherwise
Commt2	Commt2 = 1 if they do not commute & Commt2 = 0 otherwise
Commtt	Commuting time Commtt = 15 if AQ4-2 = 1, Commtt = 45 if AQ4-2 = 2 Commtt = 75 if AQ4-2 = 3 Commtt = 105 if AQ4-2 = 4 Commtt = 135 if AQ4-2 = 5 Commtt = 0 otherwise
Ducommtt	Dummy variable for commuting time > 120 minutes Ducommtt = 1 if AQ4-2 = 5 & Ducommtt = 0 otherwise

Table 4 Descriptive statistics of the explanatory variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
N0	860	0.29186	0.67185	0	3
N1	860	0.36279	0.72121	0	3
N2	860	0.29419	0.60898	0	3
N3	860	0.4	0.69958	0	4
N4	860	0.51512	0.77113	0	3
N5	860	0.45465	0.71507	0	3
N6	860	0.54884	0.76822	0	3
DN6	860	0.14767	0.51997	0	3
N7	860	0.49651	0.75449	0	3
DN 7	860	0.13605	0.50039	0	3
Age	860	55.0814	14.08003	25	75
Duage	860	0.1814	0.38557	0	1
Income	860	637.3837	332.067	100	1250
Duincome	860	0.14535	0.35266	0	1
Floor	860	104.0756	41.02996	15	175
House1	860	0.82558	0.37969	0	1
Dum1	860	0.74884	0.43393	0	1
Price1	860	0.082848	0.084586	0	1.16667
Dum2	860	0.080233	0.27181	0	1
Price2	860	0.16759	0.68034	0	6
Price3	860	0.027284	0.14864	0	2.3
Year1	860	0.3	0.45852	0	1
Year2	860	0.44767	0.49754	0	1
Floor	860	104.0756	41.02996	15	175
Dufloor	860	0.14535	0.35266	0	1
Commt2	860	0.37442	0.48425	0	1
Commtt	860	30.97674	34.76563	0	135
Ducommtt	860	0.020930	0.14323	0	1

Table 5 Results of Probit model estimation

Reason	Transportation	Living Cost	Nature	Shopping	Medical	Safety	Family & Acquaintances
Dependent Variable	y(1)	y(2)	y(3)	y(4)	y(5)	y(6)	y(7)
Constant			1.03967** (3.599)	0.56355** (3.678)		0.97000** (9.619)	1.35309** (6.912)
Mv	−	−0.66212** (−5.986)	−1.13601** (−9.603)	−	−0.17797 (−1.545)	−1.12230** (−9.915)	−0.72400** (−6.161)
N0	0.44349* (2.092)	−0.14399 (−1.848)			0.132669 (1.789)	0.53532** (2.325)	−0.14263 (−1.881)
$N0^2$	−0.16801 (−1.80)					−0.22380* (−2.230)	
N1	0.15520* (2.120)	−0.11077 (−1.650)					
N2		−0.17534* (−2.218)			−0.1357 (−1.625)		
N3			0.49034** (2.559)				
$N3^2$		0.06106 (1.597)	−0.13877 (−1.661)				
N4			0.41665* (2.015)	0.345402 (1.822)			−0.22997** (−3.133)
$N4^2$	−0.07596* (−2.230)		−0.14178 (−1.457)	−0.18057 (−1.953)			
N5					0.140428 (1.882)		
$N5^2$							−0.16824** (−3.747)
N6	−0.40844 (−1.956)		−0.217205 (−2.664)	−0.41268* (−1.998)			−0.44746** (−5.440)
$N6^2$	0.21190 (1.860)			0.15337 (1.471)		−0.07235** (−2.321)	
DN6			1.74551* (1.976)				
$DN6^2$	−0.15024** (−2.765)		−0.67958 (−1.557)				
N7	−0.18666** (−2.936)		0.16045 (1.928)				−0.29419** (−3.296)
Age		−0.01354 (−1.728)	−0.00975 (−1.933)		0.042645** (4.339)		
Age^2		0.00016 (1.629)			− 0.000545** (−4.759)		
Duage							−0.45025** (−2.590)

Table 5 Results of Probit model estimation: continued

Reason	Transportation	Living Cost	Nature	Shopping	Medical	Safety	Family & Acquaintances
Acquaintances	y(1)	y(2)	y(3)	y(4)	y(5)	y(6)	y(7)
Income	−0.000269* (−2.044)	0.00055** (3.578)		−0.000317* (−2.152)	−0.00123* (−2.054)		
Income^2					0.00000082* (2.088)		
Floor		0.00379** (3.271)					−0.00379** (−3.002)
House1	0.46656** (4.150)						
Dum1							0.45740** (3.180)
Price1	−3.1590** (−2.969)			−2.88043** (−2.539)		−3.30282* (−2.237)	−1.55980* (−2.081)
Price1^2	4.5385 (1.781)		5.77646* (2.220)	4.65124 (1.730)		10.36830 (1.897)	
Dum2				−0.54291** (−2.980)	−0.37572* (−2.169)		
Price2	−0.30520 (−1.728)						
Price2^2	0.08252 (1.793)						
Price3	−3.1038** (−3.025)		1.31424** (2.492)	−3.25814** (−2.801)	0.612108 (1.719)		
Price3^2	2.85693** (2.649)			3.71770** (2.530)			
Year1							−0.32408** (−2.509)
Year2			−0.18157 (−1.672)				−0.43455** (−3.304)
Commt2				−0.31331** (−3.077)			
Commtt^2	0.0000204 (1.603)						
AIC	577.1781	540.5209	487.3096	585.4754	566.6706	479.9519	549.5103
Proportion of Correct Predictions	0.603488	0.672093	0.718605	0.57907	0.61860	0.731395	0.643023
Log Likelihood	−560.178	−531.521	−473.31	−573.475	−556.671	−472.952	−536.510

Note: ** and * mean statistically significant at 1% and 5%, respectively.

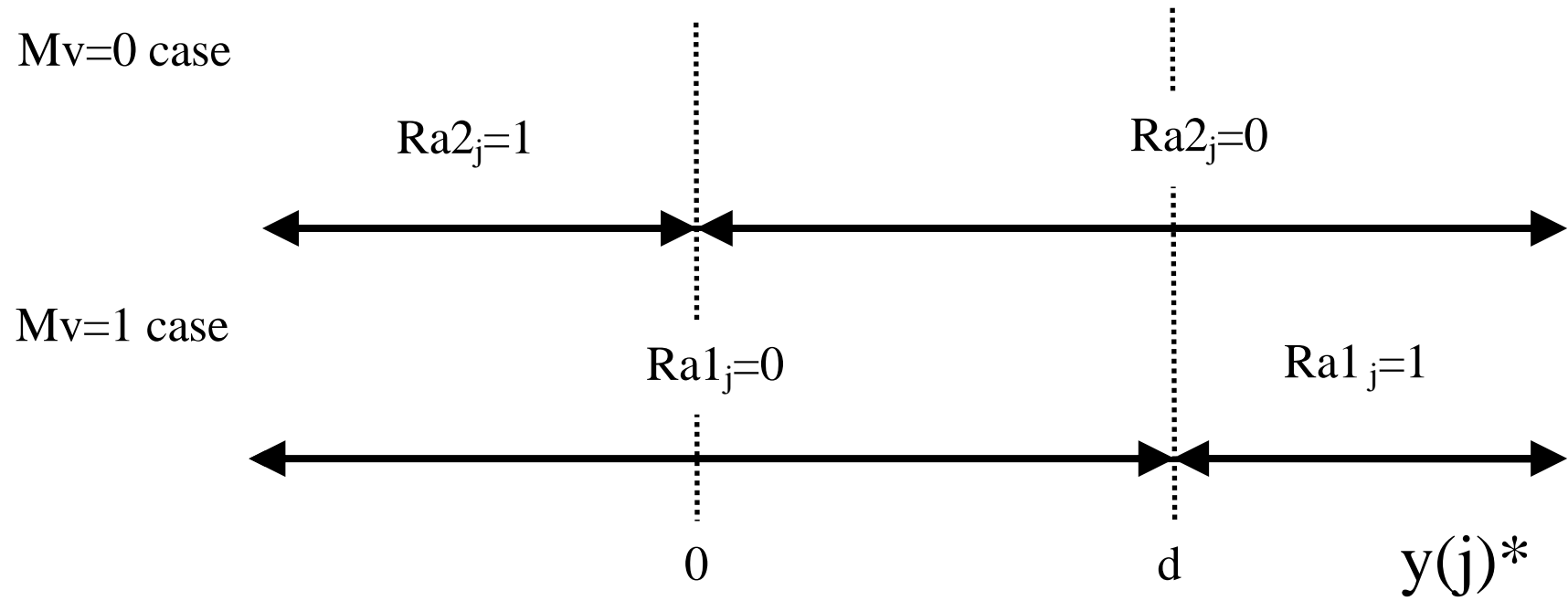**Figure 1 Location of the Kanto area and Tokyo**

Figure 2. Relationships between y(j)*, Ra1$_j$ and Ra2$_j$

Appendix

Summary of "Survey of Residential Environment"

The following is a summary of the questionnaire of our residential environment survey.

Q1.　What type of house do you reside in?

　　　1. detached house　　　2. tenement house　　　3. rental apartment house built of wood

　　　4. apartment or condominium

　AQ1-1 (Additional question 1).　What kind of ownership applies to your
　　　　residential land and housing?

　　　1.　renting land and house　　2.　renting land and have built a house on it

　　　3.　owning land and house

　AQ1-2.　How large is the residential area where you live?

　　　1.　under 50 m^2　　　　2.　50 m^2–99　　　　3.　100 m^2–149 m^2

　　　4.　150 m^2–199 m^2　　5.　200 m^2–249 m^2　　6.　over 300 m^2

If you did not choose 3, please proceed to Q2.

　AQ1-3.　What type of apartment house do you live in?

　　　1.　a condominium　　　　　　2.　a rental apartment

<Omitted>

Please answer all the following questions.

Q2.　How large is the total floor space where you live?　Please include occupied rooms, entrances, rest
　　　rooms, and kitchen.

　　　1.　under 30 m^2　　　2.　30 m^2–49 m^2　　　3.　50 m^2–69 m^2

　　　4.　70 m^2–99 m^2　　　5.　100 m^2–149 m^2　　6.　over 150 m^2

Q3.　How long have you lived in your present house?

　　　1.　under 1 year　　　　2.　1– less than 3 years　　　3.　3– less than 5 years

　　　4.　5–less than 10 years　　5.　10–　less than 15 years　　6.　over 15 years

Q4.　Does the head of household commute from home now?

　　　1.　yes (commuting)　　2.　working from home　　3.　not commuting

< AQ4-1 is omitted>

AQ4-2.　How long does it take to commute from your house to the workplace?

    1.　under 30 minutes   2.　30–59 minutes   3.　60–89 minutes

    4.　90–119 minutes   5.　over 120 minutes

Please answer all the following questions.

Q5.　How long does it take from your house to the nearest bus stop on foot?

    1.　under 5 minutes   2.　5–9 minutes   3.　10–19 minutes

    4.　20–29 minutes   5.　over 30 minutes

Q6.　How long does it take from your house to the nearest train station on foot?

    1.　under 5 minutes   2.　5–9 minutes   3.　10–19 minutes

    4.　20–29 minutes   5.　over 30 minutes

<Omitted>

Q12.　When you lose your physical strength from aging in the future, do you want to move from the house that you reside in currently?

    1. I wish to move to another house.   2. I do not wish to move.

If you chose 1, please proceed to AQ12-1.　If you did not choose 1, please proceed to AQ12-2.

AQ12-1.　If you wish to move, what type of place would you like to move to?
Please select the reasons why you want to move.
1.　Close to public transportation
2.　Cheap living costs
3.　Excellent natural surroundings
4.　Close to shops
5.　Close to medical facilities
6.　Good security
7.　Fewer natural disasters
8.　Close to family members
9.　To live with family members
10.　House with 24 hour care service
11.　Nursing home or care house
12.　Other reasons (　　　　　　　　　　　　　　)

AQ12-2.   If you do not wish to move, select all the reasons why.

1. Close to transportation
2. Close to medical facilities
3. Close to shops
4. Children are living in the neighborhood
5. House is comfortable
6. Old acquaintances or friends are living in the neighborhood
7. Living with family members
8. Good security
9. Excellent natural surroundings
10. No money to spare for moving
11. No place that we can move to
12. Other reasons (   )

The following are questions about household characteristics for all respondents.

SQ1. Identify the characteristics of the respondent.

Sex: 1. male   2. female

Age: 1.   20s   2.   30s   3.   40s   4.   50s   5.   60s   6.   70 or over

SQ2. Provide the following numbers.

Total number of family members in your house except yourself

and family composition.

1. under 10 years old	2. 10–19 years old
3. 20–29 years old	4. 30–39 years old
5. 40–49 years old	6. 50–59 years old
7. 60–69years old	8. over 70 years old

<Omitted>

SQ4. How much is your total annual family income, including annuities and taxes?

1. under 2 million yen	2. 2– less than 4 million yen	3. 4– less than 6 million yen
4. 6–less than 8 million yen	5. 8–less than 10 million yen	6. over 10 million yen

SQ5. How much fixed property tax do you pay annually?

1. under 10 thousand yen	2. 10–less than30 thousand yen
3. 30–less than 50 thousand yen	4. 50–less than 100 thousand yen
5. 100–less than 150 thousand yen	6. over 150 thousand yen
7. we do not pay it	

SQ6. How much do you pay to rent land and/or a house monthly?

1. under 10 thousand yen
2. 10– less than 30 thousand yen
3. 30— less than 50 thousand yen
4. 50— less than 100 thousand yen
5. 100— less than 150 thousand yen
6. over 150 thousand yen
7. we do not pay rent

SQ7. What is your monthly mortgage payment?

1. under 10 thousand yen
2. 10– less than 30 thousand yen
3. 30–less than 50 thousand yen
4. 50–less than 100 thousand yen
5. 100–less than 150 thousand yen
6. over 150 thousand yen

<Omitted>