UNDERUTILIZED HOUSING IN AN AGING SOCIETY: THE ROLE OF BEQUEST MOTIVES[1]

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Abstract

This study sheds light on the underutilization of owner-occupied housing by elderly households and examines the roles of bequest motives and inheritance taxes. A consumption choice model is developed to illustrate our conceptual framework and derive empirical hypotheses regarding underutilized housing. Data from Japanese households support these hypotheses and show that a bequest motive leads to the underutilization of housing through reduced mobility and increased renovation, even among working-age households. Housing underutilization is also associated with reduced short-term happiness, possibly because of suppressed consumption. These findings highlight the growing inefficiencies arising from the lumpy and inflexible nature of the housing stock under rapid demographic change and migration.

Keywords: population aging, underutilized housing, bequest motives, tax distortions, mobility, renovation, Japan, 3SLS

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1 Introduction

Developed countries have accumulated a significant number of housing units, but housing stock may be allocated inefficiently, resulting in vacancies and underutilization of occupied housing. According to the OECD Affordable Housing Database, vacancy rates were 13.6% in Japan (2018) and 11.1% in the US (2019).[1] Furthermore, Figure I shows that households in most OECD countries have occupied housing with more than one room per household member. For example, outright owners have 3.8 rooms per household member in the US and 2.6 in Japan.[2]

[Figure I here]

Some unused rooms may be intentionally used for occasional family gatherings, future co-housing with children, memories and attachments, and insurance against financial uncertainty (Skinner, 1996; Davidoff, 2010; Lockwood, 2018; Sinai and Souleles, 2005). However, the number of unused rooms held by older households can be substantial (Venti and Wise, 1989, 2004; Cocco, 2020), although standard life-cycle housing models suggest that "empty nest" households should downsize and tap their home equity to finance consumption after their children move out (e.g., Artle and Varaiya, 1978; Yang, 2009; Bajari et al., 2013; Bayer et al., 2016; Nakajima and Telyukova, 2017). Underutilized housing is also costly to the economy because it makes new housing less affordable (Ogawa and Yoshida, 2024), allocates resources to the less productive housing sector (e.g., Goolsbee and Syverson, 2023), and can result in long-term vacant housing

[1] https://www.oecd.org/housing/data/affordable-housing-database/housing-market.htm

[2] A room does not include a bathroom but includes kitchens in the Japan Household Panel Survey, the US-ACS, CASEN, ENIGH and KHS and kitchen-cum-dining rooms in EU-SILC and GSOEP. A room must be greater than four square meters in EU-SILC and six square meters in GSOEP and must extend out at least 6 inches and go from floor to ceiling in the US-ACS.

(Molloy, 2016). Several major cities such as Vancouver, Washington DC, and San Francisco have adopted vacant property taxes to mitigate these inefficiencies.

The present study sheds light on the causes of housing underutilization by using data for Japan, which is at the forefront of population aging, as evidenced by the lowest potential support ratio (age 25-64 / age 65+) of 1.8 in the world (United Nations, 2019). We hypothesize that the choice of housing capacity is influenced by bequest motives, which can be altruistic or strategic (Bernheim et al., 1985; Horioka, 2002, 2014; Hamaaki et al., 2019). Real estate is often the preferred asset to bequeath in estate planning owing to its various institutional factors and tax advantages (e.g., Page, 2003; Joulfaian, 2005; Piketty and Saez, 2013; Stark and Nicinska, 2015; DeBoer and Hoang, 2017). For example, in the United States, bequeathing real estate can provide a significant capital gains tax advantage because the tax basis of real estate is stepped up without incurring capital gains tax. In Japan, inheritance tax laws significantly favor housing over other financial assets. Although extant research shows that bequest motives affect consumption and saving in general (e.g., Abel, 1985; Hurd, 1989; Bernheim, 1991; Kotlikoff and Summers, 1981; Bernheim, 1991; Kopczuk, 2007; Kopczuk and Lupton, 2007), whether they affect elderly housing choices, particularly mobility and renovation, is an important empirical question (Venti and Wise, 1989).

To illustrate our conceptual framework, we develop a consumption choice model under perfect foresight. An agent lives for two periods (young and old) and derives periodic flow utility by consuming goods and housing services and additional terminal utility by bequeathing housing at the end of the second period. We derive nine empirical hypotheses about how a bequest motive affects housing choice: (1) housing is underutilized (housing demand exceeds the level justified by personal use) when an agent has a bequest motive and (2) housing underutilization is more

pronounced for older people because an agent has a greater demand for housing in the later period, (3) a bequest motive increases the likelihood of renovating. Regarding household mobility, the model predicts that (4) if the average housing demand of non-movers is larger than that of movers, the average bequest motive after moving is smaller; (5) the difference in housing demand between movers and non-movers increases with age; and (6) the bequest motive reduces the likelihood of moving if the average bequest motive after moving is smaller. In addition, by focusing on the flow utility for the young and old, the model predicts the effect of a bequest motive on perceived happiness: (7) housing underutilization is associated with lower short-run happiness for younger generations; (8) significant housing underutilization is associated with lower short-run happiness for older generations; and (9) housing underutilization has an ambiguous relationship with lifetime happiness.

We test these hypotheses using data from the Japanese Household Panel Survey (JHPS/KHPS). We calculated a measure of underutilization–the number of excess rooms–as the number of bedrooms exceeded the number of household members. As this measure is simply housing capacity adjusted for household size, not all excess rooms are underutilized. However, after controlling for the effect of income and the number of other household characteristics, the measure becomes a proxy for underutilization. Our main objective was to test whether bequest motives cause housing underutilization through the hypothesized action channels (renovation and mobility channels).

From the survey questions in the JHPS/KHPS, we constructed a variable representing the motive to bequeath real estate. An empirical challenge is endogeneity. For example, a household that bought a large house at a low cost may consider bequeathing it (reverse causality). We address this empirical challenge by using a rich set of control variables and instrumental variables. The

control variables included housing, household head, and child characteristics. For instrumental variables, we use the 2015 change in the inheritance tax code as an exogenous shock to household decisions. The Japanese inheritance tax code favors housing by reducing the assessed value of homes by 80% up to a threshold size. The 2015 tax change increased the threshold lot size from 240 m^2 to 330 m^2, affecting the intention to bequeath a house. This change satisfies the exclusion restriction because the threshold lot size is only relevant to inheritance taxes and does not directly affect the mobility, renovation, or underutilization of housing. Thus, we instrument the intention to bequeath a house using a set of variables that represent this change in the threshold lot size.

Our findings are summarized as follows: First, a real estate bequest motive increases housing underutilization; a one percentage point higher probability of having a bequest motive is associated with 0.077 more excess rooms. Second, the effect of bequest motives on underutilization is larger for elderly households and in large metropolitan areas, but statistically significant for working-age households and non-metropolitan areas. Third, the renovation channel is statistically significant: a one percentage point higher probability of having a bequest motive increases the renovation probability by 0.079 percentage points, thereby increasing the number of excess rooms by 0.063. Fourth, the effect of the mobility channel was statistically significant. Non-movers tend to have more excess room than matched movers, and non-mover underutilization is more pronounced in older households than in younger ones. Furthermore, a one percentage point higher probability of having a bequest motive decreases the moving probability by 0.093 percentage points, thereby increasing the number of excess rooms by 0.097. Finally, a larger number of excess rooms was associated with less perceived happiness in the short run, although its effect on long-term lifetime happiness was ambiguous.

This study makes four main contributions to the literature. First, to the best of our knowledge, this is the first study to point out the inefficiency of the bequest-motivated underutilization of housing stock. This inefficiency problem will become more prevalent in other developed countries as their average potential support ratios will decrease to the current Japanese level by 2045. Although a growing number of studies incorporate bequest motives and housing into life-cycle models (e.g., Nakajima and Telyukova, 2017), they typically focus on the retirement savings puzzle and do not study how housing assets are used.[3] The inefficient use of capital undermines welfare and economic growth because intergenerational transfers contribute significantly to capital formation (Kotlikoff and Summers, 1981; Barrett et al., 2015; Ogawa and Yoshida, 2024).

Second, this study extends our understanding of housing vacancies, which are typically defined as the difference between the number of housing units and households in a market (e.g., Rosen and Smith, 1983). Unused rooms in occupied housing units are usually omitted, although this type of vacancy is commonly used in commercial real estate, such as offices and warehouses. If unused rooms in occupied housing units are added to housing vacancy statistics, the overall vacancy rate will significantly increase. Unused rooms lead to low population density, which negatively impacts the local economy. This extended vacancy concept highlights inefficiencies arising from the lumpy, immobile, and inflexible nature of housing; that is, once completed, the supply of housing is largely inelastic, particularly for downward adjustments (Glaeser and Gyourko, 2005).

[3] Housing investments and bequest motives are also considered key factors driving the high saving rate in Japan between 1960s and 1970s because households save more to pay for housing and leave money to their children (Ito and Hoshi, 2022).

Third, we identify a new type of tax distortion. This study demonstrates the unintended inefficiencies in the use of housing capital owing to preferential housing treatment in the inheritance tax system. Furthermore, our finding that an inheritance tax change has a significant impact on bequest motives provides evidence of the significant elasticity of bequest motives with respect to inheritance tax. This finding serves as an important building block for the discussion on the optimal inheritance tax (e.g., Piketty and Saez, 2013).

Fourth, this is one of few studies on parental housing choices regarding mobility and renovation (e.g., Painter and Lee, 2009; Lee and Painter, 2014). Parents' housing choices have been studied less frequently than inheritors' housing choices because of the small proportion of the elderly. However, with the rapid population aging in many developed countries, parental housing choices are of first-order importance. For example, the proportion of working-age population peaked in Japan in 1992, the US and Europe in 2008, and China in 2010 (United Nations, 2019).

The remainder of this paper is organized as follows: Section 2 explains the conceptual framework and develops hypotheses. Section 3 describes the dataset and variables used in the analysis. Section 4 shows the overall effect of bequest motives on housing underutilization. Section 5 examines two channels of action. Section 6 presents the relationship between housing underutilization and perceived happiness. Finally, section 7 concludes the study.

2 Conceptual framework and hypotheses

Consider a model of an agent's consumption choice in a two-period overlapping generation setting. Each agent lives for two periods: young and old ($t \in \{1,2\}$) and consumes the numeraire good c_t and housing services h_t^i from a house i. Housing services are assumed to be a

linear transformation of housing assets, therefore, h_t^i can also be regarded as the quantity of quality-adjusted housing assets. The difference in housing between the first and second periods was implicitly determined by housing investment and depreciation. The agent also has a motive to bequeath house h_2^i at the end of the second period. The absence of a bequest motive for financial assets reflects a situation in which inheritance taxes favor bequests for housing.[4]

An agent solves the following lifetime utility maximization problem, taking housing rent p_t and interest rate r as

$$\max_{c_t, h_t^i} u\left(c_1, h_1^i\right) + \beta\left[u\left(c_2, h_2^i\right) + \psi b\left(h_2^i\right)\right] \qquad (1)$$

$$s.t. \quad c_1 + p_1 h_1^i + \frac{1}{1+r}\left(c_2 + p_2 h_2^i\right) = e, \qquad (2)$$

where $u(c,h)$ denotes the felicity function such that $\partial u/\partial c > 0, \partial^2 u/\partial c^2 < 0, \partial u/\partial h > 0$, and $\partial^2 u/\partial h^2 < 0$; β denotes the subjective discount factor, $b(\cdot)$ denotes the bequest motive function such that $b' > 0$ and $b'' < 0$; ψ denotes the relative weight of the bequest motive; and e denotes the present value of periodic endowments: $e = e_1 + e_2/(1+r)$. Function b represents a bequest motive in the Japanese context but can also be viewed as a version of a larger class of models featuring wealth in the utility function. These models partially resolve puzzles related to stock returns, savings rates, monetary policy, and the natural rate of interest (e.g., Carroll, 1998; Barberis et al., 2001; Dynan et al., 2002, 2004; Michaillat and Saez, 2021; Mian et al., 2021).

To solve this problem explicitly, we assume the following functions.

$$u(c,h) = \ln c + \chi \ln h, \qquad (3)$$

[4] In Japan, the inheritance tax code explicitly favors housing by reducing assessed values. In the U.S., the capital gains tax code allows the basis step-up, which typically has a large tax advantage for long-term assets like housing. Each country has its own tax code that can differentially affect housing bequests.

$$b(h) = \ln h, \qquad (4)$$

where χ denotes the relative utility weight on housing consumption. From the first-order conditions and budget constraints, the consumption demands $\{c_t^*, h_t^{i^*}\}$ are obtained. Specific derivations are provided in Appendix A.

To determine whether a bequest motive leads to the underutilization of housing conditional on not moving, we define the older generation's underutilization of housing U by comparing housing demand with and without bequest motives.

$$U \equiv h_2^{i^*}\big|_{\psi=\Psi>0} - h_2^{i^*}\big|_{\psi=0} = \frac{(1+r)e}{p_2}\left\{\frac{\beta\Psi(1+\beta+\chi)}{[(1+\beta)(1+\chi)+\beta\Psi](1+\beta)(1+\chi)}\right\} > 0. \quad (5)$$

This result indicates that an agent with a bequest motive has a larger house than required for personal housing consumption. Thus, our first hypothesis is as follows:

H1: Housing is underutilized when an agent has a bequest motive.

Furthermore, by taking a partial derivative of U with respect to the bequest weight ψ, we can show that underutilized housing increases with a bequest motive: $\partial U/\partial\psi > 0$. In a setting with more than two periods, a bequest motive becomes more important as the agent ages. Thus, our second hypothesis is as follows:

H2: The underutilization of housing is more pronounced for older people.

To determine whether a bequest motive encourages capacity-enhancing renovations, we compared the housing demands of the older and younger generations. If the older generation demands larger housing, capacity-enhancing renovation is required. The difference between h_2^i and h_1^1 is

$$R \equiv h_2^i - h_1^i = \frac{e}{(1+\beta)(1+\chi)+\beta\psi}\left(\frac{\beta(\chi+\psi)(1+r)}{p_2} - \frac{\chi}{p_1}\right). \qquad (6)$$

The sign of R depends on equilibrium housing prices. However, by taking a partial derivative of R with respect to ψ, we can show that the likelihood of renovations increases with a bequest motive: $\partial R/\partial \psi > 0$. Thus, the third hypothesis is as follows:

H3: A bequest motive increases the likelihood of a renovation.

To determine whether a bequest motive affects the mobility of the older generation, consider a case in which an agent can change houses just before the second period. Note that the agent has a bequest motive for house i because it prefers that house. However, if the agent moves to another house j, they may not have the same level of bequest motives as in the old house. Let μ denote the factor that adjusts the expected level of bequest motive for house j, so that the expected bequest utility for house j equals $\mu\psi \ln h_2^j$. The agent solves the consumption choice problem for each option at the beginning of the second period.

$$\text{Staying in house } i\text{: } \max_{c_2^i, h_2^i} \mathcal{L}^i = \ln c_2^i + \chi \ln\ h_2^i + \psi \ln h_2^i + \lambda^i\left(e_2 - c_2^i - p_2 h_2^i\right).$$

$$\text{Moving to house } j\text{: } \max_{c_2^j, h_2^j} \mathcal{L}^j = \ln c_2^j + \chi \ln\ h_2^j + \mu\psi \ln h_2^j + \lambda^j\left(e_2 - c_2^j - p_2 h_2^j\right).$$

From the demand for the numeraire goods and housing services corresponding to these two cases, $\left\{c_2^{i\,**}, h_2^{i\,**}, c_2^{j\,**}, h_2^{j\,**}\right\}$, the difference between $h_2^{j\,**}$ and $h_2^{i\,**}$ is

$$h_2^{j\,**} - h_2^{i\,**} = \frac{(\mu - 1)\psi e_2}{(1 + \chi + \mu\psi)(1 + \chi + \psi)p_2}. \qquad (7)$$

Apparently, $\mu = 1$ is associated with equal housing demand $h_2^{i\,**} = h_2^{j\,**}$. In other words, when the same level of housing consumption is observed before and after a move, the agent has the same level of bequest motive. Conversely, $\mu \in (0,1)$ corresponds to a lower demand for new house j than before the move: $h_2^{i\,**} > h_2^{j\,**}$. Thus, the average μ across agents can be inferred from the

difference in the observed housing consumption between movers and non-movers. The next hypothesis is:

H4: If the average housing demand of non-movers is larger than that of movers, then the average bequest motive after moving is smaller, that is, $\mu \in (0,1)$.

Furthermore, equation (7) shows that the size of the difference between h_2^{j**} and h_2^{i**} is proportional to ψ. Assuming that older agents have larger bequest motives on average, we propose the following hypothesis:

H5: The difference in housing demand between movers and non-movers increases with age.

The utility gain M from moving from house i to house j is:

$$M \equiv U\left(c_2^j, h_2^j\right) - U\left(c_2^i, h_2^i\right) = -\psi(1-\mu)\ln\left(\frac{e_2}{p_2}\right) + a, \qquad (8)$$

where $a \equiv \ln\left(\left(\frac{1+\chi+\psi}{1+\chi+\mu\psi}\right)\left(\frac{\chi+\mu\psi}{1+\chi+\mu\psi}\right)^{\chi+\mu\psi}\left(\frac{1+\chi+\psi}{\chi+\psi}\right)^{\chi+\psi}\right)$. Figure II plots M against e_2 for three different values of $\psi = \{1,2,3\}$, holding the other parameters and the house price fixed at $\chi = 1$, $\mu = 0.5$, and $p_2 = 1$. For $\mu \in (0,1)$, M is decreasing in endowment e_2 and negative for a large value of e_2. As we show later, hypothesis *H4* is supported empirically. Thus, it is reasonable to restrict our attention to $\mu \in (0,1)$. As a negative value of M suggests that moving is not a rational choice, an agent with a large endowment stays in house i. A larger bequest motive ψ makes the slope steeper and reduces the threshold value of e_2 that makes $M \leq 0$. Thus, a bequest motive reduces the likelihood of moving. Our next hypothesis is:

H6: A bequest motive reduces the likelihood of moving if $\mu \in (0,1)$.

[Figure II here]

Finally, we derive predictions about an agent's short-run and lifetime happiness for different bequest motive values. We interpret $u\left(c_1^*, h_1^{i*}\right)$ as short-run happiness for younger

generations, $u\left(c_2^*, {h_2^i}^*\right)$ as short-run happiness for older generations, and $u\left(c_1^*, {h_1^i}^*\right) + \beta\left[u\left(c_2^*, {h_2^i}^*\right) + \psi b\left({h_2^i}^*\right)\right]$ as lifetime happiness. By taking a partial derivative of $u\left(c_1^*, {h_1^i}^*\right)$ with respect to the bequest weight ψ, we obtain: $\partial u\left(c_1^*, {h_1^i}^*\right)/\partial\psi < 0$. Combining this result with $\partial U/\partial\psi > 0$, we predict the following:

H7: Housing underutilization is associated with lower short-run happiness for younger generations.

Intuitively, extra housing demand in the second period owing to the bequest motive suppresses consumption in the first period.

For older generations, the sign of a partial derivative of $u\left(c_2^*, {h_2^i}^*\right)$ with respect to bequest weight, ψ is ambiguous $\left(\partial u\left(c_2^*, {h_2^i}^*\right)/\partial\psi \lessgtr 0\right)$, but it is negative for a large bequest weight ψ. Again, recalling that $\partial U/\partial\psi > 0$, we predict the following:

H8: Significant underutilization of housing is associated with lower short-run happiness for older generations.

Intuitively, the suppressed flow utility from consumption outweighs the increased flow utility from greater housing services if the bequest weight is sufficiently high.

By taking a partial derivative of the Lifetime Utility with respect to bequest weight ψ, we obtain: $\frac{\partial\,(\text{Lifetime Utility})}{\partial\psi} = \beta \ln \frac{\beta(\chi+\psi)(1+r)e}{\left((1+\beta)(1+\chi)+\beta\psi\right)p_2}$. Its sign is ambiguous: negative for a small value of endowment e and positive for a large value of endowment e. Thus, we predict the following:

H9: Housing underutilization has an ambiguous relationship with lifetime happiness.

Note that hypotheses *H7-9* compare an agent's utility level with that of a counterfactual self with a different bequest motive. We test these nine hypotheses in the following sections.

3 Data

We use data from the Japan Household Panel Survey (JHPS) and the Keio Household Panel Survey (KHPS), which are jointly conducted. The KHPS began in 2004 and surveyed 4005 households, whereas the JHPS began in 2009, surveying 4,022 households without overlap. In both surveys, households were selected using stratified two-stage sampling. The demographic characteristics of the survey respondents were reasonably representative of Japanese households, except that the participants were aged between 20 and 69 years for the KHPS and 20 years or above for the JHPS. These two surveys were integrated in 2014 into the Japan Household Panel Survey (JHPS/KHPS).[5]

We used homeowner data from the JHPS/KHPS between 2004 and 2018. We exclude the self-employed because their bequest motives are driven by business strategies and alternative tax codes. Regarding housing decisions, we used residential mobility and the renovation of current housing. A dummy variable for a residential move takes the value one if the household moves its housing and takes zero otherwise. The renovation dummy variable takes the value of one if the household has experienced a change in its housing without changing its address.

Household attributes include the head's age, income, financial wealth, housing wealth, household size, and number of children. They also include indicators of whether the household head is married, employed, or has a college degree. Location characteristics included indicators for eight regions and city size categories.

[5] See Seko, Sumita, and Naoi (2012) for more detailed explanation of the survey.

3.1 Bequest motive

In surveys for 2007–2009 and 2018–2019, participants answered questions about the intention to bequeath their assets, the anticipated inheritance of housing, and the plan to use the inherited houses. We define a dummy variable for bequest motives based on the following question: "Would you like to leave the asset of yours and your spouse's to heirs excluding your spouse?" The bequest motive dummy takes the value of one if the answer is yes and zero otherwise.[6]

Table I compares the bequest motives before the 2015 tax change (from the 2007–2009 to surveys) with those after the tax change (from the 2018 survey). These descriptive statistics provide indirect evidence of positive bequest elasticity, which Piketty and Saez (2013) consider critical in determining the optimal inheritance tax rate. In our empirical analysis, we tested the effect of the inheritance tax on bequest motives.

[Table I here]

3.2 Underutilization

We constructed a measure of housing underutilization by calculating the difference between the number of rooms and household members. We call this measure excess rooms and compute for all households in the sample.

$$\textit{Excess rooms} = \textit{the number of rooms} - \textit{the number of household members.}$$

[6] The 2007-2009 surveys asked about the bequest motive about real estate and financial assets conditional on the intention to bequeath some assets. In contrast, the 2018 survey asked about real estate and financial assets unconditionally: "Would you like to leave the asset of yours and your spouse's to heirs excluding your spouse?" Respondents need to select one option from the four options in the bequest intention: 1) Yes, 2) No, 3) Do not have the asset, and 4) Do not know. We treat the first options having the bequest motive and we treat other options as having no bequest motive.

This measure of housing capacity, adjusted for household size, is affected by income and other household characteristics; therefore, not all excess rooms are underutilized. However, after controlling for the effect of household and property characteristics in the regression, this variable represents housing underutilization.

Figure III depicts the age profiles of excess rooms for movers, non-movers, and renovators. The number of excess rooms generally increased with age for all household types. Thus, hypothesis *H2* was confirmed: the underutilization of housing is more pronounced for older people. However, non-movers had more room than movers of almost all ages. Furthermore, the rate of increase with age was higher in non-movers than in movers. Thus, the empty-nest problem is more pronounced in nonmobile households.

[Figure III here]

Interestingly, renovators tend to have even more rooms. Renovations included modernization and changing the number of rooms, either positively or negatively. Thus, forward-looking capacity expansion can result in excess rooms until they are used. However, after the age of 50 years, the number of excess rooms did not increase. This suggests that relatively old household heads renovate their houses to decrease the number of rooms by combining excess rooms or increasing the household size by accommodating coresident children.

3.3 Descriptive statistics

Table II presents the descriptive statistics for the three subsamples: (1) households that did not move or renovate their housing, (2) households that moved their housing in the previous year, and (3) households that renovated their houses in the previous year. Household income, savings, and home equity are deflated by the consumer price index (2015=100).

Most households did not move or renovate their housing, confirming the low mobility of Japanese households.[7] Based on the average statistics in this sample, the number of rooms was 5.8, the average lot area was 231.7 m^2, 89% of houses were detached, 55% of houses were located in the Kanto (Tokyo) and Kinki (Osaka) areas, and 71% of houses were built after 1981, when the building code incorporated modern earthquake resistance requirements. The age of the household head is 54 years, real income is 7 million JPY, and real financial wealth is 12 million JPY measured in 2015 prices. 35% of the household heads have college degrees, 80% are married, 35% are full-time workers, and the average household size is 3.4 persons. The proportion of households that intended to bequeath was 43% for housing and 36% for financial assets.

The sample of movers is characterized by a smaller lot size (163m^2), smaller real financial wealth (9 million JPY), younger age (42 years), fewer children (0.7 coresident and 0.3 non-coresident children), a smaller proportion of married households (50%), a larger proportion of female household heads (28%), and a larger proportion of full-time workers (49%). The proportion of households intending to buy real estate and financial assets is lower (28% and 30%, respectively).

The sample of renovators is characterized by a larger number of rooms (6.3), detached houses (93%), an older age (57 years old), fewer co-resident children (0.8), and more non-coresident children (0.9), higher real income (7.5 million JPY), and larger real financial wealth

[7] Attrition can be an issue because respondents who moved between two waves may drop out of the sample. To alleviate this problem, we checked the original interviewer's survey data and identified movers from stayers in the dropped sample.

(14.8 million JPY). The proportion of bequest motives was high (54% for housing and 45% for financial assets).

[Table II here]

4 The effect of bequest motives on underutilization

Our first research hypothesis *H1* states that housing is underutilized when an agent has a bequest motive. In this section, we estimate the effects of bequest motives on housing underutilization. Subsequently, we analyze several potential action channels in Section 5. Endogeneity is a challenge in estimating the causal relationship between bequest motives and underutilization. Some confounders may cause both bequest motives and housing underutilization. For example, a household that anticipates living with a child may maintain extra unused rooms and desire to bequeath their house. To address confounding issues, we included a rich set of housing and household characteristics. Another challenge is the reverse causality. For example, a household that happens to buy a large house at a reasonable price may begin to consider bequeathing it. Alternatively, a household that modernizes its house with extra rooms may consider bequeathing the renovated house.

To address reverse causality and unobserved confounders, we construct a vector of instrumental variables using changes in inheritance taxes. We use a two-stage least squares (TSLS) estimation. In the first stage (equation (9)), we regress the real estate bequest motive on the vector of instrumental variables, control variables, and region and year fixed effects.

$$B^H{}_{\mathrm{it}} = \boldsymbol{z}'_{it-1}\boldsymbol{\gamma}_{\boldsymbol{z}} + \boldsymbol{x}'_{it-1}\boldsymbol{\gamma}_{\boldsymbol{x}} + J_j + T_t + u_{it}, \tag{9}$$

where $B^H{}_{\mathrm{it}}$ denotes the indicator for household i's bequest motives for real estate, $\boldsymbol{z}_{it-1}$ denotes the vector of instrumental variables, $\boldsymbol{x}_{it-1}$ denotes the covariate vector related to households and

housing characteristics, J_j and T_t denote the region- and year-fixed effects, respectively, and u_{it} denotes the error term. In the second stage (equation (10)), we regress our measure of housing underutilization on the instrumented bequest motive and covariates, including the region- and year-fixed effects:

$$r_{it}^{e} = \alpha_B \widehat{B^H}_{it} + \boldsymbol{x}'_{it-1}\boldsymbol{\alpha_x} + J_j + T_t + w_{it}, \tag{10}$$

where r_{it}^{e} is the number of excess rooms, as defined in Section 3; $\widehat{B^H}_{it}$ denotes the instrumented bequest motive obtained from the first stage; and w_{it} is the error term. The TSLS estimation is summarized schematically in Figure B. 1 (Appendix B). The arrows connecting $\boldsymbol{z}_{it-1} \rightarrow B^H{}_{\text{it}}$ and $\boldsymbol{x}_{it-1} \rightarrow B^H{}_{\text{it}}$ represent the first stage estimation, and the arrows connecting $B^H{}_{\text{it}} \rightarrow r_{it}^{e}$ and $\boldsymbol{x}_{it-1} \rightarrow r_{it}^{e}$ represent the second stage estimation.

The covariate vector $\boldsymbol{x}_{it-1}$ includes housing characteristics, household income and wealth, marital status, and number of children (see Table II). In particular, we include detailed child characteristics: the number of family members, a dummy for family size that has decreased since 2004, a dummy for male children, the number of non-coresident children, and the number of coresident children.

Instrument vector $\boldsymbol{z}_{it-1}$ is a set of variables that captures a major change in the 2015 inheritance tax code. Before the tax change, the assessed value of a residential lot was reduced by 80–240 m^2. The 2015 change relaxed this size limit to 330 m^2 while increasing the overall effective tax rate for all asset types and reducing the basic and per heir exemptions. This tax change significantly increased the tax benefits of bequeathing real estate instead of financial assets, particularly for small lots of up to 330 m^2. Moreover, these lot size thresholds are unique to inheritance taxes and unrelated to any other taxes or regulations. Thus, we construct dummy variables for small lots (≤ 240 m^2), medium lots (240 m^2 < lot size ≤ 330 m^2), and large lots (> 330

m^2) and interact these dummy variables with a post-2015 dummy. The key identifying assumption is a stable relationship between real estate bequest motives and lot size in the absence of the 2015 inheritance tax change. We check this assumption using placebo tests with a falsified year of the tax change (2008). Table C. 1 in Appendix C shows no significant coefficients of the interaction terms between the lot size dummies and the falsified tax change dummy. Thus, we confirm the parallel trend assumption, which is necessary to identify the change in the bequest motives induced by the 2015 tax changes. Figure IV shows the combined lot size coefficients from the first-stage results (equation (9)). The real estate bequest motive increased significantly after the tax change, particularly for small lots up to 330 m^2.

[Figure IV here]

Table III shows the results of the overall effect of real estate bequest motives on the number of excess rooms.[8] According to the first specification (columns 1 and 2), the coefficient of the instrumented bequest motive for real estate on the number of excess rooms is 0.07714, which is statistically significant at the 1% level. Because the bequest probability is expressed as a percentage, this coefficient indicates that a one percentage point larger probability of having a real estate bequest motive results in 0.08 more excess rooms on average. This result confirms hypothesis *H1*: Housing is underutilized when an agent has a bequest motive.

We tested the validity of the first-stage IV model in three ways. Using the Kleibergen-Paap rk LM test (Kleibergen and Paap, 2006), we can reject the null hypothesis of under-identification. Using the Kleibergen-Paap Wald rk F statistic, we reject the null hypothesis of weak instruments by at least 10% based on the critical values (10% maximal IV relative bias, 10.27)

[8] More detailed results for the first stage regression are reported in Appendix D.1 (Table D.1).

provided by Stock and Yogo (2005). Using Hansen's overidentification J test, we do not reject the null hypothesis of the orthogonality condition.

In the second specification (columns 3 and 4), we include the interaction term between the lot area and the post-tax dummy. This specification controls for the possibility that the number of excess rooms generally changed after the tax change, regardless of the size limit thresholds. The estimated coefficient of the instrumented bequest motive for real estate increases to 0.09579. Thus, a 1% higher probability of having a real estate bequest motive results in 0.10 more excess rooms. However, the result of the Kleibergen-Paap Wald rk F statistic shows a lower value of 8.509, indicating that we cannot reject the hypothesis of weak instruments. Therefore, this is discussed based on the first specification.

[Table III here]

Table IV shows the second-stage estimation results for the subsamples. Column 1 shows the results when we exclude households intending to make inter-vivos transfers from the 2018 sample. The coefficient on the instrumented bequest motive for real estate is 0.072 and approximately equal to our main estimate. Columns 2 and 3 show the results for different age groups. The effect of real estate bequest motives on excess rooms is larger than the main estimate for elderly households (0.093). This coefficient suggests that an elderly household has one more excess room if it is 10.8% more likely to have a real estate bequest motive for real estate. This result formally confirms hypothesis *H2*: The underutilization of housing is more pronounced for older people.

However, the effect is also statistically significant for working-age households (0.047), despite its smaller magnitude. This result is striking because the tax-induced bequest motive affects housing capacity choices even before 60 years of age. These households may maintain excess

capacity for more than 20 years on average, given the average lifespan of 81.5 years for males and 87.6 years for females.

Columns 4 and 5 show the subsamples by region. The effect of bequest motives was larger in large metro areas than in non-metro areas, although the effect was statistically significant in both regions. Housing in large metropolitan areas may be preferable to housing in rural areas because a large fraction of the younger generations live in large metropolitan areas.

[Table IV here]

5 Action channels

Bequest motives can affect housing utilization through several action channels. The first channel involves renovation decisions. Hypothesis *H3* states that a bequest motive increases the likelihood of renovations. If people have bequest motives, they are expected to renovate their houses as they age to increase their housing capacity, regardless of whether the bequest motive is altruistic or strategic. We refer to this channel as the renovation channel.

The second channel involves mobility decisions. Hypotheses *H4* and *H5* collectively state that if the average housing demand of non-movers is larger than that of movers, the difference between them increases with age, and Hypothesis *H6* states that a bequest motive reduces the likelihood of moving. If a person intends to bequeath their current house, then moving is likely to be associated with a reduced motive to bequeath a new house because of uncertainty about housing quality. In this case, they are less likely to move and conditional on moving, the new house will be smaller because of the reduced bequest motive. There would be the opposite case, in which a person who does not intend to bequeath their current house moves to a larger house because of a

bequest motive. Thus, it is an empirical question whether moving is associated with a larger housing capacity. We call this the channel mobility channel.

We estimate causal relationships between real estate bequest motives and the number of excess rooms through renovation and mobility decisions using three-stage least squares (3SLS) estimation.[9] The first is a linear probability model for real estate bequest motives (equation (9)). We address the endogeneity issues using the instrument vector $\boldsymbol{z}_{it-1}$ specified in Section 4. The second equation is a linear probability model for house-related actions such as mobility and renovation:

$$y_{it} = \beta_B \widehat{B^H}_{it} + \boldsymbol{x}'_{it-1}\boldsymbol{\beta_x} + J_j + T_t + v_{it}, \tag{11}$$

where y_{it} denotes the indicator for an action related to housing (either moving or renovation) at time t, and $\widehat{B^H}_{it}$ denotes the instrumented bequest motive. The third equation is a linear model of the number of excess room r^e_{it} as a function of the probability of taking a house-related action.

$$r^e_{\text{it}} = \alpha_{\text{y}}\hat{y}_{it} + \boldsymbol{x}'_{it-1}\boldsymbol{\alpha}_{\text{x}} + J_j + T_t + w^3_{it}, \tag{12}$$

where $\hat{y}_{it}$ is the estimated probability of a house-related action. The 3SLS estimation is summarized schematically in (Appendix B). The arrows connecting $\boldsymbol{z}_{it-1} \rightarrow B^H{}_{\text{it}}$ and $\boldsymbol{x}_{it-1} \rightarrow B^H{}_{\text{it}}$ represents the first equation, the arrows connecting $B^H{}_{\text{it}} \rightarrow y_{it}$ and $\boldsymbol{x}_{it-1} \rightarrow y_{it}$ represents the second equation, and the arrows connecting $y_{it} \rightarrow r^e_{it}$ and $\boldsymbol{x}_{it-1} \rightarrow r^e_{it}$ represents the third equation. We checked the rank condition to identify the parameters using the checkreg3 command in STATA (Baum, 2007). As a robustness check, we use the TSLS and IV probit models to

[9] See Greene (2018), pp.403-404 for details of the estimation method.

estimate the effects of bequest motives on mobility (Appendices D.2 and E.1) and renovation (Appendices D.3 and E.2).

5.1 Renovation channel

Table V shows the estimation results for the renovation channels. The action variable y_{it} is a dummy variable for renovations during the sample period. The sample is restricted to non-movers and includes both renovators and non-renovators. The first stage estimation (column 1) is essentially equivalent to that shown in Table III. In column 2, the instrumented bequest motive has a statistically significant positive effect on renovation. A one percentage point higher probability of bequest motives increases the renovation probability by 0.079 percentage points. In Appendix D.4, we further analyze the effect of bequest motives on different types of renovations. We find that the effect through the renovation channel is primarily associated with the capacity-increasing renovation (Table D. 5). The estimated coefficient is 0.092. Thus, a household intending to bequeath a house tends to renovate the house to increase the capacity, possibly to live with a child's household. These results support hypothesis *H3*.

In the third-stage regression (column 3), the coefficient of the estimated probability of renovation is positive and statistically significant. A one percentage point higher probability of renovation was associated with 0.793 more excess rooms. Thus, a one percentage point higher probability of bequest motives was associated with 0.063 more excess rooms (0.079×0.793) through the renovation channel. This effect is separate from that through the mobility channel because it does not include the effect through renovation. The mobility channel effect is 54% greater than the renovation channel effect.

[Table V here]

5.2 Mobility channel

To test *H4* and *H5* regarding the housing demand of non-movers relative to that of movers, we calculated the difference in the number of excess rooms between matched pairs of movers and non-movers. Specifically, we first constructed matched pairs of movers and non-movers using a one-to-one propensity score. Then, for each pair, we constructed non-mover underutilization as:

$$\textit{Non-mover underutilization} = \textit{Excess rooms for non-movers} - \textit{Excess rooms for movers}$$

Figure V depicts the estimated non-mover underutilization according to the age of the household head. Households were divided into those with and without recent renovations. For both groups, non-mover underutilization was non-negative. In other words, the average housing demand of non-movers is greater than that of movers. Thus, according to hypothesis *H4*, the average bequest motive after moving is smaller, that is, $\mu \in (0,1)$. For ages 30–44, non-mover underutilization is indistinguishable from zero. Thus, for these relatively young households, the average bequest motive does not seem to change after moving.

Furthermore, non-mover underutilization generally increases with age for those aged 35 years and older. Non-mover underutilization was the largest for the oldest group, with approximately two to three rooms. Thus, this result confirms *H5*: The difference in housing demand between movers and non-movers increases with age. hypothesis *H2*: The underutilization of housing is more pronounced for older people.

For younger ages, the graph is generally downward sloping because households begin to have children occupying rooms. By comparing households with and without renovation, we found

that those with renovation tended to have more underutilized rooms, particularly those aged 45–59 years.[10]

For hypothesis *H6* about the effect of bequest motives on mobility, we use the 3SLS estimation, where the action variable y_{it} is a dummy variable for a recent move. The sample includes both movers and non-movers but excludes households that renovated their houses during the sample period because we analyze renovation in the next section. In the covariate vector, we do not include the interaction term between the post-2015 dummy and lot size because of the better Kleibergen-Paap Wald rk F statistic in the first stage, as discussed in Section 4. In addition, the TSLS estimation result of the instrumented bequest motive's effect on non-mover underutilization confirms this result (Appendix F).

[Figure V here]

Table VI shows the estimation results. In the second equation (column 2), the instrumented bequest motive had a statistically significant negative effect on mobility. A one percentage point higher probability of bequest motives reduces the probability of moving by 0.093 percentage points. This result supports hypothesis *H6*: A bequest motive reduces the likelihood of moving. In the third-stage estimation (column 3), the coefficient of the estimated probability of moving represents the marginal effect of mobility on the number of excess rooms. Because the probability is expressed as a percentage at this stage, the coefficient -1.042 indicates that a one percentage point lower probability of bequest-driven mobility increases the number of excess rooms by 1.042. Overall, a one percentage point higher probability of bequest motives was associated with 0.097 more excess rooms (0.093×1.042) through the mobility channel. In

[10] Appendix F shows additional properties of underutilized rooms.

addition, the TSLS estimation result of the instrumented bequest motive's effect on non-mover underutilization confirms this result (Appendix F).

[Table VI here]

6 Relation with happiness

Hypotheses *H7*, *H8*, and *H9* compare the utility of an agent with that of the counterfactual self with a different bequest motive. In our empirical analysis, we used a dummy variable for perceived happiness in three different timespans: recent week, recent year, and entire life. Thus, our empirical hypothesis is that significant underutilization of housing is associated with lower short-run happiness for both the younger and older generations; however, housing underutilization has an ambiguous relationship with lifetime happiness. We tested whether households' subjective well-being was correlated with excess rooms. We estimated a linear model for a dummy variable representing perceived happiness as a function of the number of excess rooms, conditional on housing and household characteristics. As usual, we assume an i.i.d. error term conditional on the observed household characteristics and number of excess rooms.

Table VII shows the results of the study. The short-run happiness is represented by the dummy variables for happiness for the recent week (columns 1 and 2) and for the recent year (columns 3 and 4). For households with the working-age (i.e., young) head (columns 1 and 3), the coefficients on the number of excess rooms are negative (-0.0377 for the recent week and -0.0713 for the recent year). In particular, the coefficient is statistically significant at the 10% level for the recent years. These results support hypothesis *H7*. Similarly, for households with the elderly head (columns 2 and 4), the coefficients on the number of excess rooms are negative

(-0.0713 for the recent week and -0.0394 for the recent year). The coefficient is statistically significant at the 10% level for the most recent week, supporting hypothesis *H8*.

For lifetime happiness (columns 5 and 6), the coefficients of the number of excess rooms are indistinguishable from zero for both the younger and older generations, although the sign is negative. These results are consistent with hypothesis *H9* because households face a trade-off between lower short-term happiness and higher satisfaction with bequest motives.

[Table VII here]

7 Conclusion

This study examines how housing is underutilized in an aging society owing to bequest motives. Our goal is to demonstrate, both theoretically and empirically, how the intention to bequeath housing causes housing underutilization by affecting household mobility and renovation decisions. Our consumption choice model illustrates the conceptual framework and provides empirical hypotheses on underutilized housing. We test these hypotheses using the Japan Household Panel Survey data and show that (1) the intention to leave housing as a bequest leads to the underutilization of housing; (2) the impact of bequest motives on underutilization is larger for elderly households and in large cities, but statistically significant for working-age households and rural areas; (3) the bequest motive reduces mobility and increases renovation, resulting in underutilization; and (4) the underutilization of housing is associated with decreased perceived happiness. Our study is the first to demonstrate a clear link between bequest motives and underutilized housing and sheds light on aging societies in which housing choices by older generations are important. Unused rooms in an occupied housing unit are usually unobserved but constitute an important part of housing vacancies, highlighting the downward rigidity and

lumpiness of the housing supply. We also contribute to the discussion of optimal inheritance taxes by identifying a new form of tax distortion.

Appendix A: The derivation of hypotheses

Consider the model of an agent's consumption choice in a two-period overlapping generation setting. Each agent lives for two periods, young and old ($t = \{1,2\}$) and consumes the numeraire good c_t and housing services h_t^i from house i. Housing services are assumed to be a linear transformation of housing assets, so h_t^i can also be regarded as the quantity of quality-adjusted housing assets. The difference in housing between the first and second periods was implicitly determined by housing investment and depreciation. The agent also has a motive to bequeath house h_2^i at the end of the second period. The absence of a bequest motive for financial assets reflects a situation in which inheritance taxes favor housing bequests.

Each agent solves the following lifetime utility maximization problem by taking housing rents p_t and interest rate r as given:

$$\max_{c_t, h_t} u\left(c_1, h_1^i\right) + \beta\left[u\left(c_2, h_2^i\right) + \psi b\left(h_2^i\right)\right] \text{ (A1)}$$

$$s.t. \quad c_1 + p_1 h_1^i + \frac{1}{1+r}\left(c_2 + p_2 h_2^i\right) = e, \text{ (A2)}$$

where $u(c, h)$ denotes the felicity function such that $\partial u/\partial c > 0, \partial^2 u/\partial c^2 < 0, \partial u/\partial h > 0, \partial^2 u/\partial h^2 < 0$; β denotes the subjective discount factor, $b(\cdot)$ denotes the bequest motive function such that $b' > 0, b'' < 0$; ψ denotes the relative weight on the bequest motive; and e denotes the present value of periodic endowments: $e = e_1 + e_2/(1 + r)$. The Lagrangian for this problem is:

$$\mathcal{L} = u\left(c_1, h_1^i\right) + \beta\left[u\left(c_2, h_2^i\right) + \psi b\left(h_2^i\right)\right] + \lambda\left[e - c_1 - p_1 h_1^i - \frac{1}{1+r}\left(c_2 + p_2 h_2^i\right)\right]. \text{ (A3)}$$

To solve this problem explicitly, we assume the following functions.

$u(c,h) = \ln c + \chi \ln h$, (A4)

$b(h) = \ln h$, (A5)

where χ denotes the relative utility weight on housing consumption. The first-order conditions were as follows:

$c_1: \frac{1}{c_1} = \lambda$, (A6)

$c_2: \frac{\beta}{c_2} = \frac{\lambda}{1+r}$, (A7)

$h_1^i: \frac{\chi}{h_1^i} = \lambda p_1$, (A8)

$h_2^i: \beta\left(\frac{\chi}{h_2^i} + \frac{\psi}{h_2^i}\right) = \frac{\lambda p_2}{1+r}$, (A9)

$\lambda: e - c_1 - p_1 h_1^i - \frac{1}{1+r}\left(c_2 + p_2 h_2^i\right) = 0.$ (A10)

From (A6) and (A7), we obtain:

$c_2 = \beta c_1 (1+r).$ (A11)

From (A6) and (A8), we obtain:

$h_1^i = \chi \frac{c_1}{p_1}.$ (A12)

From (A7) (A9) (A11), we obtain:

$h_2^i = (\chi + \psi)\frac{c_2}{p_2} = \beta(1+r)(\chi+\psi)\frac{c_1}{p_2}.$ (A13)

By substituting (A11) (A12) and (A13) into (A10), we obtain consumption demand.

$c_1^* = \frac{1}{(1+\beta)(1+\chi)+\beta\psi} e$ (A14)

$h_1^{i\,*} = \frac{\chi c_1}{p_1} = \frac{\chi}{(1+\beta)(1+\chi)+\beta\psi}\frac{e}{p_1}$ (A15)

$$c_2^* = \beta(1+r)c_1 = \frac{\beta(1+r)}{(1+\beta)(1+\chi)+\beta\psi}e \text{ (A16)}$$

$$h_2^{i\,*} = \frac{(\chi+\psi)c_2}{p_1} = \frac{(\chi+\psi)\beta(1+r)}{(1+\beta)(1+\chi)+\beta\psi}\frac{e}{p_2} \text{ (A17)}$$

To determine whether a bequest motive leads to underutilized housing conditional on no movement, we define the older generation's underutilization of housing U by comparing housing demand with and without bequest motives.

$$U \equiv h_2^{i\,*}\big|_{\psi=\Psi>0} - h_2^{i\,*}\big|_{\psi=0} = \frac{(\chi+\Psi)\beta(1+r)}{(1+\beta)(1+\chi)+\beta\Psi}\frac{e}{p_2} - \frac{\chi\beta(1+r)}{(1+\beta)(1+\chi)}\frac{e}{p_2}$$

$$= \frac{\beta(1+r)e}{p_2}\left[\frac{\chi+\Psi}{(1+\beta)(1+\chi)+\beta\Psi} - \frac{\chi}{(1+\beta)(1+\chi)}\right] = \frac{\beta(1+r)e}{p_2}\left\{\frac{\Psi(1+\beta+\chi)}{[(1+\beta)(1+\chi)+\beta\Psi](1+\beta)(1+\chi)}\right\} > 0 \text{ (A18)}$$

This result $U > 0$ indicates that an agent with a bequest motive owns a larger house than required for personal housing consumption. Thus, our first research hypothesis is as follows:

H1: Housing is underutilized when an agent has a bequest motive.

Furthermore, by taking a partial derivative of U with respect to the significance of a bequest motive ψ, we can show that underutilized housing increases with a bequest motive.

$$\frac{\partial U}{\partial \Psi} = \frac{e(1+r)\beta(1+\beta+\chi)}{p_2\left((1+\beta)(1+\chi)+\beta\Psi\right)^2} > 0. \text{ (A19)}$$

In a setting with more than two periods, a bequest motive becomes more significant as the agent becomes older. Thus, a corollary is:

H2: The underutilization of housing is more pronounced for older people.

To see whether a bequest motive encourages renovations to increase housing capacity, we compare housing demand between the older and younger generations. If the older generation demands more housing, capacity-increasing renovation is required. The difference between h_2^i and h_1^1 is

$$R \equiv h_2^i - h_1^1 = \frac{(\chi+\psi)\beta(1+r)}{(1+\beta)(1+\chi)+\beta\psi}\frac{e}{p_2} - \frac{\chi}{(1+\beta)(1+\chi)+\beta\psi}\frac{e}{p_1} = \frac{e}{(1+\beta)(1+\chi)+\beta\psi}\left(\frac{(\chi+\psi)\beta(1+r)}{p_2} - \frac{\chi}{p_1}\right). \text{(A20)}$$

The sign of R depends on the equilibrium housing prices. However, by taking a partial derivative of R with respect to ψ, we can show that the likelihood of renovations increases with a bequest motive.

$$\frac{\partial R}{\partial \psi} = \frac{\beta e}{\left((1+\beta)(1+\chi)+\beta\psi\right)^2}\left[\frac{(1+\chi+\beta)(1+r)}{p_2} + \frac{\chi}{p_1}\right] > 0. \text{(A21)}$$

Thus, the third hypothesis is:

H3: A bequest motive increases the likelihood of a renovation.

To determine whether a bequest motive affects the mobility of the older generation, consider a case in which an agent can change houses just before the second period. Note that the agent has a bequest motive for house i because it prefers that house. However, if the agent moves to another house j, the agent may not have the same level of bequest motives as in the old house. Let μ denote the factor adjusting the expected level of bequest motive for house j, so that the

expected bequest utility for house j is $\mu\psi \ln h_2^j$. An agent makes the following choice at the beginning of the second period:

Staying in house i: $\mathcal{L}^i = \ln c_2^i + \chi \ln\ h_2^i + \psi \ln h_2^i + \lambda^i\left(e_2 - c_2^i - p_2 h_2^i\right)$. (A22)

Moving to house j: $\mathcal{L}^j = \ln c_2^j + \chi \ln\ h_2^j + \mu\psi \ln h_2^j + \lambda^j\left(e_2 - c_2^j - p_2 h_2^j\right)$. (A23)

Demand for the numeraire goods and housing services for these two cases are:

Staying in house i: $c_2^{i\,**} = \frac{e_2}{1+\chi+\psi}$, $h_2^{i\,**} = \frac{(\chi+\psi)e_2}{(1+\chi+\psi)p_2}$, (A24)

Moving to house j: $c_2^{j\,**} = \frac{e_2}{1+\chi+\mu\psi}$, $h_2^{j\,**} = \frac{(\chi+\mu\psi)e_2}{(1+\chi+\mu\psi)p_2}$. (A25)

The difference between $h_2^{j\,**}$ and $h_2^{i\,**}$ is:

$h_2^{j\,**} - h_2^{i\,**} = \frac{e_2}{p_2}\left(\frac{\chi+\mu\psi}{1+\chi+\mu\psi} - \frac{\chi+\psi}{1+\chi+\psi}\right) = \frac{(\mu-1)\psi e_2}{(1+\chi+\mu\psi)(1+\chi+\psi)p_2}$. (A26)

Apparently, $\mu = 1$ is associated with equal housing demand $h_2^{i\,**} = h_2^{j\,**}$. In other words, when the same level of housing consumption is observed before and after a move, the agent has the same level of bequest motive. In contrast, $\mu \in (0,1)$ corresponds to a smaller demand for new house j than before the move: $h_2^{i\,**} > h_2^{j\,**}$. Thus, the average μ across agents can be inferred from the difference in the observed housing consumption between movers and non-movers.

H4: If housing demand by non-movers is larger than that by movers on average, then the average bequest motive is smaller after moving that is, $\mu \in (0,1)$.

Furthermore, the magnitude of the difference between h_2^{j**} and h_2^{i**} is proportional to ψ. Assuming that older agents have larger bequest motives on average, we propose the following hypothesis:

H5: The difference in housing demand between movers and non-movers increases with age.

The utility gain M by moving from house i to house j is:

$$M \equiv U\left(c_2^j, h_2^j\right) - U\left(c_2^i, h_2^i\right) = -\psi(1-\mu)\ln\left(\frac{e_2}{p_2}\right) + a, \quad \text{(A27)}$$

where $a \equiv \ln\left(\left(\frac{1+\chi+\psi}{1+\chi+\mu\psi}\right)\left(\frac{\chi+\mu\psi}{1+\chi+\mu\psi}\right)^{\chi+\mu\psi}\left(\frac{1+\chi+\psi}{\chi+\psi}\right)^{\chi+\psi}\right)$. Figure II shows the graph of M against e_2 for three different values of $\psi = \{1,2,3\}$ while keeping the other parameters and the housing price fixed at $\chi = 1, \mu = 0.5,$ and $p_2 = 1$. For $\mu \in (0,1)$, M is decreasing in endowment e_2 and negative for a large value of e_2. As we show later, hypothesis H4 holds empirically. Thus, it is reasonable to restrict our attention to $\mu \in (0,1)$. As a negative value of M suggests that moving is not a rational choice, an agent with a large endowment stays in house i. A larger bequest motive ψ makes the slope steeper and reduces the threshold value of e_2 that makes $M \leq 0$. Thus, a bequest motive decreases the likelihood of moving. Our next hypothesis is:

H6: A bequest motive decreases the likelihood of moving.

Finally, we derived predictions about an agent's happiness in the short run and lifetime for different BM values of bequest motives. We interpret $u\left(c_1^*, h_1^{i\,*}\right)$ as short-term happiness for

younger generations, $u\left(c_2^*, {h_2^i}^*\right)$ as short-term happiness for older generations, and $u\left(c_1^*, {h_1^i}^*\right) + \beta\left[u\left(c_2^*, {h_2^i}^*\right) + \psi b\left({h_2^i}^*\right)\right]$ as long-term or lifetime happiness.

By taking a partial derivative of $u\left(c_1^*, {h_1^i}^*\right)$ with respect to bequest weight ψ, we obtain:

$$\frac{\partial u\left(c_1^*, {h_1^i}^*\right)}{\partial \psi} = -\frac{\beta(1+\chi)}{(1+\beta)(1+\chi)+\beta\psi} < 0. \text{ (A28)}$$

By combining this result with $\frac{\partial U}{\partial \psi} > 0$, we predict:

H7: The underutilization of housing is associated with less short-term happiness for younger generations.

For older generations, a partial derivative of $u\left(c_2^*, {h_2^i}^*\right)$ with respect to bequest weight, ψ equals:

$$\frac{\partial u\left(c_2^*, {h_2^i}^*\right)}{\partial \psi} = \frac{\chi(1+\chi)-\beta\psi}{(\chi+\psi)\left((1+\beta)(1+\chi)+\beta\psi\right)} \lesseqgtr 0. \text{ (A29)}$$

Although the sign is indeterminate, it is negative for a large bequest weight ψ. Again, recalling $\frac{\partial U}{\partial \psi} > 0$, we predict the following:

H8: Significantly underutilized housing is associated with less short-term happiness for older generations.

Finally, by taking a partial derivative of the lifetime utility with respect to bequest weight ψ, we obtain:

$$\frac{\partial LifetimeUtility}{\partial \psi} = \beta \ln \frac{\beta(\chi+\psi)(1+r)e}{\left((1+\beta)(1+\chi)+\beta\psi\right)p_2}. \text{ (A30)}$$

Its sign is ambiguous: negative for a small value of endowment e and positive for a large value of endowment e. Thus, we predict the following:

H9: Underutilization of housing has an ambiguous relationship with lifetime happiness.

Appendix B: Diagram summarizing the empirical strategy

Figure B. 1 illustrates the empirical strategies used in this study. The TSLS estimation in Section 4 is composed of the first stage equation (9) (the arrow labeled γ_z connecting $\boldsymbol{z}_{it-1} \rightarrow {B^H}_{\text{it}}$ and the arrow labled γ_x connecting $\boldsymbol{x}_{it-1} \rightarrow {B^H}_{\text{it}}$) and the second stage equation (10) (the arrow labeled α_B connecting ${B^H}_{\text{it}} \rightarrow r_{it}^e$ and the arrow labled α_x connecting $\boldsymbol{x}_{it-1} \rightarrow r_{it}^e$). The error terms in these equations are u_{it} and w_{it}. The 3SLS estimation in Section 4 is composed of the first stage equation (9) (the arrow labeled γ_z connecting $\boldsymbol{z}_{it-1} \rightarrow {B^H}_{\text{it}}$ and the arrow labled γ_x connecting $\boldsymbol{x}_{it-1} \rightarrow {B^H}_{\text{it}}$), the second stage equation (11) (the arrow labeled β_B connecting ${B^H}_{\text{it}} \rightarrow y_{it}$ and the arrow labled β_x connecting $\boldsymbol{x}_{it-1} \rightarrow y_{it}$), and the third stage equation (12) (the arrow labeled α_y connecting $y_{\text{it}} \rightarrow r_{it}^e$ and the arrow labled α_x connecting $\boldsymbol{x}_{it-1} \rightarrow r_{it}^e$). The error terms in these equations are u_{it}, v_{it}, and w_{it}^3.

[Figure B. 1 here]

Appendix C: Placebo tests

The main identifying assumption in such an empirical analysis is that the owner of housing with a larger lot size and other owners would have witnessed similar bequest motive trends in the absence of a change in the inheritance tax code. Table C. 1 presents the estimation results of bequest motive models with false tax changes for 2008. From these models, we find no significant coefficients of the interaction terms of lot size dummies and false tax change dummies. Thus, we conclude that the parallel trend assumptions are satisfied, which are necessary conditions to identify the change in bequest motives owing to tax changes in 2015.

[Table C. 1 here]

Appendix D: IV linear probability model of mobility and renovation

To check the robustness of the 3SLS estimation in Section 5, we estimate the IV linear probability model of mobility and renovation using TSLS without introducing a third equation for excess rooms. The first stage estimates the motives, and the second stage estimates the mobility and renovation probabilities using the instrumented bequest motive.

D.1 Bequest motives (the first stage)

The first-stage equation is given in equation (9). The estimation result of this step was identical for all IV models, except for small variations stemming from sample differences. Thus, we show the first-stage results for bequest motives only in columns 1 and 3 of Table D. 1 based on the TSLS estimation of the mobility model.

Households owning large residential lots (> 330 m^2) decreased their BMs for real estate by 10.3 percentage points after the inheritance tax change. Although the tax change also increased the benefits for lots between 240 and 330 m^2, the coefficient was not statistically significant. These size thresholds are relevant only for inheritance tax because we separately control for lot size. Thus, this result provides evidence that the elasticity of bequest motives with respect to effective tax rates is positive and significant, contributing to the discussion on the optimal inheritance tax rate (e.g., Piketty and Saez, 2013).

[Table D. 1 here]

Unsurprisingly, children also impact bequest motives. Households with no children had a 29.9 percentage-point lower probability of having a bequest motive. An additional number of coresident children did not significantly impact the bequest-motive probability. Thus, if parents have at least one coresident child, there is a high probability of bequeathing housing. Conversely, an additional non-coresident child decreases the bequest-motive probability by 2.64 percentage points; that is, the bequest-motive probability is the highest with only one child. Parents are willing to buy housing if they have only one child, regardless of their current co-residence status. However, parents lose their motivation to bequeath housing when they have more than one child because an indivisible housing asset can become a source of disputes between multiple heirs. These results are consistent with altruistic and selfish bequest motives. The coefficient for male children is small and statistically insignificant. Thus, the primogeniture system may no longer dominate Japan.

Age and several other household characteristics are also associated with bequest motives. The relationship between bequest motives and age is U-shaped, with a minimum at 43 years. As the BMs expressed by young households are noisy, we can conclude that the probability of having

bequest motives increases at an increasing rate after their forties. Female household heads had a 5.5 percentage-point smaller probability of bequest motives.

Housing characteristics are also important. Condominiums are associated with a smaller probability (-9.05 percentage points), whereas houses built after 1981 with significantly improved earthquake resistance standards are associated with a larger probability (4.4 percentage points). These results suggest that households with housing bequest motives tend to own fewer depreciating assets, detached housing (as opposed to condominiums) has a larger proportion of non-depreciating land, and newer structures with improved building standards depreciate less. Condominiums also incur large capital expenditures later in life.

D.2 Mobility (the second stage)

Columns 2 and 4 of Table D. 1 present the second-stage results for the moving decisions. The instrumented bequest motive has a statistically significant negative coefficient (-0.0700 in column 2). Thus, bequest motives for real estate make households less likely to move. When parents intend to bequeath a house, moving is often a suboptimal decision because of the high transaction costs. Its brokerage fee of 6 % is the highest among many developed countries. Thus, the low mobility of households is reasonable for those intending to bequeath real estate. The consequence is more pronounced in empty nests because low mobility is a cause of empty nests.

We validate our IV model using three tests. Using the Kleibergen-Paap rk LM test (Kleibergen and Paap, 2006), we can reject the null hypothesis of under-identification. Using the Kleibergen-Paap Wald rk F statistic, we reject the null hypothesis of weak instruments by at least 10% based on the critical values (10% maximal IV relative bias, 10.27) provided by Stock and

Yogo (2005). Using Hansen's overidentification J test, we do not reject the null hypothesis of the orthogonality condition.

The no-child dummy is associated with a two percentage-point lower mobility, whereas the male children variable is associated with a 0.4 percentage-point higher mobility. Additional coresident children also experienced a decrease in their parents' mobility. These results suggest that some parents move to their non-coresident male child's location. We found that mobility increases with age after retirement at around 60 years of age.[11] The estimated age profile of mobility exhibited a U-shaped bottom at 59 years. However, the positive coefficient of log real home equity (0.00058) suggests that a negative home equity makes moving more difficult.

The U-shaped age profile also suggests that households tend not to move before retirement. Working-age households may find it difficult to move when children are present. The negative coefficient of the number of coresident children (-0.0076) may be partly driven by the low mobility of working-age households.

Another trigger for moving beyond retirement is the loss of family members. The coefficient is significantly positive (0.0129) on the "Family decreased since 2004" dummy. Households that experienced family loss, such as death or divorce, were more likely to move back to their residence. Death of a family member was the most common reason, accounting for 16% of the mover households in the sample. This result, similar to that of Venti and Wise (2004), implies that

[11] The mandatory retirement age is 60 years old for 81% of firms according to Ministry of Health, Labour, and Welfare, General Survey on Working Conditions in 2016, http://www.mhlw.go.jp/toukei/itiran/roudou/jikan/syurou/16/index.html (accessed on April 14, 2017)

households move to smaller housing units after family loss. Our results are consistent with those of Bonnet et al. (2010), who found that widowhood significantly increased residential mobility in France, particularly for older adults and children.

Table D. 2 presents the results of the subsample analysis. The estimates were mostly statistically insignificant because of the lack of statistical power. When we exclude households intending to make inter-vivo transfers from the 2018 sample, the depression effect of bequest motives on mobility increases by 7.25 percentage points (Column 1). Although we do not have the same information for the earlier sample, this negative effect may be even larger if we exclude all inter-vivo transfer intentions. Columns 2 and 3 show the subsamples according to the age of the household head. The negative effect seems to be greater for the working-age population, although the results are inconclusive. Columns 4 and 5 show the subsamples by region. The negative effects of bequest motives appear to be concentrated in rural regions without large metropolitan areas. However, the standard errors were sufficiently large to draw a conclusion.

[Table D. 2 here]

D.3 Renovation (the second stage)

Columns 2 and 4 of Table D. 3 present the second-stage estimation results of the renovation equation. The instrumented bequest motive has a statistically significant positive coefficient (0.154 in column 2). Thus, households with bequest motives are more likely to renovate their houses. For example, parents may renovate their houses to add rooms when they expect to live with a child inheriting the house.

The age profile was a concave function with a peak at 46 years of age. Thus, it seems reasonable for elderly households to be less likely to renovate. Children also play an important role in renovation decisions. The no-child dummy has a positive coefficient (0.0380), as does the number of non-coresident children also has a positive coefficient (0.00640). This implies that households without children renovate houses to meet their needs. If a house was built after 1981 under the new building code, the probability of renovation would be smaller by 0.88 percentage points.

[Table D. 3 here]

Table D. 4 presents the results of the subsample analysis. The exclusion of inter-vivo transfers in the 2018 sample significantly changed the coefficient of bequest motives. However, decomposing the sample into working-age and elderly household heads had a significant impact. The effect of bequest motives was significantly greater in younger households (19.7 percentage points). Considering that 44 is the most active age for renovation activities, bequest motives can drive renovations, particularly for households in their fifties. The effect of bequest motives was greater in regions with large metropolitan areas. As young households generally prefer large cities, parents find it easier to live with their child's family if their house is located in a large city. The major type of bequest-driven renovation can be expanded to accommodate inherited child families in large cities.

[Table D. 4 here]

D.4 Decomposing renovation types

We distinguished between three types of renovations: capacity-increasing, capacity-maintaining, and capacity-decreasing. We decomposed the dummy variable for renovation into three categories: $y_{it} = y_{it}^{increasing} + y_{it}^{maintaining} + y_{it}^{decreasing}$. We then estimated equation (10) for each of the decomposed dependent variables: Thus, the estimated coefficients from the decomposed equations are added to the original coefficients for the aggregate renovation equation. The estimation results are summarized in Table D. 5 and the results based on the subsamples are listed in Table D. 6.

Column 1 of Table D. 5 demonstrates that the effect of bequest motives is the largest for capacity-increasing renovations (9.2 percentage points). Simultaneously, bequest motives also drive working-age households' capacity-increasing renovations (9.1 percentage points in Table D. 6). Conversely, the effect of bequest motives is insignificant for capacity-decreasing renovations (Column 3). Thus, the positive impact of bequest motives on renovation is driven mainly by parents' renovations to increase the number of rooms, possibly accommodating a child's family residing together. This result explains the excess rooms for renovators (see Figure II) and confirms that parents renovate their houses to add rooms when they expect to live with the child inheriting the house. However, working-age households' capacity-increasing renovations may result in the long-term inefficiency of maintaining excess rooms until they begin living with a child. This inefficiency is primarily caused by inheritance tax but is exacerbated by imperfect financial markets, where households need to arrange mortgage financing for renovations before retirement. Capacity-maintaining renovation by working-age households is likely to involve seismic reinforcement and the repair of walls and roofs.

[Table D. 5 and Table D. 6 here]

Appendix E: IV Probit model

As a robustness check, we estimated the IV Probit model by considering the nonlinear relationship between bequest motives and the probability of moving and renovation decisions. We simultaneously estimate the following bequest and outcome equations using maximum likelihood:

$$B_{it}^{H} = 1\left[\boldsymbol{z}_{it-1}^{'}\boldsymbol{\theta_1}' + \boldsymbol{x}_{it-1}^{'}\boldsymbol{\delta_1}, + J_j + T_t + \varepsilon_{\mathbf{1}'\,it} > 0\right]$$

$$y_{it} = 1\left[\beta_{2}' B_{it}^{H} + \boldsymbol{x}_{it-1}^{'}\boldsymbol{\delta_2}' + J_j + T_t + \varepsilon_{\mathbf{2}'\,it} > 0\right]$$

One benefit of this model is that identification may not require an exclusion restriction for an instrumental vector, unlike in a linear model, because the model is identified by nonlinearity (Wooldridge, 2010). Thus, we can obtain a consistent estimate even if the instruments are contaminated (i.e., if an exclusion restriction is not satisfied).

E.1 Mobility

Table E. 1 shows the IV Probit estimation results and the average partial effect (APE) for interpretation. The instrumented bequest motive for real estate has a statistically significant negative coefficient. The partial effect of the bequest motive on mobility, on average, was -9.08 percentage points. Other statistically significant coefficients are also larger in magnitude than in the linear model, as the literature suggests that probit estimates tend to show larger marginal effects on probability than in the linear model (Wooldridge, 2010, Chapter 15). For example, the APE is -3.59 percentage points for a no-child dummy and 2.27 percentage points for a family- decrease dummy.

[Table E. 1 here]

E.2 Renovation

According to the IV Probit model in Table E. 2, the estimated average partial effect of bequest motives is more moderate (4.1 percentage points) than that estimated by the IV linear model. Considering the advantage of the IV probit model when the exclusion restriction is imperfect, we consider the probit estimate as the main result. The other coefficients were mostly consistent with those of the linear model.

[Table E. 2 here]

Appendix F: The effect of bequest motives on non-mover underutilization

Table F. 1 shows the estimation results when non-mover underutilization was used as the outcome. For both the first and second specifications, the second-stage coefficients of the instrumented bequest motive (0.07185 in column 2 and 0.09738 in column 4) are similar to those for the excess rooms reported in Table III. This result implies that non-movers are the main drivers of housing underutilization.

[Table F. 1 here]

Table F. 2 presents the second-stage estimation results of the subsamples. The estimated coefficients are generally consistent with those in the

IV, which is based on excess rooms. The effect of bequest motives on underutilized rooms becomes slightly smaller (0.068) if we exclude inter vivos transfer (column 1), but the difference is small relative to standard errors. The effect is smaller for working-age households (0.039, column 2) than for elderly households (0.092, column 3), consistent with hypothesis *H2*. However, even working-age households keep underutilized rooms because of real estate bequest motives. Finally, the effect is larger in large metropolitan areas than in non-metro areas, possibly because housing in urban locations is preferred by their heirs.

[Table F. 2 here]

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Table I Frequencies of Reported Bequest Motives

Real Estate

Year	No	Yes	Total
2006	1,651	595	2,246
	(73.51)	(26.49)	(100.00)
2007	2,217	931	3,148
	(70.43)	(29.57)	(100.00)
2008	2,092	848	2,940
	(71.16)	(28.84)	(100.00)
2017	2,136	1,627	3,763
	(56.76)	(43.24)	(100.00)
2018	1,821	1,658	3,479
	(52.34)	(47.66)	(100.00)
Total	9,917	5,659	15,576
	(63.67)	(36.33)	(100.00)

Pearson's Chi2 =497.909, p=0.00

Financial Assets

Year	No	Yes	Total
2006	1,711	535	2,246
	(76.18)	(23.82)	(100.00)
2007	2,309	837	3,146
	(73.39)	(26.61)	(100.00)
2008	2,134	807	2,941
	(72.56)	(27.44)	(100.00)
2017	2,319	1,450	3,769
	(61.53)	(38.47)	(100.00)
2018	1,939	1,544	3,483
	(55.67)	(44.33)	(100.00)
Total	10,412	5,173	15,585
	(66.81)	(33.19)	(100.00)

Pearson's Chi2 = 436.616, p=0.00

Note: This table compares the bequest motives regarding real and financial assets for different survey years. The year in the table corresponds to the year prior to the survey; for example, the 2006 figures were taken from the 2007 survey. Proportions for each year are shown in parentheses. Each panel also shows Pearson χ^2 test for the null hypothesis that responses do not vary by year.

Table II Descriptive Statistics

	1. Households that did not move or renovate housing in 2006-2009 or 2017-2018		2. Households that moved in 2006-2009 or 2017-2018			3. Households that renovated housing in 2006-2009 or 2017-2018		
Variable	Mean	S. D.	Mean	S. D.	(ii)-(i)	Mean	S. D.	(iii)-(i)
Number of excess rooms(t+1)	2.534	2.080	1.224	1.555	***	3.210	2.151	***
Bequest motive for real estate (t+1) (=1)	0.429	0.495	0.277	0.449	***	0.543	0.499	***
Bequest motive for real estate (excluding inter vivos)(t+1) (=1)	0.436	0.496	0.297	0.459	***	0.548	0.499	***
Bequest motive for financial asset (t+1) (=1)	0.364	0.481	0.297	0.459	*	0.447	0.498	***
Bequest motive for financial asset (excluding inter vivos)(t+1) (=1)	0.387	0.487	0.319	0.468	*	0.478	0.501	***
Lot area, m2	231.7	398.3	163.0	213.1	***	288.8	316.8	***
Lot area, m2 [0,100] (=1)	0.736	0.441	0.824	0.382	***	0.607	0.489	***
Lot area, m2 (240,330] (=1)	0.117	0.322	0.108	0.312		0.165	0.372	**
Lot area, m2 (>330) (=1)	0.147	0.354	0.068	0.252	***	0.228	0.421	***
After inheritance tax change (=1)	0.465	0.499	0.358	0.481	***	0.382	0.487	***
# of rooms	5.768	1.850	5.547	1.763		6.279	2.124	***
# of rooms [1,3] (=1, Reference)	0.051	0.220	0.061	0.240		0.034	0.181	
# of rooms [4 or over] (=1)	0.940	0.238	0.939	0.240		0.959	0.199	
# of rooms: missing (=1)	0.009	0.096	0.000	0.000	***	0.007	0.086	
Detached house (=1)	0.887	0.317	0.831	0.376	*	0.925	0.264	**
Town house (=1)	0.010	0.100	0.020	0.141		0.007	0.086	
Condominium (=1)	0.127	0.333	0.176	0.382		0.079	0.270	***
Wooden apartment (=1)	0.001	0.035	0.000	0.000	***	0.004	0.061	
Other types of houses (=1)	0.001	0.035	0.000	0.000	***	0.000	0.000	***

Ground lease (=1)	0.024	0.154	0.027	0.163		0.011	0.106	*
Real housing equity (10,000JPY)	1,532	2,106	1,492	2,312		1,722	2,157	
Real housing equity is missing (=1)	0.164	0.371	0.155	0.364		0.157	0.365	
Built after 1981 (=1)	0.706	0.456	0.682	0.467		0.640	0.481	**
Age of household head	53.640	13.865	41.858	14.875	***	56.551	12.907	***
Real Income (10,000JPY)	693.2	454.9	820.5	842.4	*	747.2	474.8	*
Real income: missing (=1)	0.037	0.188	0.014	0.116	**	0.026	0.160	
Real financial wealth (10,000JPY)	1,160	1,973	944	1,875		1,481	1,885	***
Real financial wealth is missing (=1)	0.030	0.172	0.007	0.082	***	0.034	0.181	
College graduate (=1)	0.347	0.476	0.412	0.494		0.348	0.477	
Married (=1)	0.786	0.410	0.500	0.502	***	0.768	0.423	
Female household head (=1)	0.160	0.366	0.284	0.452	***	0.184	0.388	
Single (=1)	0.052	0.222	0.061	0.240		0.056	0.231	
Full-time worker (=1)	0.352	0.478	0.493	0.502	***	0.292	0.456	**
Part-time worker (=1)	0.132	0.338	0.203	0.403	**	0.161	0.368	
Retired (=1)	0.165	0.371	0.041	0.198	***	0.184	0.388	
# of family members	3.356	1.381	3.439	1.346		3.146	1.294	***
Family decreased since 2004 (=1)	0.112	0.315	0.162	0.370		0.150	0.358	*
Male children (=1)	0.551	0.497	0.392	0.490	***	0.479	0.501	**
# of non-coresident children	0.689	1.024	0.270	0.686	***	0.929	1.244	***
# of coresident children	1.020	1.042	0.716	0.976	***	0.768	0.896	***
No child (=1)	0.213	0.410	0.486	0.502	***	0.213	0.411	
Hokkaido (=1)	0.044	0.206	0.034	0.181		0.045	0.209	
Tohoku (=1)	0.056	0.231	0.041	0.198		0.030	0.172	**
Kanto (=1)	0.341	0.474	0.372	0.485		0.311	0.464	
Chubu (=1)	0.162	0.368	0.149	0.357		0.167	0.373	
Kinki (=1)	0.208	0.406	0.243	0.430		0.186	0.390	
Chugoku (=1)	0.053	0.225	0.027	0.163	*	0.083	0.277	*
Shikoku (=1)	0.031	0.174	0.027	0.163		0.034	0.182	

Kyushuu/Okinawa (=1)	0.104	0.305	0.108	0.312		0.144	0.352	*
Year 2006 (=1)	0.146	0.353	0.196	0.398		0.176	0.382	
Year 2007 (=1)	0.199	0.399	0.236	0.426		0.225	0.418	
Year 2008 (=1)	0.190	0.393	0.209	0.408		0.217	0.413	
Year 2017 (=1)	0.246	0.431	0.236	0.426		0.172	0.378	***
Year 2018 (=1)	0.219	0.414	0.122	0.328	***	0.210	0.408	
Number of observations	10,608		148			267		

Note: ***, **, and * indicate the results of a paired t-test of equal means between two samples at the 1%, 5%, and 10% significance levels, respectively. Welch's method was used to test the difference in averages under the hypothesis of heteroscedasticity.

Table III TSLS Estimation of the Excess Room Model

Dependent Variable	1. Bequest Motives for Real Estate (1st stage)	2. Number of Excess Rooms (2nd stage)	3. Bequest Motives for Real Estate (1st stage)	4. N of Excess Rooms (2nd stage)
Bequest motive for real estate (t+1) (%)		0.07714***		0.09579***
		-0.01337		(0.01778)
Lot area, m2 (240,330] (=1)	0.00346		0.00114	
	(0.0195)		(0.0196)	
Lot area, m2 (>330) (=1)	0.123***		0.115***	
	(0.0194)		(0.0209)	
Lot area, m2 (240,330] ×tax change (=1)	-0.0135		-0.00828	
	(0.0280)		(0.0284)	
Lot area, m2 (>330)×tax change (=1)	-0.103***		-0.0833***	
	(0.0261)		(0.0310)	
After tax-change (=1)	0.153***	-1.338***	0.156***	-1.734***
	(0.0154)	(0.219)	(0.0157)	(0.309)
Lot area, 100m2	0.00219*	0.0229*	0.00347*	-0.0164
	(0.00127)	(0.0138)	(0.00178)	(0.0220)
Lot area × tax change (=1)			-0.00301	0.0665**
			(0.00259)	(0.0271)
Housing characteristics	Yes	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes	Yes
Fixed Effects (city sizes, region and year)	Yes	Yes	Yes	Yes

# of observations	10,635	10,635	10,635	10,635
R-squared	0.150	-2.255	0.150	-3.772
Kleibergen-Paap rk LM	41.54	[0]	31.05	[0]
Kleibergen-Paap Wald rk F	10.75		8.509	
Hansen J	45.57	[0.000]	26.68	[0.000]

Note: Cluster standard errors for households are indicated in parentheses. Significant level: *** p<0.01, ** p<0.05, * p<0.1.

Table IV Subsample Analysis of the Effect of Bequest Motives on Excess Rooms

Variables	1. Excluding the intention of inter vivos in 2018 sample	2. The working-age household head (<60)	3. The elderly household head (>=60)	4. Metropolitan areas	5. Non-metropolitan areas
Bequest motive for real estate (t+1) (%)	0.07154***	0.04650***	0.09343***	0.09426***	0.05997***
	(0.01270)	(0.01190)	(0.02309)	(0.02303)	(0.01564)
Lot area × tax change (=1)	No	No	No	No	No
Housing characteristics	Yes	Yes	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes	Yes	Yes
Fixed Effects (city sizes, region and year)	Yes	Yes	Yes	Yes	Yes
# of observations	9,991	6,781	3,854	5,878	4,757
R-squared	-1.820	-0.631	-4.349	-4.511	-1.057
Kleibergen-Paap rk LM	41.56	26.57	19.63	17.51	21.44
	[0.000]	[0.000]	[0.000]	[0.002]	[0.000]
Kleibergen-Paap Wald rk F	10.777	6.962	4.83	4.801	5.391

Note: The estimate is the coefficient β_B on the instrumented bequest motives for real estate in the second-stage linear mobility regression. The regions with the largest metropolitan areas were Tokyo, Kanagawa, Chiba, Saitama, Aichi, Osaka, Kyoto, Hyogo, and Fukuoka. Heteroscedasticity-consistent standard errors for households are shown in parentheses. Significant level: *** p<0.01, ** p<0.05, * p<0.1. The coefficients of the other variables are suppressed.

Table V 3SLS Estimation of the Renovation Channel

Dependent Variable	1. Bequest Motives for Real Estate	2. Renovation	3. Excess rooms
Predicted renovation (t+1) (%)			0.7929***
			(0.07516)
Bequest motive for real estate (t+1) (=1)		0.0789***	
		(0.0294)	
Lot area, m2 (240,330] (=1)	0.0374**		
	(0.0163)		
Lot area, m2 (>330) (=1)	0.141***		
	(0.0194)		
Lot area, m2 (240,330] ×tax change (=1)	-0.00254		
	(0.0145)		
Lot area, m2 (>330)×tax change (=1)	-0.00295		
	(0.0188)		
After tax change (=1)	0.145***	-0.0176***	0.226
	(0.0149)	(0.00666)	(0.253)
Lot area, 100m2	-0.000543	-4.78e-05	0.0342*
	(0.00132)	(0.000460)	(0.0205)
Lot area × tax change (=1)			
Housing characteristics	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes
Fixed effects (region and year)	Yes	Yes	Yes
# of observations	10,510	10,510	10,510

Note: Cluster standard errors for households are indicated in parentheses. Significant level: *** p<0.01, ** p<0.05, * p<0.1.

Table VI 3SLS Estimation of the Mobility Channel

Dependent Variable	1. Bequest Motives for Real Estate	2. Moving	3. Excess Rooms
Predicted Move (t+1) (%)			-1.042***
			(0.00894)
Bequest motive for real estate (t+1) (=1)		-0.0933***	
		(0.0128)	
Lot area, m2 (240,330] (=1)	0.0747***		
	(0.0165)		
Lot area, m2 (>330) (=1)	0.137***		
	(0.0199)		
Lot area, m2 (240,330] ×tax change (=1)	0.0393		
	(0.0324)		
Lot area, m2 (>330)×tax change (=1)	0.0248		
	(0.0238)		
After tax change (=1)	0.0941***	0.00863**	-0.317
	(0.0151)	(0.00382)	(0.251)
Lot area, 100m2	0.000205	0.000103	0.0136
	(0.00151)	(0.000347)	(0.0239)
Lot area × tax change (=1)	No	No	No
Housing characteristics	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes
Fixed effects (region and year)	Yes	Yes	Yes
Number of Observations	8,324	8,324	8,324

Note: Cluster standard errors for households are indicated in parentheses. Significant level: *** p<0.01, ** p<0.05, * p<0.1.

Table VII Perceived Happiness and the Number of Excess Rooms

Variables	Happiness for the recent week		Happiness for the recent year		Happiness for the entire life	
	1. The working-age household head (<60)	2. The elderly household head (>=60)	3. The working-age household head (<60)	4. The elderly household head (>=60)	5. The working-age household head (<60)	6. The elderly household head (>=60)
Number of excess rooms	-0.0377	-0.0957*	-0.0713*	-0.0394	-0.341	-0.284
	(0.0473)	(0.0526)	(0.0417)	(0.0503)	(0.299)	(0.255)
Housing characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Regions fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
# of observations	14,425	10,443	14,426	10,443	14,426	10,443
R-squared	0.012	0.016	0.012	0.016	0.001	0.002

Note: The regions with large metropolitan areas are Tokyo, Kanagawa, Chiba, Saitama, Aichi, Osaka, Kyoto, Hyogo, and Fukuoka. Heteroscedasticity-consistent standard errors for households are shown in parentheses. Significant level: *** p<0.01, ** p<0.05, * p<0.1.

Table C. 1 Placebo tests: False tax change in 2008

Dependent Variable Variables	1. Bequest Motives for Real Estate (1st stage for Excess room model)	2. Bequest Motives for Real Estate (1st stage for mobility, LPM)	3. Bequest Motives for Real Estate (IV Probit)	4. Bequest Motives for Real Estate (1st stage for renovation, LPM)	5. Bequest Motives for Real Estate (IV Probit)
Lot area, m2 (240,330] (=1)	0.00261	-0.00617	-0.000744	0.000414	0.0165
Lot area, m2 (>330) (=1)	0.116***	0.0991***	0.279***	0.116***	0.328***
Falsified Tax Change	0.0203	0.0177	0.0569	0.0185	0.0549
Lot (240,330] x False Change	-0.0216	-0.0193	-0.0768	-0.0194	-0.0703
Lot >330 x False Change	-0.0141	-0.00768	-0.0211	-0.0150	-0.0348
Lot area, 100m2	3.28e-05*	0.00327*	0.0102*	0.00320*	0.00947*
Covariates	Yes	Yes	Yes	Yes	Yes
Fixed effects(region and year)	Yes	Yes	Yes	Yes	Yes
# of observations	5,659	5,546	5,546	5,615	5,615

Note: Clustered standard errors for households in models are shown in parentheses. Significant level: *** p<0.01, ** p<0.05, * p<0.1.

Table D. 1 TSLS Estimation of the Mobility Model

Dependent Variable	1. Bequest Motives for Real Estate	2. Moving	3. Bequest Motives for Real Estate	4. Moving
Variables	(1st stage)	(2nd stage)	(1st stage)	(2nd stage)
Bequest motive for real estate (t+1) (=1)		-0.0700**		-0.0721**
		(0.0287)		(0.0310)
Lot area, m2 (240,330] (=1)	0.000209		-0.00228	
	(0.0194)		(0.0195)	
Lot area, m2 (>330) (=1)	0.120***		0.112***	
	(0.0193)		(0.0208)	
Lot area, m2 (240,330] ×tax change (=1)	-0.00506		0.000557	
	(0.0278)		(0.0282)	
Lot area, m2 (>330)×tax change (=1)	-0.103***		-0.0815***	
	(0.0259)		(0.0308)	
After tax change (=1)	0.152***	0.00474	0.156***	0.00547
	(0.0153)	(0.00493)	(0.0156)	(0.00547)
Lot area, 100m2	0.00223*	-5.62e-05	0.00361**	4.49e-05
	(0.00126)	(0.000191)	(0.00178)	(0.000297)
Lot area × tax change (=1)			-0.00323	-0.000207
			(0.00258)	(0.000383)
# of rooms [4 or over] (=1)	0.0166	0.00154	0.0169	0.00158
	(0.0204)	(0.00591)	(0.0204)	(0.00591)
# of rooms: missing (=1)	-0.0681	-0.0146**	-0.0681	-0.0147**
	(0.0495)	(0.00697)	(0.0494)	(0.00711)
Condominium (=1)	-0.0905***	-0.000471	-0.0907***	-0.000675
	(0.0154)	(0.00532)	(0.0154)	(0.00553)

Ground lease (=1)	-0.0590**	-0.0121	-0.0589**	-0.0122
	(0.0291)	(0.00929)	(0.0291)	(0.00929)
Real housing equity, ln	0.0036***	0.00058*	0.0036***	0.00059*
	(0.00112)	(0.000337)	(0.00112)	(0.000343)
Real housing equity is missing (=1)	-0.00371	-0.000455	-0.00391	-0.000482
	(0.0141)	(0.00384)	(0.0141)	(0.00386)
Built after 1981 (=1)	0.0445***	-0.000307	0.0444***	-0.000221
	(0.0105)	(0.00330)	(0.0105)	(0.00333)
Age of household head(/10)	-0.119***	-0.0503***	-0.119***	-0.0506***
	(0.0238)	(0.00926)	(0.0238)	(0.00946)
Age of household head(squared, /100)	0.0139***	0.0043***	0.0140***	0.00434***
	(0.00233)	(0.000861)	(0.00233)	(0.000888)
Real income, ln	0.0178**	0.00524**	0.0177**	0.00528**
	(0.00726)	(0.00245)	(0.00726)	(0.00248)
Real income: missing (=1)	0.113**	0.0190	0.113**	0.0193
	(0.0524)	(0.0160)	(0.0524)	(0.0163)
Real financial wealth, ln	0.0185***	0.00110	0.0185***	0.00114
	(0.00176)	(0.000743)	(0.00176)	(0.000773)
Real financial wealth is missing (=1)	0.148***	0.00951	0.147***	0.00977
	(0.0328)	(0.00619)	(0.0328)	(0.00637)
College graduate (=1)	0.00469	0.00288	0.00472	0.00289
	(0.00997)	(0.00268)	(0.00997)	(0.00269)
Married (=1)	0.0341*	-0.00412	0.0343*	-0.00404
	(0.0177)	(0.00527)	(0.0177)	(0.00529)
Female household head (=1)	-0.0554***	-0.00309	-0.0551***	-0.00318
	(0.0143)	(0.00544)	(0.0143)	(0.00548)
Single (=1)	0.0555**	0.00708	0.0550**	0.00713
	(0.0251)	(0.00725)	(0.0251)	(0.00731)

Full-time worker (=1)	0.00753	0.00434*	0.00781	0.00437*
	(0.0101)	(0.00263)	(0.0101)	(0.00265)
Part-time worker (=1)	-0.0115	0.00442	-0.0115	0.00439
	(0.0136)	(0.00413)	(0.0136)	(0.00413)
Retired (=1)	-0.0141	-0.00384	-0.0138	-0.00383
	(0.0171)	(0.00307)	(0.0171)	(0.00309)
# of family members	-0.00170	0.00148	-0.00177	0.00147
	(0.00541)	(0.00159)	(0.00541)	(0.00159)
Male children (=1)	0.0141	0.00423*	0.0142	0.00427*
	(0.0119)	(0.00240)	(0.0119)	(0.00242)
# of non-coresident children	-0.0264***	-0.00360**	-0.0265***	-0.00366**
	(0.00639)	(0.00152)	(0.00639)	(0.00157)
# of coresident children	-0.0180**	-0.0076***	-0.0180**	-0.00763***
	(0.00910)	(0.00231)	(0.00910)	(0.00234)
No child (=1)	-0.299***	-0.0200**	-0.299***	-0.0206*
	(0.0186)	(0.0100)	(0.0186)	(0.0108)
Family decreased since 2004 (=1)	0.0563***	0.0129***	0.0567***	0.0131***
	(0.0147)	(0.00450)	(0.0147)	(0.00457)
Fixed effects(region and year)	Yes	Yes	Yes	Yes
Constant	0.323***	0.138***	0.322***	0.139***
	(0.0812)	(0.0302)	(0.0812)	(0.0306)
# of observations	10,756	10,756	10,756	10,756
R-squared	0.151	-0.050	0.151	-0.054
# of events		148		148
Kleibergen-Paap rk LM	40.36	[0.000]	29.85	[0.027]
Kleibergen-Paap Wald rk F	10.43		8.148	
Hansen J	3.850	[0.278]	4.345	[0.227]

Note: Cluster standard errors for households are indicated in parentheses. Significant level: *** p<0.01, ** p<0.05, * p<0.1. The coefficients of the missing categories were suppressed for number of rooms, housing wealth, income, and financial wealth.

Table D. 2 Subsample Analysis of the Effect of Bequest Motives on Mobility

Variable	1.Excluding the intention of inter vivos in 2018 sample	2. The working-age household head (<60)	3. The elderly household head (>=60)	4. Metropolitan areas	5. Non-metropolitan areas
Bequest motive for real estate (t+1) (=1)	-0.0725**	-0.0920**	-0.0298	0.00696	-0.0851**
	(0.0288)	(0.0455)	(0.0246)	(0.0604)	(0.0367)
Lot area × tax change (=1)	No	No	No	No	No
Housing characteristics	Yes	Yes	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes	Yes	Yes
Fixed effects(region and year)	Yes	Yes	Yes	Yes	Yes
# of observations	10,104	6,861	3,895	5,937	4,819
R-squared	-0.058	-0.067	-0.015	0.023	-0.105
# of events	138	124	24	91	57
Kleibergen-Paap rk LM	40.30	27.13	18.21	15.97	21.86
	[0]	[0.034]	[0]	[0.586]	[0]
Kleibergen-Paap Wald rk F	10.43	7.099	4.477	4.330	5.499
Hansen J	3.336	6.262	0.793	1.802	8.875
	[0.343]	[0.1]	[0.851]	[0.614]	[0.031]

Note: The estimate is the coefficient β_4 on the instrumented bequest motives for real estate in the second-stage linear mobility regression. The regions with the largest metropolitan areas were Tokyo, Kanagawa, Chiba, Saitama, Aichi, Osaka, Kyoto, Hyogo, and Fukuoka. Heteroscedasticity-consistent standard errors for households are shown in parentheses. Significant level: *** p<0.01, ** p<0.05, * p<0.1. The coefficients of the other variables are suppressed.

Table D. 3 TSLS Estimation of the Renovation Model

Dependent Variable	1. Bequest Motives	2. Renovation	3. Bequest Motives	4. Renovation
Variables	(1st stage)	(2nd stage)	(1st stage)	(2nd stage)
Bequest motive for real estate (t+1) (=1)		0.154**		0.154**
		(0.0697)		(0.0769)
Lot area, m2 (240,330] (=1)	0.000209		-0.00228	
	(0.0194)		(0.0195)	
Lot area, m2 (>330) (=1)	0.120***		0.112***	
	(0.0193)		(0.0208)	
Lot area, m2 (240,330] ×tax change (=1)	-0.00506		0.000557	
	(0.0278)		(0.0282)	
Lot area, m2 (>330)×tax change (=1)	-0.103***		-0.0815***	
	(0.0259)		(0.0308)	
After tax change (=1)	0.152***	-0.0278**	0.156***	-0.0282**
	(0.0153)	(0.0111)	(0.0156)	(0.0127)
Lot area, 100m2	0.00223*	-0.000444	0.00361**	-0.000519
	(0.00126)	(0.000413)	(0.00178)	(0.000680)
Lot area × tax change (=1)			-0.00323	0.000182
			(0.00258)	(0.000761)
# of rooms [4 or over] (=1)	0.0166	0.000270	0.0169	0.000269
	(0.0204)	(0.00656)	(0.0204)	(0.00657)
# of rooms: missing (=1)	-0.0681	0.00949	-0.0681	0.00945
	(0.0495)	(0.0182)	(0.0494)	(0.0184)
Condominium (=1)	-0.0905***	0.00890	-0.0907***	0.00887

	(0.0154)	(0.00793)	(0.0154)	(0.00849)
Ground lease (=1)	-0.0590**	0.000821	-0.0589**	0.000771
	(0.0291)	(0.0103)	(0.0291)	(0.0104)
Real housing equity, ln	0.00359***	-0.000567	0.00358***	-0.000564
	(0.00112)	(0.000443)	(0.00112)	(0.000456)
Real housing equity is missing (=1)	-0.00371	0.000713	-0.00391	0.000735
	(0.0141)	(0.00501)	(0.0141)	(0.00501)
Built after 1981 (=1)	0.0445***	-0.00881*	0.0444***	-0.00878*
	(0.0105)	(0.00493)	(0.0105)	(0.00510)
Age of household head(/10)	-0.119***	0.0304***	-0.119***	0.0305**
	(0.0238)	(0.0112)	(0.0238)	(0.0119)
Age of household head(squared, /100)	0.0139***	-0.00308**	0.0140***	-0.00309**
	(0.00233)	(0.00122)	(0.00233)	(0.00131)
Real income, ln	0.0178**	0.00344	0.0177**	0.00346
	(0.00726)	(0.00306)	(0.00726)	(0.00313)
Real income: missing (=1)	0.113**	0.0115	0.113**	0.0115
	(0.0524)	(0.0210)	(0.0524)	(0.0215)
Real financial wealth, ln	0.0185***	-0.000702	0.0185***	-0.000691
	(0.00176)	(0.00145)	(0.00176)	(0.00156)
Real financial wealth is missing (=1)	0.148***	-0.00513	0.147***	-0.00502
	(0.0328)	(0.0164)	(0.0328)	(0.0170)
College graduate (=1)	0.00469	-0.00206	0.00472	-0.00206
	(0.00997)	(0.00376)	(0.00997)	(0.00376)
Married (=1)	0.0341*	-0.0116	0.0343*	-0.0116
	(0.0177)	(0.00711)	(0.0177)	(0.00722)
Female household head (=1)	-0.0554***	0.00962	-0.0551***	0.00958
	(0.0143)	(0.00704)	(0.0143)	(0.00723)

Single (=1)	0.0555**	-0.0122	0.0550**	-0.0122
	(0.0251)	(0.0102)	(0.0251)	(0.0103)
Full-time worker (=1)	0.00753	-0.00686*	0.00781	-0.00687*
	(0.0101)	(0.00370)	(0.0101)	(0.00373)
Part-time worker (=1)	-0.0115	0.00508	-0.0115	0.00508
	(0.0136)	(0.00561)	(0.0136)	(0.00560)
Retired (=1)	-0.0141	-0.00236	-0.0138	-0.00240
	(0.0171)	(0.00685)	(0.0171)	(0.00684)
# of family members	-0.00170	0.00157	-0.00177	0.00158
	(0.00541)	(0.00210)	(0.00541)	(0.00210)
Male children (=1)	0.0141	-0.00981**	0.0142	-0.00981**
	(0.0119)	(0.00451)	(0.0119)	(0.00452)
# of non-coresident children	-0.0264***	0.00640*	-0.0265***	0.00638*
	(0.00639)	(0.00333)	(0.00639)	(0.00344)
# of coresident children	-0.0180**	-0.00229	-0.0180**	-0.00232
	(0.00910)	(0.00366)	(0.00910)	(0.00372)
No child (=1)	-0.299***	0.0380*	-0.299***	0.0378
	(0.0186)	(0.0223)	(0.0186)	(0.0244)
Family decreased since 2004 (=1)	0.0563***	-0.000866	0.0567***	-0.000912
	(0.0147)	(0.00706)	(0.0147)	(0.00753)
Fixed effects(region and year)	0.0648***	-0.00857	0.0651***	-0.00856
	(0.0172)	(0.00740)	(0.0172)	(0.00757)
Fixed effects(region and year)	Yes	Yes	Yes	Yes
Constant	0.323***	-0.0994***	0.322***	-0.0993***
	(0.0812)	(0.0344)	(0.0812)	(0.0360)
# of observations	10,756	10,756	10,756	10,756
R-squared	0.151	-0.167	0.151	-0.166

# of events		267		267
Kleibergen-Paap rk LM	40.36	[0.000]	29.85	[0.020]
Stock_Yogo_Kleibergen-Paap Wald rk F	10.43		8.148	
Hansen J	3.999	[0.262]	4.362	[0.225]

Note: Heteroscedasticity-consistent standard errors for households are shown in parentheses. Significant level: *** p<0.01, ** p<0.05, * p<0.1. The coefficients of the missing categories were suppressed for number of rooms, housing wealth, income, and financial wealth.

Table D. 4 Subsample Analysis of the Effect of Bequest Motives on Renovation

Variables	1.Excluding the intention of inter vivos in 2018 sample	2. The working-age household head (<60)	3. The elderly household head (>=60)	4. Metropolitan areas	5. Non-metropolitan areas
Bequest motive for real estate (t+1) (=1)	0.150**	0.197**	0.0452	0.238*	0.0773
	(0.0695)	(0.0856)	(0.0978)	(0.125)	(0.0923)
Lot area × tax change (=1)	No	No	No	No	No
Housing characteristics	Yes	Yes	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes	Yes	Yes
Fixed effects(region and year)	Yes	Yes	Yes	Yes	Yes
# of observations	10,104	6,861	3,895	5,937	4,819
R-squared	-0.154	-0.335	0.007	-0.513	-0.010
# of events	250	143	124	128	139
Kleibergen-Paap rk LM	40.30	27.13	18.21	15.97	21.86
Stock_Yogo_Kleibergen-Paap Wald rk F	10.43	7.099	4.477	4.330	5.499
Hansen J	3.488	0.630	8.236	5.259	4.494
	[0.322]	[0.89]	[0.041]	[0.154]	[0.213]

Note: The regions with large metropolitan areas are Tokyo, Kanagawa, Chiba, Saitama, Aichi, Osaka, Kyoto, Hyogo, and Fukuoka. Heteroscedasticity-consistent standard errors for households are shown in parentheses. Significant level: *** p<0.01, ** p<0.05, * p<0.1. The coefficients of the other variables are suppressed.

Table D. 5 Decomposed coefficients on the instrumented bequest motives for renovation

Variables	1. Capacity-Increasing Renovations (2nd stage)	2. Capacity-Maintaining Renovations (2nd stage)	3. Capacity-Decreasing Renovations (2nd stage)
Bequest motive for real estate (t+1)			
(=1)	0.0921**	0.0534	-0.0109
	(0.0402)	(0.0491)	(0.0244)
Lot area × tax change (=1)	No	No	No
Housing characteristics	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes
Fixed effects(region and year)	Yes	Yes	Yes
# of observations	10,754	10,754	10,754
R-squared	-0.320	-0.025	-0.000
# of events	54	153	58

Note: Coefficients are the estimated β_4 in equation (10). The clustered standard errors for households are shown in parentheses.

Significant level: *** p<0.01, ** p<0.05, * p<0.1.

Table D. 6 Subsample Analysis of the Effect of Bequest Motives on Three Types of Renovation

	1. Excluding the intention of inter vivos in 2018 sample	2. Working population (age of the household head < 60)	3. Elderly population (age of the household head>= 60)	4. Metropolitan areas	5. Non-Metropolitan areas
(A)Capacity-Increasing Renovations					
Housing bequest motive (t+1) (=1)	0.0879**	0.0912**	0.0898	0.0729	0.0417
	(0.0393)	(0.0432)	(0.0627)	(0.0599)	(0.0538)
# of observations	9,989	6,859	3,894	5,936	4,817
# of events	50	26	28	19	35
(B)Capacity-Maintaining Renovations					
Housing bequest motive (t+1) (=1)	0.0534	0.0932	-0.0512	0.144	0.0235
	(0.0483)	(0.0654)	(0.0665)	(0.0902)	(0.0686)
# of observations	9,989	6,859	3,894	5,936	4,817
# of events	142	85	68	82	71
(C)Capacity-Decreasing Renovations					
Housing bequest motive (t+1) (=1)	-0.0112	0.00170	-0.0167	-0.0188	-0.000729
	(0.0238)	(0.0296)	(0.0370)	(0.0389)	(0.0340)

# of observations	9,989	6,859	3,894	5,936	4,817
# of events	56	31	27	26	32

Note: Coefficients are the estimated β_4 in equation (2). The clustered standard errors for households are shown in parentheses.

Significant level: *** p<0.01, ** p<0.05, * p<0.1.

Table E. 1 IV Probit Model for Mobility

Dependent Variable	1. Bequest Motives for Real Estate	2. Moving		3. Bequest Motives for Real Estate	4. Moving	
Variables	(1st stage)	(2nd stage)	(APE)	(1st stage)	(2nd stage)	(APE)
Bequest motive for real estate (t+1) (=1)		-1.214***	-0.0908*		-1.193***	-0.0871*
		(0.266)	(0.0465)		(0.274)	(0.0464)
Lot area, m2 (240,330] (=1)	0.00924			-7.12e-05		
	(0.0574)			(0.0578)		
Lot area, m2 (>330) (=1)	0.345***			0.316***		
	(0.0564)			(0.0610)		
Lot area, m2 (240,330] ×tax change (=1)	-0.0460			-0.0258		
	(0.0801)			(0.0815)		
Lot area, m2 (>330)×tax change (=1)	-0.307***			-0.238***		
	(0.0742)			(0.0916)		
After tax change (=1)	0.424***	0.0336	0.00252	0.433***	-0.0131	0.00252
	(0.0439)	(0.116)	(0.00903)	(0.0450)	(0.130)	(0.00896)
Lot area, 100m2	0.00727*	-0.0213	-0.00159	0.0114**	-0.0359	-0.00180
	(0.00414)	(0.0176)	(0.00130)	(0.00551)	(0.0250)	(0.00124)
Lot area × tax change (=1)				-0.00967	0.0263	
				(0.00828)	(0.0293)	
# of rooms [4 or over] (=1)	0.0384	0.0433	0.00324	0.0393	0.0423	0.00309
	(0.0620)	(0.135)	(0.0101)	(0.0621)	(0.136)	(0.00993)
# of rooms: missing (=1)	-0.208	-3.326	-0.249	-0.209	-3.139	-0.229
	(0.148)	(291.4)	(21.80)	(0.148)	(167.1)	(12.20)
Condominium (=1)	-0.265***	0.0187	0.00140	-0.267***	0.0149	0.00109

	(0.0464)	(0.102)	(0.00750)	(0.0464)	(0.103)	(0.00740)
Ground lease (=1)	-0.240**	-0.263	-0.0197	-0.239**	-0.257	-0.0188
	(0.103)	(0.208)	(0.0168)	(0.103)	(0.210)	(0.0165)
Real housing equity, ln	0.00947***	0.00902	0.000675	0.00946***	0.00927	0.000677
	(0.00322)	(0.00730)	(0.000589)	(0.00322)	(0.00734)	(0.000582)
Real housing equity is missing (=1)	-0.0218	-0.00493	-0.000369	-0.0224	-0.00432	-0.000316
	(0.0418)	(0.0954)	(0.00714)	(0.0418)	(0.0960)	(0.00701)
Built after 1981 (=1)	0.135***	-0.0745	-0.00558	0.134***	-0.0771	-0.00563
	(0.0313)	(0.0743)	(0.00532)	(0.0313)	(0.0748)	(0.00522)
Age of household head(/10)	-0.285***	-0.644***	-0.00970***	-0.287***	-0.643***	-0.00965***
	(0.0781)	(0.166)	(0.00287)	(0.0781)	(0.167)	(0.00283)
Age of household head(squared, /100)	0.0354***	0.0531***		0.0355***	0.0528***	
	(0.00746)	(0.0170)		(0.00746)	(0.0171)	
Real income, ln	0.0445**	0.107**	0.00801*	0.0443**	0.110**	0.00801*
	(0.0221)	(0.0534)	(0.00453)	(0.0221)	(0.0539)	(0.00451)
Real income: missing (=1)	0.271*	0.280	0.0210	0.272*	0.292	0.0214
	(0.162)	(0.419)	(0.0321)	(0.162)	(0.422)	(0.0316)
Real financial wealth, ln	0.0553***	0.0168	0.00126	0.0552***	0.0166	0.00121
	(0.00524)	(0.0124)	(0.00109)	(0.00524)	(0.0125)	(0.00108)
Real financial wealth is missing (=1)	0.450***	0.00515	0.000386	0.450***	-4.69e-05	-3.42e-06
	(0.0930)	(0.323)	(0.0242)	(0.0931)	(0.325)	(0.0238)
College graduate (=1)	0.00433	0.0570	0.00426	0.00462	0.0580	0.00424
	(0.0291)	(0.0671)	(0.00518)	(0.0291)	(0.0675)	(0.00510)
Married (=1)	0.117**	-0.0489	-0.00366	0.118**	-0.0487	-0.00355
	(0.0563)	(0.122)	(0.00902)	(0.0563)	(0.123)	(0.00886)
Female household head (=1)	-0.191***	-0.0803	-0.00601	-0.190***	-0.0778	-0.00568
	(0.0488)	(0.0937)	(0.00753)	(0.0488)	(0.0943)	(0.00740)
Single (=1)	0.183**	0.269	0.0201	0.182**	0.274	0.0200

	(0.0763)	(0.168)	(0.0141)	(0.0763)	(0.169)	(0.0139)
Full-time worker (=1)	0.0239	0.101	0.00753	0.0248	0.102	0.00743
	(0.0295)	(0.0687)	(0.00542)	(0.0295)	(0.0691)	(0.00534)
Part-time worker (=1)	-0.0431	0.0814	0.00609	-0.0433	0.0836	0.00611
	(0.0424)	(0.0923)	(0.00689)	(0.0424)	(0.0928)	(0.00677)
Retired (=1)	-0.0344	-0.218	-0.0163	-0.0340	-0.220	-0.0161
	(0.0485)	(0.164)	(0.0132)	(0.0485)	(0.165)	(0.0130)
# of family members	-0.0144	0.0186	0.00139	-0.0145	0.0202	0.00148
	(0.0168)	(0.0366)	(0.00274)	(0.0168)	(0.0368)	(0.00269)
Male children (=1)	0.0347	0.130	0.00970	0.0345	0.129	0.00942
	(0.0320)	(0.0925)	(0.00709)	(0.0320)	(0.0929)	(0.00698)
# of non-coresident children	-0.0760***	-0.147***	-0.0110**	-0.0761***	-0.148***	-0.0108**
	(0.0178)	(0.0563)	(0.00524)	(0.0178)	(0.0567)	(0.00521)
# of coresident children	-0.0266	-0.173**	-0.0130**	-0.0266	-0.177**	-0.0129**
	(0.0262)	(0.0687)	(0.00599)	(0.0262)	(0.0693)	(0.00596)
No child (=1)	-0.886***	-0.479***	-0.0359*	-0.886***	-0.476***	-0.0348*
	(0.0555)	(0.162)	(0.0198)	(0.0555)	(0.164)	(0.0197)
Family decreased since 2004 (=1)	0.176***	0.304***	0.0227**	0.178***	0.301***	0.0220**
	(0.0439)	(0.0934)	(0.00957)	(0.0439)	(0.0939)	(0.00952)
Fixed effects(region and year)	Yes	Yes		Yes	Yes	
ρ	0.803***			0.787***		
	(0.220)			(0.225)		
Constant	-0.624**	-0.447		-0.624**	-0.453	
	(0.250)	(0.553)		(0.250)	(0.557)	
# of observations	10,756	10,756	10,756	10,756	10,756	10,756
Log-likelihood	-7130.9912			-7129.8744		
ρ	0.666		[0.000]	0.657		[0.000]

Note: Standard errors of APE are calculated using the delta method. Significant level: *** p<0.01, ** p<0.05, * p<0.1. The coefficients of the missing categories were suppressed for number of rooms, housing wealth, income, and financial wealth.

Table E. 2 IV Probit Model for Renovation

Dependent Variable	1. Bequest Motives	2. Renovation		3. Bequest Motives	4. Renovation	
Variables	(1st stage)	(2nd stage)	APE	(1st stage)	(2nd stage)	APE
Bequest motive for real estate (t+1) (=1)		0.629**	0.0410		0.599*	0.0385
		(0.307)	(0.0273)		(0.321)	(0.0275)
Lot area, m2 (240,330] (=1)	0.0110			0.00297		
	(0.0584)			(0.0589)		
Lot area, m2 (>330) (=1)	0.348***			0.321***		
	(0.0569)			(0.0616)		
Lot area, m2 (240,330] ×tax change (=1)	-0.0287			-0.0116		
	(0.0810)			(0.0823)		
Lot area, m2 (>330)×tax change (=1)	-0.304***			-0.239***		
	(0.0747)			(0.0922)		
After tax change (=1)	0.423***	-0.202**	-0.0131*	0.434***	-0.179*	-0.0129*
	(0.0440)	(0.0923)	(0.00725)	(0.0450)	(0.101)	(0.00720)
Lot area, 100m2	0.00696*	0.00166	0.000109	0.0110**	0.00365	2.97e-05
	(0.00415)	(0.00642)	(0.000413)	(0.00552)	(0.00733)	(0.000456)
Lot area × tax change (=1)				-0.00955	-0.00795	
				(0.00829)	(0.0147)	
# of rooms [4 or over] (=1)	0.0368	0.0355	0.00232	0.0378	0.0376	0.00241
	(0.0620)	(0.141)	(0.00917)	(0.0621)	(0.141)	(0.00904)
# of rooms: missing (=1)	-0.208	0.0757	0.00494	-0.208	0.0750	0.00481
	(0.148)	(0.316)	(0.0207)	(0.148)	(0.317)	(0.0204)
Condominium (=1)	-0.263***	-0.0570	-0.00372	-0.264***	-0.0625	-0.00401
	(0.0465)	(0.110)	(0.00703)	(0.0465)	(0.111)	(0.00695)
Ground lease (=1)	-0.240**	-0.158	-0.0103	-0.239**	-0.158	-0.0102
	(0.103)	(0.244)	(0.0159)	(0.103)	(0.245)	(0.0157)

Real housing equity, ln	0.0095***	-0.0003	-2.03e-05	0.0095***	-0.00024	-1.55e-05
	(0.00322)	(0.00759)	(0.000495)	(0.00322)	(0.00761)	(0.000489)
Real housing equity is missing (=1)	-0.0197	0.0342	0.00223	-0.0205	0.0340	0.00218
	(0.0419)	(0.0891)	(0.00582)	(0.0419)	(0.0893)	(0.00574)
Built after 1981 (=1)	0.135***	-0.0573	-0.00374	0.134***	-0.0570	-0.00366
	(0.0314)	(0.0613)	(0.00416)	(0.0314)	(0.0615)	(0.00411)
Age of household head(/10)	-0.284***	0.337**	0.000528	-0.285***	0.331**	0.000609
	(0.0781)	(0.163)	(0.00214)	(0.0781)	(0.164)	(0.00212)
Age of household head(squared, /100)	0.0353***	-0.0294*		0.0354***	-0.0286*	
	(0.00746)	(0.0156)		(0.00746)	(0.0157)	
Real income, ln	0.0451**	0.105**	0.00683**	0.0451**	0.106**	0.00682**
	(0.0222)	(0.0483)	(0.00312)	(0.0222)	(0.0485)	(0.00308)
Real income: missing (=1)	0.274*	0.434	0.0283	0.275*	0.444	0.0285
	(0.162)	(0.361)	(0.0231)	(0.163)	(0.362)	(0.0228)
Real financial wealth, ln	0.0546***	0.0339**	0.00221***	0.0545***	0.0345**	0.00221***
	(0.00525)	(0.0137)	(0.000797)	(0.00525)	(0.0139)	(0.000786)
Real financial wealth is missing (=1)	0.450***	0.312	0.0204	0.450***	0.316	0.0203
	(0.0933)	(0.197)	(0.0125)	(0.0934)	(0.198)	(0.0124)
College graduate (=1)	0.00592	-0.0144	-0.000940	0.00619	-0.0139	-0.000891
	(0.0291)	(0.0593)	(0.00388)	(0.0291)	(0.0595)	(0.00383)
Married (=1)	0.115**	-0.145	-0.00944	0.116**	-0.144	-0.00923
	(0.0563)	(0.109)	(0.00739)	(0.0563)	(0.109)	(0.00730)
Female household head (=1)	-0.192***	0.0568	0.00370	-0.190***	0.0563	0.00361
	(0.0488)	(0.0925)	(0.00616)	(0.0488)	(0.0927)	(0.00608)
Single (=1)	0.183**	-0.106	-0.00688	0.182**	-0.107	-0.00685
	(0.0765)	(0.151)	(0.0101)	(0.0765)	(0.152)	(0.00994)
Full-time worker (=1)	0.0227	-0.112*	-0.00727*	0.0235	-0.111*	-0.00713*
	(0.0296)	(0.0621)	(0.00425)	(0.0296)	(0.0622)	(0.00419)
Part-time worker (=1)	-0.0439	0.0742	0.00484	-0.0440	0.0738	0.00473
	(0.0424)	(0.0793)	(0.00524)	(0.0424)	(0.0795)	(0.00517)
Retired (=1)	-0.0370	-0.0610	-0.00398	-0.0365	-0.0597	-0.00383

	(0.0485)	(0.0927)	(0.00605)	(0.0485)	(0.0929)	(0.00597)
# of family members	-0.0129	0.0359	0.00234	-0.0131	0.0360	0.00231
	(0.0168)	(0.0323)	(0.00213)	(0.0168)	(0.0324)	(0.00210)
Male children (=1)	0.0331	-0.123*	-0.00801*	0.0331	-0.122*	-0.00785*
	(0.0320)	(0.0651)	(0.00450)	(0.0320)	(0.0652)	(0.00445)
# of non-coresident children	-0.0764***	0.0462	0.00301	-0.0764***	0.0456	0.00293
	(0.0178)	(0.0345)	(0.00241)	(0.0178)	(0.0346)	(0.00238)
# of coresident children	-0.0289	-0.109*	-0.00712*	-0.0287	-0.110*	-0.00705*
	(0.0262)	(0.0566)	(0.00367)	(0.0262)	(0.0568)	(0.00362)
No child (=1)	-0.887***	0.0526	0.00343	-0.886***	0.0454	0.00291
	(0.0555)	(0.139)	(0.00944)	(0.0555)	(0.142)	(0.00943)
Family decreased since 2004 (=1)	0.178***	0.0903	0.00589	0.179***	0.0953	0.00611
	(0.0440)	(0.0847)	(0.00536)	(0.0440)	(0.0855)	(0.00530)
Fixed effects(region and year)	Yes	Yes		Yes	Yes	
Constant	-0.631**	-3.713***		-0.631**	-3.715***	
	(0.250)	(0.540)		(0.250)	(0.542)	
# of observations	10,756	10,756	10,756	10,756	10,756	10,756
Log likelihood	-7633.2191			-7632.3613		
ρ	-0.2621825		[0.1653]	-0.2454533		[0.2136]

Note: Standard errors of the APEs were calculated using the delta method. Significant level: *** p<0.01, ** p<0.05, * p<0.1. The coefficients of the missing categories were suppressed for number of rooms, housing wealth, income, and financial wealth.

Table F. 1 TSLS Estimation of Non-Mover Underutilization

Dependent Variable	1. Bequest Motives for Real Estate (1st stage)	2. Non-Mover Under-utilization (2nd stage)	3. Bequest Motives for Real Estate (1st stage)	4. Non-Mover Under-utilization (2nd stage)
Bequest motive for real estate (t+1) (%)		0.07185***		0.09738***
		(0.0185)		(0.02941)
Lot area, m2 (240,330] (=1)	-0.0121		-0.0186	
	(0.0259)		(0.0259)	
Lot area, m2 (>330) (=1)	0.114***		0.0919***	
	(0.0273)		(0.0283)	
Lot area, m2 (240,330] ×tax change (=1)	-0.00647		0.00683	
	(0.0352)		(0.0356)	
Lot area, m2 (>330)×tax change (=1)	-0.105***		-0.0589	
	(0.0322)		(0.0377)	
Lot area, m2	2.89e-05	0.000305*	6.48e-05***	-0.000252
	(1.76e-05)	(0.000174)	(2.11e-05)	(0.000359)
Lot area × tax change (=1)			-7.51e-05**	0.000842**
			(3.25e-05)	(0.000418)
Housing characteristics	Yes	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes	Yes
Fixed Effects (city sizes, region and year)	Yes	Yes	Yes	Yes
# of observations	9,036	9,036	9,036	9,036
R-squared	0.149	-1.096	0.150	-2.288
Kleibergen-Paap rk LM	20.36	[0.000]	13.23	[0.000]

Kleibergen-Paap Wald rk F	5.447	3.513

Note: The estimate is the coefficient of instrumented bequest motives for real estate in the second-stage linear mobility regression. The regions with the largest metropolitan areas were Tokyo, Kanagawa, Chiba, Saitama, Aichi, Osaka, Kyoto, Hyogo, and Fukuoka. The clustered standard errors for households are shown in parentheses. Significant level: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table F. 2 Subsample Analysis of the Effect of Bequest Motives on Underutilized Rooms

Variables	1. Excluding the intention of inter vivos in 2018 sample	2. The working-age household head (<60)	3. The elderly household head (>=60)	4. Metropolitan areas	5. Non-metropolitan areas
Bequest motive for real estate (t+1)(%)	0.06763***	0.03918***	0.09197***	0.0865***	0.04914***
	(0.01576)	(0.01449)	(0.02709)	(0.02724)	(0.01824)
Lot area × tax change (=1)	No	No	No	No	No
Housing characteristics	Yes	Yes	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes	Yes	Yes
Fixed Effects (city sizes, region and year)	Yes	Yes	Yes	Yes	Yes
# of observations	8,709	5,708	3,328	5,193	3,843
R-squared	-0.918	-0.173	-2.493	-1.821	-0.393
Kleibergen-Paap rk LM	28.80	21.11	14.75	12.68	15.84
	[0]	[0]	[0.005]	[0.013]	[0.003]
Kleibergen-Paap Wald rk F	7.467	5.407	3.583	3.512	3.975

Note: The estimate is the coefficient β_B on the instrumented bequest motives for real estate in the second-stage linear mobility regression. The regions with the largest metropolitan areas were Tokyo, Kanagawa, Chiba, Saitama, Aichi, Osaka, Kyoto, Hyogo, and Fukuoka. Heteroscedasticity-consistent standard errors for households are shown in parentheses. Significant level: *** p<0.01, ** p<0.05, * p<0.1. The coefficients of the other variables are suppressed.

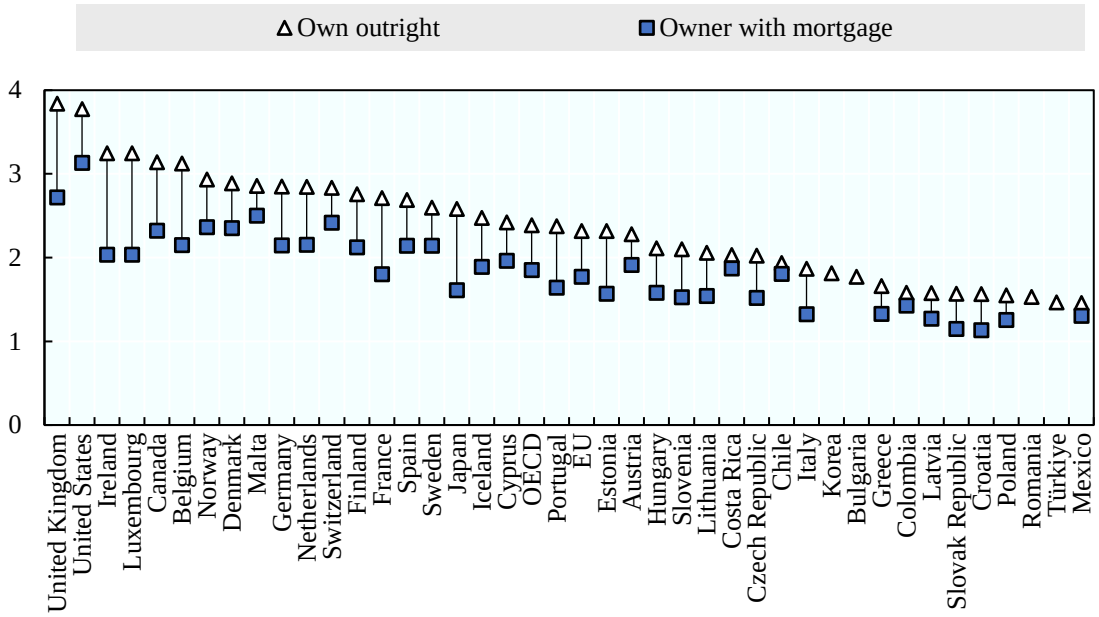


Figure I Average Number of Rooms per Household Member

Source: OECD Affordable Housing Database HC2.1.1. OECD calculations based on European Union Statistics on Income and Living Conditions (EU SILC 2020) survey for European countries except for Italy 2019 and Iceland 2018; calculations from Statistics Canada based on the 2016 Canada Census of Population for Canada; Encuesta de Caracterización Socioeconómica Nacional (CASEN 2013) for Chile; the Gran Encuesta Integrade de Hogares (GEIH 2020) for Colombia ; the Encuesta Nacional de Hogares (ENAHO 2020) for Costa Rica ; the German Socioeconomic Panel (GSOEP 2014) for Germany; the Korean Housing Survey 2020; the Japan Household Panel Study (JHPS 2020) for Japan; Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH 2020) for Mexico; Türkiye-National SILC (2020); Understanding Society - The UK Household Longitudinal Study 2020; American Community Survey (ACS 2020) for the United States.



Figure II Utility Gain from Moving

Notes: This figure shows the utility difference between moving and staying against second-period endowment e_2. Three graphs correspond to different values of bequest motives: $\psi = 1$ (the dotted red curve), $\psi = 2$ (the dashed orange curve), and $\psi = 3$ (the solid green curve). The other parameters are fixed at $\chi = 1$, $\mu = 0.5$, $p_2 = 1$.

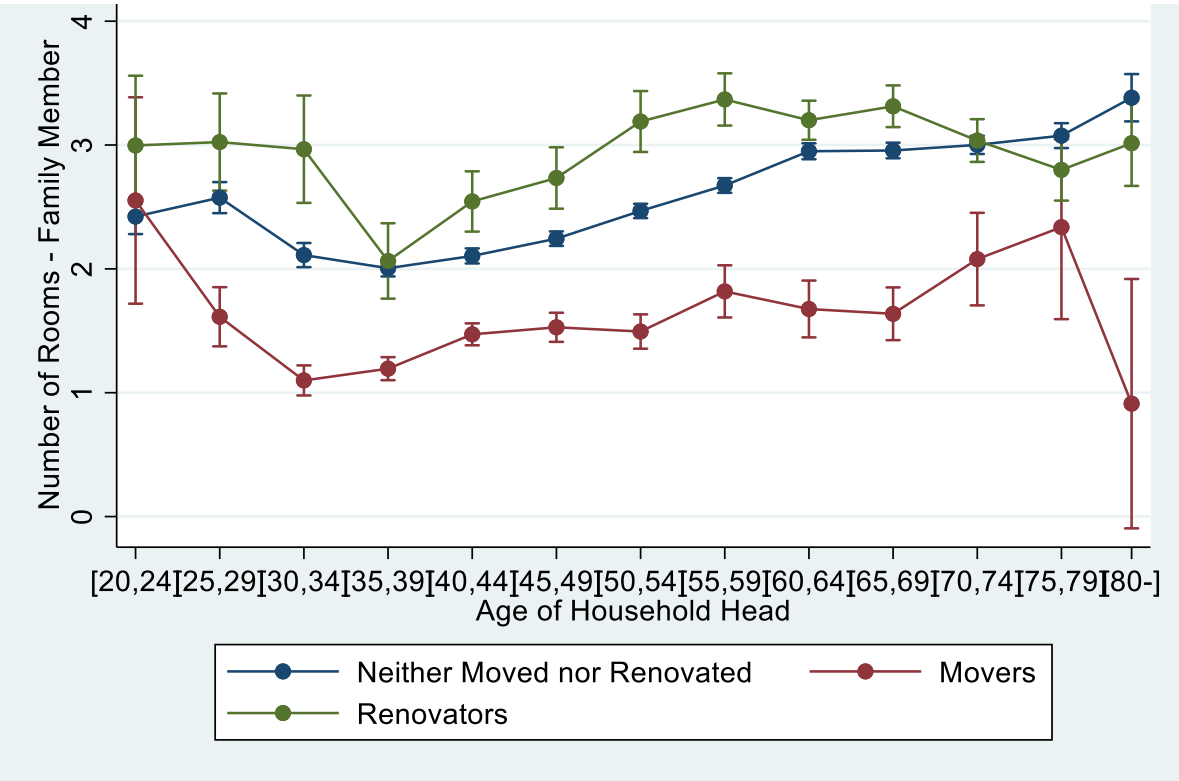


Figure III The Number of Excess Rooms

Note: This figure shows the number of excess rooms, which is defined as the difference between the number of rooms and household members for various age bins. The three lines represent renovators (green), recent movers (red), and others (blue).

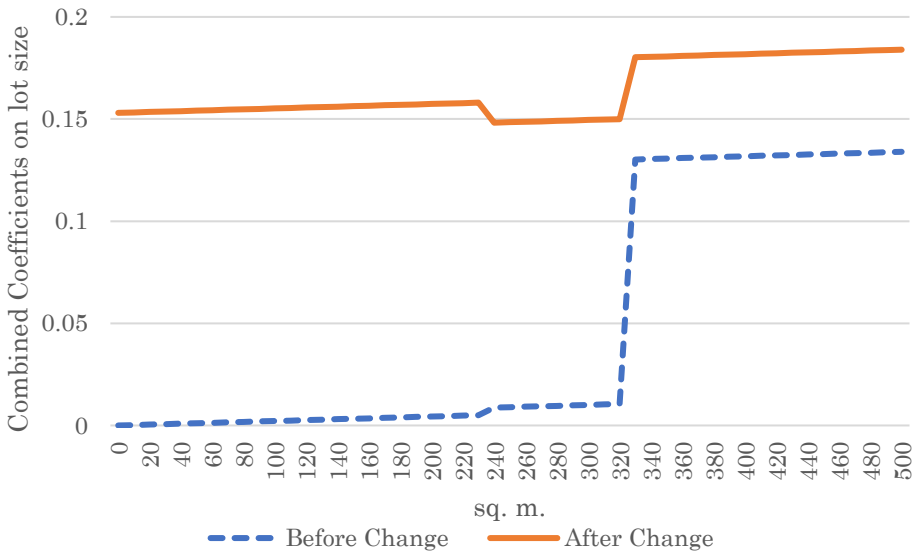


Figure IV The effect of lot size on the probability to express real estate bequest motives

Notes: This figure shows the combined coefficients of lot size-related variables in the first-stage linear regression before (blue dashed line) and after (orange solid line) the 2015 tax change. The dependent variable was a dummy variable representing real estate bequest motives.

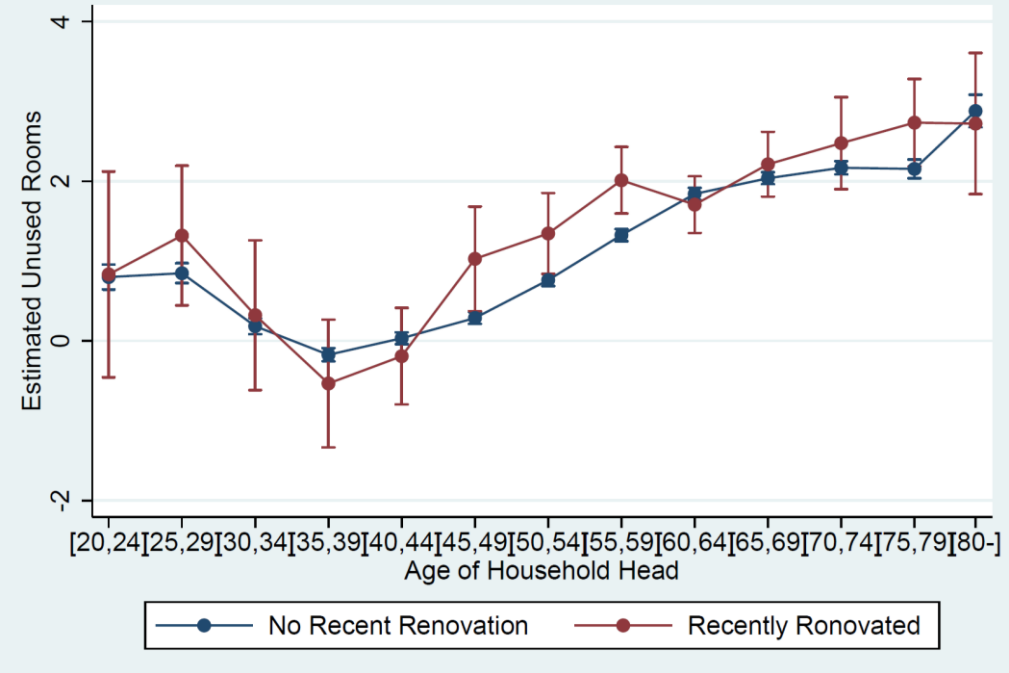


Figure V The Non-Mover Underutilization

Notes: This figure shows the measure of non-mover underutilization of housing, defined as the difference in the number of excess rooms between matched pairs of movers and non-movers. The red line with a circular marker represents recent renovators and the blue line with a square marker represents non-renovators.

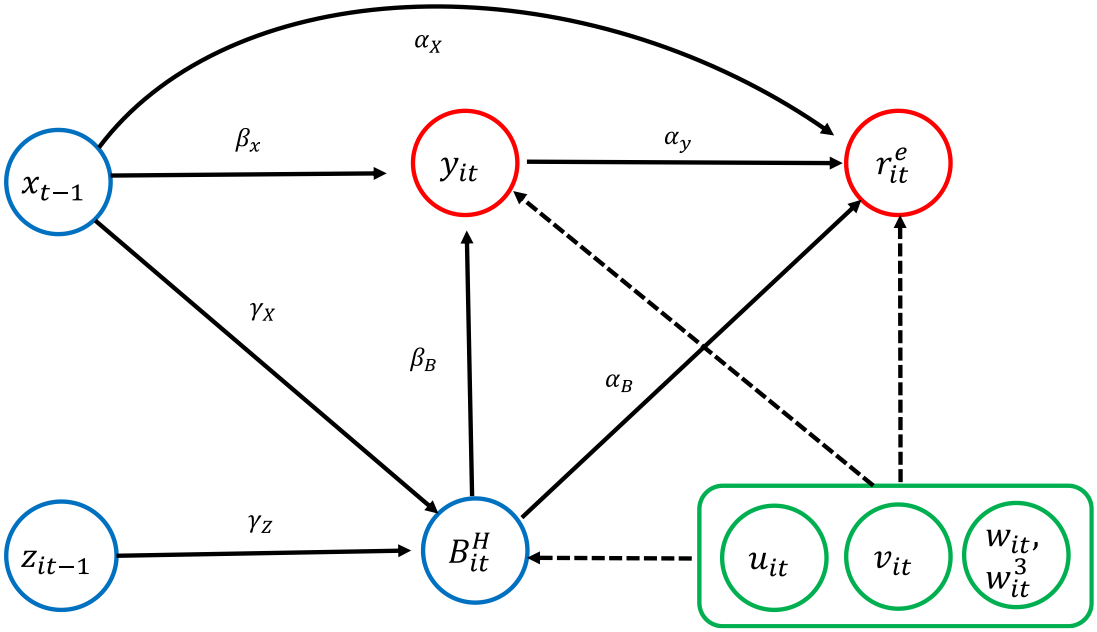


Figure B. 1 Directed Acyclic Graph