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Abstract

Using Japanese household micro survey data for the period 2000–2015, this study examines the effects of home ownership on household stock holdings. To disentangle the effect of housing assets (land value) and mortgage debt on a household's portfolio of stocks as a share of their liquid financial assets, we apply the instrumental variable approach proposed by Chetty et al. (2017) that employs differences in average land price indices across housing markets in the year in which household portfolios are measured and those in the year in which the house was purchased. Our estimates suggest that an exogenous increase in land value (while holding mortgage debt constant) increases the portfolio of stocks, while an increase in mortgage debt (while holding land value constant) reduces it. We also find that an increase in land value and mortgage debt (while holding home equity constant) does not affect the portfolio of stocks, but increases the repayment of mortgage debt.

JEL classifications: D14, G11, R21

Keywords: housing, home equity, mortgage debt, portfolio choice

1. Introduction

Since real estate is the largest physical asset for the majority of households in developed economies, the effect of home ownership on households' portfolio choices is an important issue. Despite its relevance, the impact of home ownership on household portfolios remains unclear. While many theoretical studies predict that home ownership lowers the demand for risky financial assets such as stocks, the existing empirical analyses have failed to reach a clear consensus regarding the effect of home ownership on household portfolios. On the one hand, Fratantoni (1998) and Faig and Shum (2002) find that households with larger mortgage payments or that are saving more to invest in their own houses hold less risky financial portfolios. On the other hand, Heaton and Lucas (2000) find a positive relationship between mortgage debt and stock holdings. Other studies have found that the relationship between home ownership and stock holdings is non-monotonic (Yamashita 2003); the relationship depends on the empirical proxy used for stock holdings (Yao and Zhang 2005) or home ownership (Cocco 2005), or else there is no significant relationship (Shum and Faig 2006).[1]

Recently, Chetty et al. (2017) set forth an analytical framework to reconcile the theory with the available data. Their contributions are twofold. First, they construct a theoretical model of household portfolio choice that separates the effects of property values from the effects of home equity (current

[1] Yamashita (2003) finds that there is a positive relationship between the house-to-net worth ratio and stockholding for households with a lower house-to-net worth ratio and a negative relationship for households with a higher house-to-net worth ratio. Yao and Zhang (2005) find that the relationship between the *equity-to-net worth* ratio and the house-to-net worth ratio is negative (substitution effect), while the relationship between the *equity-to-liquid assets* ratio and the house-to-net worth ratio is positive (diversification effect). Cocco (2005) finds that investment in housing reduces equity market participation, especially for younger and poorer households, but the relationship between mortgage debt and stockholding is positive.

property value minus current mortgage debt). Their model predicts that an incremental increase in property value while holding home equity fixed reduces a household's portfolio of stocks as a share of liquid wealth through three channels: (1) by increasing the illiquidity of the household portfolio (Grossman and Laroque 1990, Chetty and Szeidl 2007), (2) by increasing exposure to house price risk (Flavin and Yamashita 2002), and (3) by increasing mortgage debt (negative wealth effect), as a higher property value while holding home equity fixed essentially means higher mortgage debt. In contrast, the model predicts that incremental increases in home equity while holding property values fixed, which is equivalent to reducing mortgage debt, increases the share of liquid wealth through the positive wealth effect and the diversification effect (Yao and Zhang 2005). Thus, it is critical to distinguish the effects of home equity and mortgage debt on household portfolio choice. Second, on the empirical side, Chetty et al. (2017) argue that it is important to extract *exogenous* changes in property values and home equity to make a causal inference about household portfolios, because both home ownership and portfolio choices are endogenous and might be affected by unobserved factors. For instance, if there is a measurement error in households' lifetime income, we may observe a positive relationship between home ownership, mortgage debt, and stockholding because households with higher future income tend to buy larger houses, have greater debt capacity, and invest more in stocks. Chetty et al. (2017) address this endogeneity problem using three research designs and obtain empirical results that are consistent with their theory.

Using micro data for more than 4,000 households in Japan for the period 2000–2015, this study examines the effect of housing on household financial portfolios by employing one of the empirical methodologies of Chetty et al. (2017), in which instruments for property value and home equity use variations in the current and time-of-purchase house price indices. Chetty et al. (2017) argue that the current house price index is a strong predictor of property value, but also positively affects home equity. To separate the effect of current house prices on property values from that on home equity, they use a second instrument, the house price index at the time of purchase, because households that bought houses when prices were higher tend to incur larger mortgage debts and have smaller home equity. Using these two house price indices as instrumental variables (IVs), Chetty et al. (2017) conduct two-stage least squares (2SLS) regressions. We first carry out the estimations employing their IV methodology, but obtain mixed results in terms of consistency with Chetty et al. (2017). In particular, we find that the effect of property values (land values in our case) on households' portfolio of stocks when holding home equity fixed is not significantly negative, as was the case in Chetty et al. (2017). We also note the possibility that households that bought houses when the average price was higher might have reduced their mortgage debt more aggressively, which might make the effect of the house price index at the time of purchase on *current* home equity ambiguous. To deal with this problem, we conduct 2SLS regressions using another specification form in which the land value and the amount of the *initial* mortgage debt are the instrumented variables.[2] In addition, we conduct 2SLS regressions in

[2] As we argue below, the choice of two instrumental variables from among land value, mortgage debt, and home equity does not affect our estimation results, although the interpretation of each coefficient differs (see also Michielsen et al. 2016). The main point of our specification form is the use of *initial* mortgage debt instead of *current* mortgage debt.

which the dependent variable is the amount of repayment of mortgage debt. Our main findings are twofold. First, we find that an exogenous increase in current land value while holding initial mortgage debt fixed increases households' portfolio of stocks (positive wealth effect), while an increase in initial mortgage debt while holding current land value fixed reduces their portfolio of stocks (negative wealth effect). However, we note that the statistical significance of the negative effect of initial mortgage debt on the portfolio of stocks is weaker, which suggests that the effect might be heterogeneous among households. Second, we find that an exogenous increase in current land value and initial mortgage debt while holding home equity fixed does not affect households' portfolio of stocks, which is inconsistent with the theoretical reasoning and empirical findings of Chetty et al. (2017). However, we find that the same increase in current land value and initial mortgage debt increases households' repayment of their mortgage debt. This finding suggests that the illiquidity and pricing risks of housing assets affect Japanese households' financial decisions through their debt repayments rather than through investment in stocks.

To the best of our knowledge, this study is the first to apply the methodology of Chetty et al. (2017) to Japanese data to examine the causal effect of home ownership on household stock holdings. Previous studies that applied the methods used by Chetty et al. (2017) to European countries showed mixed results. Fougère and Poulhès (2012) used data on French households and found that home equity and mortgage debt have significant, opposite-signed effects on household stock portfolios. Quantitatively, they reported that the positive effect associated with an increase in home equity dominates the negative risk effect associated with owning a more expensive house in France, while these effects are cancelled out in Chetty et al. (2017), who use US household data. They argue that the quantitative discrepancy between France and the US is presumably because fixed adjustment costs for housing in France are higher than those in the US. Michielsen et al. (2016) used data on Dutch households and found that neither home equity nor mortgage debt had a significant impact on household stock portfolios. They argued that this is presumably because investment in stocks is relatively unpopular and the investment aspect of housing is less important for Dutch households than for US and French households. Our estimation results for stock portfolios using Japanese data are similar to those of Fougère and Poulhès (2012), which is consistent with the general perception that the housing adjustment cost in Japan is higher than that in other developed countries, including the US. In addition, we provide evidence that holding illiquid and risky housing assets affects Japanese households' portfolios through their debt repayment rather than through investment in stocks.

The remainder of the paper is organized as follows. Section 2 explains the empirical methodology. Section 3 explains our data and sample selection, while Section 4 presents the empirical results. Section 5 summarizes and discusses our empirical findings.

2. Empirical strategy

Following Chetty et al. (2017), we first examine the effects of home ownership on households' portfolio of stocks by estimating the following OLS regression:

$$\text{Stock share}_{it} = \alpha + \beta_1 \text{Land value}_{it} + \beta_2 \text{Home equity}_{it} + \gamma \mathbf{X_{it}} + \varepsilon_{it}, \quad (1)$$

where Stock share represents household i's stock portfolio as a share of their total liquid financial assets, Land value represents the current value of residential land that the household owns, Home equity represents the current land value minus current mortgage debt outstanding, and $\mathbf{X_{it}}$ denotes a vector of control variables. Due to the data limitations described in Section 3, we use Land value instead of property value, which includes the value of construction as well as land. In equation (1), β_1 captures the effect of land value on Stock share while holding home equity fixed, while β_2 captures the effect of home equity on Stock share while holding land value fixed. The theoretical model in Chetty et al. (2017) predicts that $\beta_1 < 0$, because an incremental increase in a household's land value increases (i) the illiquidity of the household's portfolio (Grossman and Laroque 1990, Chetty and Szeidl 2007), (ii) its exposure to house price risk (Flavin and Yamashita 2002), and (iii) its debt burden, as a higher land value for the same level of home equity essentially implies a higher mortgage debt. In contrast, the model in Chetty et al. (2017) predicts that $\beta_2 > 0$ because of the diversification effect (Yao and Zhang 2005), whereby a household seeks to diversify its increased net worth and maintain a constant share of risky assets. Note also that higher home equity while holding land value fixed is equivalent to lower mortgage debt, which increases the share of risky financial assets. Finally, $\beta_1 + \beta_2$ captures the effect of land value and home equity on Stock share while holding mortgage debt fixed. The sign of $\beta_1 + \beta_2$ depends on the magnitude of the negative impact of having more illiquid and risky housing assets (land) and the positive wealth effect of having greater home equity.

Chetty et al. (2017) argue that the OLS estimates of β_1 and β_2 may be biased because the error term in equation (1) is likely to be correlated with $\mathrm{Land\ value}$. For instance, if future labor income of households is unobservable and positively correlated with $\mathrm{Land\ value}$, implying that households with higher lifetime income own more valuable houses and incur larger mortgage debts, the OLS estimate of β_1 is biased upward (Cocco 2005). To overcome the endogeneity problem, Chetty et al. (2017) propose three research designs that generate an exogenous variation in mortgage debt and home equity that is orthogonal to the unobserved determinants of $\mathrm{Stock\ share}$. We apply one of their research designs utilizing variations in mean house prices as instrumental variables for $\mathrm{Land\ value}$ and $\mathrm{Home\ equity}$ as described below.

Following Chetty et al. (2017), we use two instruments in estimating equation (1): the average land price of the region in which households live in the current year (the year in which household portfolios are measured), denoted as $\mathrm{Lprice\_current}$, and the average land price of the same region in the year in which the households bought their houses, denoted as $\mathrm{Lprice\_purchase}$. The idea is as follows (see Figure 1).[3] Suppose that two households, Household A and Household B, bought identical houses in the same region (Tokyo-Chuo) but Household B bought at a time when the house price was lower. Then, Households A and B have the same current $\mathrm{Land\ value}$, but Household B is likely to have greater $\mathrm{Home\ equity}$ because of the smaller initial mortgage debt incurred. This effect is captured by

[3] This illustration closely follows the exposition in Fougère and Poulhès (2012; Appendix A).

the difference in Lprice_purchase. Next, suppose Household C bought a house for the same price at the same time as Household A, but the house that Household C bought is located in a different region (for instance, Tokyo-Josei) and its current price is higher than that of Household A's house. Then, Households A and C are likely to have the same amount of initial mortgage debt, but Household C is likely to have a larger Land value and Home equity because of the higher current land price. This effect is captured by the difference in Lprice_present. Using these two instruments, we estimate equation (1) using a 2SLS regression of the following form:

$$\text{Stock share}_{it} = \alpha + \beta_1 \widehat{\text{Land value}}_{it} + \beta_2 \widehat{\text{Home equity}}_{it} + \gamma \mathbf{X_{it}} + \varepsilon_{it} \quad (2a)$$

$$\text{Land value}_{it} = \delta + \lambda_1 \text{Lprice\_present}_j + \lambda_2 \text{Lprice\_purchase}_j + \eta \mathbf{X_{it}} + u_1 \quad (2b)$$

$$\text{Home equity}_{it} = \zeta + \sigma_1 \text{Lprice\_present}_j + \sigma_2 \text{Lprice\_purchase}_j + \theta \mathbf{X_{it}} + u_2, \quad (2c)$$

where subscript j denotes the household's region of residence. In equation (2b), Chetty et al. (2017) predict that given current regional prices, obtained by controlling Lprice_present, Lprice_purchase is negatively associated with Land value ($\lambda_2 < 0$) because households tend to buy smaller houses when prices are relatively higher. In contrast, the effect of Lprice_present on the current value of land is clearly positive. In equation (2c), Lprice_present is expected to be positively associated with Home equity ($\sigma_1 > 0$) given the same house prices at the time of purchase, while Lprice_purchase is negatively associated with Home equity ($\sigma_2 < 0$) for the same current house prices because households are likely to purchase more expensive houses and incur larger mortgage debts. By extracting exogenous variations in Land value and Home equity from equations (2b) and (2c), it is expected that we can obtain consistent estimates of β_1 and β_2 in equation (2a).

We not only replicate Chetty et al. (2017) using Japanese data, but also improve their empirical strategy. The empirical specifications in Chetty et al. (2017) contain some ambiguity. First, in Chetty et al. (2017), the negative coefficient of Land value (β_1) in equation (2a) can be attributed to an increase in either (i) the illiquidity of housing assets, (ii) households' exposure to house price risk, or (iii) mortgage debt. While (i) and (ii) stem from the risk associated with housing assets, (iii) derives from the liability side (negative net worth effect). Thus, even if we obtain a significantly negative estimate of β_1, we cannot distinguish the relative importance among (i)–(iii) quantitatively.[4] Second, and more importantly, while Chetty et al. (2017) expect that the average land price in the year in which households bought their houses (Lprice_purchase) negatively affects their home equity ($\sigma_2 < 0$), this may not be the case if households that bought expensive houses repay their mortgage debt more rapidly than those that bought cheaper houses. In this case, the effect of Lprice_purchase on home equity, which is defined as the current land value minus *current* mortgage debt, is ambiguous. In contrast, the effect of Lprice_purchase on the amount of the *initial* mortgage debt is clearly positive. In addition, if a household that bought an expensive house tended to repay mortgage debt more rapidly instead of investing in stocks, the effect of mortgage debt on the portfolio of stocks might also be ambiguous.

To deal with these two problems, first, we estimate the following modified version of

[4] As noted above, the sum of coefficients $\beta_1 + \beta_2$ captures the effect of an increase in land value and home equity while holding mortgage debt fixed. If the quantitative impact of a ¥1 increase in housing assets and a ¥1 decrease in mortgage debt is the same, we can distinguish the relative importance among (i)–(iii) from $\beta_1 + \beta_2$.

equations (2a)–(2c) using 2SLS regressions:

$$\text{Stock share}_{it} = \alpha + \beta_1' \widehat{\text{Land value}}_{it} + \beta_2' \widehat{\text{Initial mortgage}}_{it} + \gamma' \mathbf{X_{it}} + \varepsilon_{it}' \quad (3a)$$

$$\text{Land value}_{it} = \delta + \lambda_1 \text{Lprice\_present}_j + \lambda_2 \text{Lprice\_purchase}_j + \eta \mathbf{X_{it}} + u_1 \quad (3b)$$

$$\text{Initial mortgage}_{it} = \xi + \pi_1 \text{Lprice\_present}_j + \pi_2 \text{Lprice\_purchase}_j + \kappa \mathbf{X_{it}} + u_2. \quad (3c)$$

In this specification, we expect that Lprice_present positively affects Land value ($\lambda_1 > 0$), while Lprice_purchase positively affects Initial mortgage ($\pi_2 > 0$). The sign of β_1' depends on the increased risk associated with higher land values, which negatively affects Stock share, and on the wealth effect, which positively affects Stock share. If the latter effect dominates the former, we expect β_1' to be positive. We expect the sign of β_2' to be negative because of the negative wealth effect. $\beta_1' + \beta_2'$ captures the effect of land value and initial mortgage debt on Stock share while holding home equity fixed (for instance, buying an expensive house).

Second, using 2SLS regressions, we estimate the following equations in which the dependent variable is the amount of mortgage repayment (current mortgage debt outstanding minus initial mortgage debt outstanding):

$$\text{Mortgage repayment}_{it} = \alpha + \beta_1^{\text{M}} \widehat{\text{Land value}}_{it} + \beta_2^{\text{M}} \widehat{\text{Initial mortgage}}_{it} + \gamma^{\text{M}} \mathbf{X_{it}} \quad (4a)$$

$$\text{Land value}_{it} = \delta + \lambda_1 \text{Lprice\_present}_j + \lambda_2 \text{Lprice\_purchase}_j + \eta \mathbf{X_{it}} + u_1 \quad (4b)$$

$$\text{Initial mortgage}_{it} = \xi + \pi_1 \text{Lprice\_present}_j + \pi_2 \text{Lprice\_purchase}_j + \kappa \mathbf{X_{it}} + u_2. \quad (4c)$$

Taken together with equations (3a)–(3c), the regression results for equations (4a)–(4c) suggest whether or not the investment in stocks and mortgage debt repayment are substitutes. For example, if households that incur a larger mortgage debt repay their mortgage debt more rapidly instead of investing in stocks, we expect that β_2' is insignificant, while β_2^{M} is positive.

3. Data and variables

3.1. Data and sample selection

The household data used in this study are taken from the *Nikkei Kinyu Kodo Chosa NEEDS-RADAR* (Nikkei RADAR, hereafter), which is a household survey of people living in the Metropolitan area in Japan, where the Metropolitan area is defined as the area within a 40 km radius of the Tokyo station encompassing the Tokyo, Saitama, Chiba, Kanagawa, and Ibaraki prefectures. The Nikkei RADAR survey is conducted in the fourth quarter, i.e., from October to December, each year, and we use data from the period 2000–2015. Individuals who make financial decisions on behalf of the household including saving, investment, and borrowing are asked to respond to the survey questionnaire. Because the Nikkei RADAR data are restricted to households in the Metropolitan area, average income and financial wealth are larger than the national averages.[5]

To construct average land prices for residential areas in which households live, i.e., $\mathrm{Lprice\_present}$ and $\mathrm{Lprice\_purchase}$, we used the dataset of "Public notice of land prices (PNLP)" provided by the Land Appraisal Committee of the Ministry of Land, Infrastructure, Transport and Tourism of the Government of Japan. From Nikkei RADAR, we identified the following 10 residential

[5] For example, the mean household ordinary income before tax deduction in 2010 in the Nikkei RADAR was 6.09 million yen, while the national average was 5.58 million yen (Source: Family Income and Expenditure Survey by the Statistics Bureau, Ministry of Internal Affairs and Communications).

areas in which households reside: Tokyo-Chuo (central part), Tokyo-Jonan (southern part), Tokyo-Johoku (northern part), Tokyo-Josei (western part), Tokyo-Joto (eastern part), Tokyo-outer, Saitama, Chiba, Kanagawa, and Ibaraki.[6] In addition, we identified whether a household was located 0–10 km, 10–20 km, 20–30 km, or 30–40 km from the Tokyo station.[7] By combining these two pieces of geographical information, we constructed 22 regions in which households were located (see Table 1 for a list of the 22 regions).[8] Accordingly, we constructed average land prices for these 22 regions during the period 1983–2015 from PNLP and matched them with the Nikkei RADAR data. The number of observations was 42,709 (approximately 2,700 for each year).

To examine the effects of land value and home equity on stock portfolios, we exclude households that are renters, those that are homeowners but do not live in stand-alone houses (e.g., those living in an apartment or condominium), those that do not have any mortgage debt, and those that do not have any liquid financial assets.[9] We exclude homeowners that do not live in stand-alone houses

[6] The precise definitions of the six regions in terms of wards and cities included in Tokyo prefecture are as follows: Tokyo-Chuo (central part) consists of Chiyoda, Chuo, Minato, Shinjuku, and Bunkyo; Tokyo-Jonan (southern part) consists of Shinagawa, Meguro, Ota, Setagaya, and Shibuya; Tokyo-Johoku (northern part) consists of Toshima, Kita, Itabashi, and Nerima; Tokyo-Josei (western part) consists of Nakano and Suginami, and Tokyo-Joto (eastern part) consists of Taito, Sumida, Koto, Arakawa, Adachi, Katsushika, and Edogawa. Tokyo-outer includes cities other than the 23 wards listed above.

[7] "10–20 km" means more than 10km and equal to or less than 20km.

[8] The total number of regions is not 40 (10×4) because, for example, all households in Tokyo-Chuo (central part) live in the area that is 0–10 km from Tokyo station.

[9] Previous empirical studies examining the effect of property value and home equity on households' portfolio of stocks are not unanimous regarding the sample selection criteria. Chetty et al.'s (2017) criteria differ from ours in that they include households that do not have any mortgage debt and exclude households with negative equity. We do not exclude negative equity households from our estimation sample for two reasons. First, as discussed in Subsection 3.2, our home equity variable does not account for the value of construction (houses), so negative equity households should not be taken at face value. Second, while mortgage debt in some US states (e.g., Florida) is without recourse, and thus debtor households can walk away from debt if home equity falls below zero, mortgage debt in Japan is with recourse. Thus, we do not think there is a strong argument for excluding negative equity households a priori. Regarding mortgage debt, we follow the sample selection criteria of Fougère and Poulhès (2012), who also exclude households that do not have any mortgage debt. They argue that if the household has no mortgage debt, property value and

because the Nikkei RADAR does not contain information about the property value of these households. This leaves us with 8,491 observations. For the reason explained below, we also exclude households for which the difference between the national average mortgage interest rate in the year of the survey (i.e., the year in which household portfolios were measured) is lower than the interest rate in the year of in which the current mortgage debt was incurred by more than one percentage point. We also exclude households whose current mortgage debt is larger than the initial debt. This leaves us with 5,574 observations. Finally, we exclude households for whom we cannot obtain data for one of the dependent variables, independent variables, or instrumental variables described in the next subsection. Thus, we end up with an estimation sample of 4,495 observations.

3.2. Variables

Tables 2 and 3 show the definitions and summary statistics, respectively, of the variables used in our estimations. The main dependent variable, Stock share, represents stock holdings as a share of total liquid financial assets, where total liquid financial assets is the sum of assets held in deposits, bonds, stocks, mutual funds, and foreign currency-denominated financial assets. In our estimation sample, on average, households hold 9% of their total liquid financial assets in stocks. This small share is mainly due to the fact that 70% of households do not hold any stocks (see the mean of Stock holder in Table 3). The mean amount of Mortgage repayment, which is defined as the difference between initial mortgage debt and current mortgage debt, is about ¥10.6 million. Next, turning to independent variables,

home equity are equivalent and cannot be identified. In contrast, Michielsen et al. (2016) includes households that are renters and that do not have any mortgage debt.

we use Land value, Home equity, and Initial mortgage as our main variables. Land value represents the current value of residential land, which is subjectively evaluated by respondent households in the Nikkei RADAR. Two points are worth noting. First, while the self-evaluated land value may differ from the market value, we think that using the self-evaluated land value is preferable to using the market value for our analysis because what matters for a household's portfolio choice is the subjectively evaluated value of its property. Second, because of data limitations, we do not know the value of construction for stand-alone houses, and thus we use the land value instead of the property value. We also do not know the property value of non-stand-alone residences, such as apartments or condominiums, and thus exclude households that do not live in stand-alone houses from our estimation sample. While the use of land value, which excludes the value of construction, may induce a degree of measurement error, this is not likely to be a serious problem because the value of construction is generally smaller than the value of land in Japan. Consistent with this view, the durability of Japanese buildings is relatively low, and hence the rate of real depreciation is high compared with Europe or the US.[10] Home equity is defined as the current land value minus the current mortgage debt. We also use Initial mortgage, which is the amount of the initial mortgage debt at the time of purchase. The average amounts of Land value, Home equity, and Initial mortgage are ¥30.9 million, ¥8.2 million, and ¥33.3 million, respectively.

As explained above, the instrumental variables Lprice_present and Lprice_purchase are

[10] For instance, Yoshida (2016) finds that the depreciation rate for housing is 6.2–7.0% in Japan, while it is merely 1.5% in the US.

constructed from PNLP data. In constructing Lprice_purchase, we need information about the year in which the house was purchased. The Nikkei RADAR does not provide this information, but it does provide the year in which each household borrowed its current residential mortgage, and thus we assume that the year in which households incurred their current mortgage debt is the same as the year in which they purchased their house. While we think this assumption is mostly valid, we have to be careful about the possibility of refinancing. In Japan, there is a widespread rule of thumb that a household should switch to a new mortgage contract if the current interest rate is one percentage point or more lower than the interest rate on an existing mortgage contract after taking into account the transaction costs of refinancing. Hence, we exclude households for which the difference between the national average mortgage interest rate in the year of the survey is more than one percentage point lower than the mortgage interest rate in the year in which they obtained their existing mortgage.[11] We also exclude households whose current mortgage debt is larger than the initial mortgage debt, on the presumption that they refinanced their loans at some point and/or used home equity lines of credit.

As for control variables, we use dummy variables for the current year, the purchase year, age of household head, and residential area (whether or not the house is located outside of the 23 Tokyo wards). In Figure 2, we show the distribution of the current year and the purchase year. Regarding the distribution of the purchase year, we note that the number of observations for households that bought houses after 2007 is smaller, because mortgage interest rates continued to decline during this period,

[11] We use the standardized interest rate for a fixed-rate mortgage loan provided by the Japan Housing Finance Agency, the government sponsored agency.

and we exclude observations for which the difference in mortgage rates between the current year and purchase year is more than one percentage point. Turning to the characteristics of households, our sample mainly consists of household heads whose are in their 30s, 40s, or 50s, i.e., those who are likely to have a current mortgage debt. To control for heterogeneity among households, we also include household annual income and the amount of total liquid financial assets held as additional dependent variables. The mean income in our sample is ¥8.5 million, while the mean total liquid financial assets is ¥7.8 million.

4. Results

4.1. Main results

Table 4 shows the OLS estimates using equation (1). In column (i), we do not include any covariates other than Land value and Home equity. Similar to the findings of Chetty et al. (2017) and other studies, we obtain a significantly positive coefficient for Land value, which is inconsistent with the theoretical prediction that an increase in Land value while holding Home equity fixed reduces the portfolio of stocks. The coefficient for Home equity is positive but statistically insignificant. In column (ii), we include the control variables explained in the previous section. We find that the coefficient for Land value remains positive, as in column (i), but both the value of the point estimate and its statistical significance becomes weaker. The coefficient for Home equity is also smaller than that in column (i) and is statistically insignificant. In summary, using Japanese data, we find that the

OLS estimates of the relationship between home ownership and the portfolio of stocks is unstable, which is consistent with the empirical findings of Chetty et al. (2017) and other studies.

Next, Table 5 reports 2SLS regression results using equations (2a)–(2c) that replicate those of Chetty et al. (2017). Columns (i) and (ii) report the first-stage regressions of Land value and Home equity, respectively, while column (iii) reports the second-stage 2SLS estimates of Stock share. Compared with the 2SLS estimates of Chetty et al. (2017), we notice several differences. First, regarding the first-stage regression for Land value in column (i), unlike Chetty et al. (2017), we do not obtain a negative coefficient for average regional land prices in the year of purchase, Lprice_purchase. While Chetty et al. (2017) argue that US households tend to buy smaller (cheaper) houses when house prices are high, our estimation result suggests that the same reasoning does not apply to Japanese households. The effect of average current land prices (Lprice_present) on Land value is positive and significant, as in Chetty et al. (2017). The first-stage regression result for Home equity in column (ii) is also in line with that of Chetty et al. (2017); we find that the effect of the current land price index on Home equity is significantly positive, while the effect of the land price index in the year of purchase is significantly negative. Second, turning to the second-stage regression for Stock share in column (iii), as expected, we obtain a positive and significant (albeit weak) coefficient for Home equity, which is consistent with Chetty et al. (2017), but we do not obtain a significantly negative coefficient for Land value. The sum of the coefficients for Land value and Home equity is significantly positive, while it is insignificant in Chetty et al. (2017). This result suggests that the positive impact of an exogenous increase in home equity (land value) outweighs the negative impact of an increase in exposure to housing risks in Japan. In summary, we obtain mixed results in terms of consistency with those of Chetty et al. (2017).

Next, Table 6 reports 2SLS estimates using equations (3a)–(3c), which modify the empirical specifications in Chetty et al. (2017). Columns (i) and (ii) report the first-stage regressions on Land value and Initial mortgage, respectively, while column (iii) reports the second-stage regression on Stock share. Consistent with our prediction, we find that the effects of Lprice_present on Land value in column (i) and that of Lprice_purchase on Initial mortgage in column (ii) are significantly positive. Turning to the second-stage regression in column (iii), we find that the coefficient for Land value is significantly positive, which suggests that the positive effect of an increase in home equity on the portfolio of stocks is larger than the negative effect of increased risk associated with housing assets (land). In contrast, we find that the effect of an exogenous increase in Initial mortgage on the portfolio of stocks is significantly negative, although the level of statistical significance is at the 10%. The point estimate of the coefficient for Land value indicates that a ¥1 million increase in the value of residential land increases a household's stock portfolio by 0.5 percentage points, while that of Initial mortgage indicates that a ¥1 million increase in initial residential mortgage debt reduces the stock portfolio by 0.6 percentage points, thus these effects almost cancel each other out. Consistent with these point estimates, the sum of the coefficients for Land value and Initial mortgage is insignificant. All of the second-stage regression results are qualitatively the same as those obtained in

Table 5 using Chetty et al.'s (2017)s regression form.

Finally, Table 7 reports 2SLS estimates using equations (4a)–(4c), in which the dependent variable is Mortgage repayment. Columns (i) reports the second-stage regression result using Land value and Home equity as endogenous regressors, while column (ii) reports the second-stage regression result using Land value and Initial mortgage as endogenous regressors. The results in columns (i) and (ii) both show that the mortgage repayment is larger when there is an exogenous increase in land value and mortgage debt while holding home equity constant. This result contrasts with the regression results for the portfolio of stocks in Tables 5 and 6, in which we do not obtain significant effects from the same increases in land value and mortgage debt.

4.2. Extensions

In this subsection, we conduct two additional exercises. First, to take account of the fact that about 70 percent of households in our estimation sample do not possess any stocks, and thus the dependent variable is left-censored at zero, we estimate the IV-Tobit regression model in which the dependent and independent variables are the same as those in the 2SLS regression. Second, we estimate the IV-Probit regression model in which the dependent variable is the dummy variable for owning stocks (i.e., the extensive margin of stockholding). If changes in Land value and Initial mortgage significantly affect the extensive margin, we need to control for the selection effect if we are to obtain consistent estimates for the effect on stock portfolios conditional on participating in the stock market (i.e., the intensive margin of stockholding).

In Table 8, column (i) shows the estimates of the IV-Tobit regression. We find that the coefficient for Land value is significantly positive, while the coefficient for Initial mortgage is negative but insignificant. The latter result occurs because the standard error of Initial mortgage is approximately twice that of Land value, which suggests that there might be significant heterogeneity among households regarding the effect of a residential mortgage on their stock portfolio choices.

Column (ii) of Table 8 shows the estimates of the IV-Probit regression for the extensive margin of stockholdings. We find that the coefficient for Land value is significantly positive, while the coefficient for Initial mortgage is negative but insignificant. This result indicates that the 2SLS estimates for the subgroup of home owners who also own stocks likely yield biased estimates as a result of a sample selection problem. To obtain consistent estimates for the intensive margin of stockholding, we need an additional exogenous variable that affects households' participation in the stock market but does not affect the share of stocks in their portfolios.[12]

Overall, we find that an exogenous increase in land value (while holding initial mortgage debt fixed) significantly increases households' stockholding regardless of the estimation method and the dependent variable employed. In contrast, the effect of initial mortgage debt (while holding land value fixed) on stockholding is weaker.

5. Summary and discussion

[12] As instruments for participation in the stock market, Fougère and Poulhès (2012) use the unemployment rate in the household's residential area and a dummy variable for the household's inheritance of securities.

Employing micro survey data for households in the Metropolitan area of Japan during the period 2000–2015, this study investigates the effects of home ownership on a household's portfolio of stocks. To disentangle the effects of land value from those of mortgage debt on a household's portfolio of stocks, we apply the methodology proposed by Chetty et al. (2017) and utilize variations in residential land price indices in 22 regional markets. Our empirical analysis yielded the following results. First, an exogenous increase in land value (while holding mortgage debt fixed) led to an increase in households' portfolio of stocks, which suggests the existence of positive wealth effects that is quantitatively larger than the negative effects of owning illiquid and risky housing assets. Second, we found that an increase in initial mortgage debt (while holding land value fixed) led to a decrease in the portfolio of stocks, providing further evidence of the wealth effects. However, we note that the statistical significance of the effect of residential mortgages on households' stock portfolios is relatively weaker than that of land value. This result suggests that there might be significant heterogeneity among Japanese households in relation to the effect of mortgage debt. Third, we found that a simultaneous increase in land value and mortgage debt (while holding home equity fixed) does not affect households' stock portfolio, but it does increase their repayment of their mortgage debt.

In relation to previous studies, our estimation results differ from those of Chetty et al. (2017), who find a negative effect of property value (while holding home equity fixed) on the stock portfolio. Our results are similar to those of Fougère and Poulhès (2012), in that both studies find that the positive effect of an increase in home equity (either an increase in land value or a decrease in mortgage debt) on the stock portfolio is larger than the negative effect of increased exposure to risky housing assets. As a possible explanation for the discrepancy with the findings of Chetty et al. (2017), Fougère and Poulhès (2012) provide numerical simulations to show that an increase in housing adjustment costs lowers the quantitative impact of property value on the stock portfolio. Consistent with their argument, housing adjustment costs in Japan are likely to be higher than those in the US. For instance, the share of used houses in the secondary market is 13.5% in Japan, while it is 77.6% in the US (Ministry of Land, Infrastructure, Transport, and Tourism), indicating that housing assets are more illiquid, and thus harder to adjust in Japan.[13] In addition, we provide evidence for another possible mechanism through which the effect of property value (while holding home equity fixed) on the stock portfolio is lowered in Japan: mortgage repayment. Our finding of a positive effect of land value and mortgage debt (while holding home equity fixed) on mortgage repayment suggests that holding illiquid and risky housing assets affects households' portfolios through their repayment of mortgage debt rather than investment in stocks, implying that debt repayment and stock investment are substitutes. A possible explanation for this finding is the difference in residential mortgages. In Japan, residential mortgage debt is with recourse, while in some US states (e.g., Florida) it is without recourse, implying that Japan's households cannot walk away from mortgage debt, even if home equity becomes negative. Because of the higher debt burden, Japan's households might repay mortgage debt rather than invest in stocks when they have a larger housing exposure.

[13] http://www.mlit.go.jp/common/000135252.pdf (in Japanese)

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Figure 1: Residential land price indices in Tokyo-Chuo and Tokyo-Josei

This figure illustrates the identification strategy explained in Section 2. The setting is as follows. The portfolios of households A (baseline), B, and C are measured in 2003. Household B bought an identical house to Household A in Tokyo-Chuo, but Household B's year of purchase was 2000, while it was 1993 for Household A. Household C bought a house for the same price as Household A in the same year, 1993, but the house was located in a different area (Tokyo-Josei).

Source: Land Appraisal Committee of the Ministry of Land, Infrastructure, Transport, and Tourism, "Public notice of land prices"

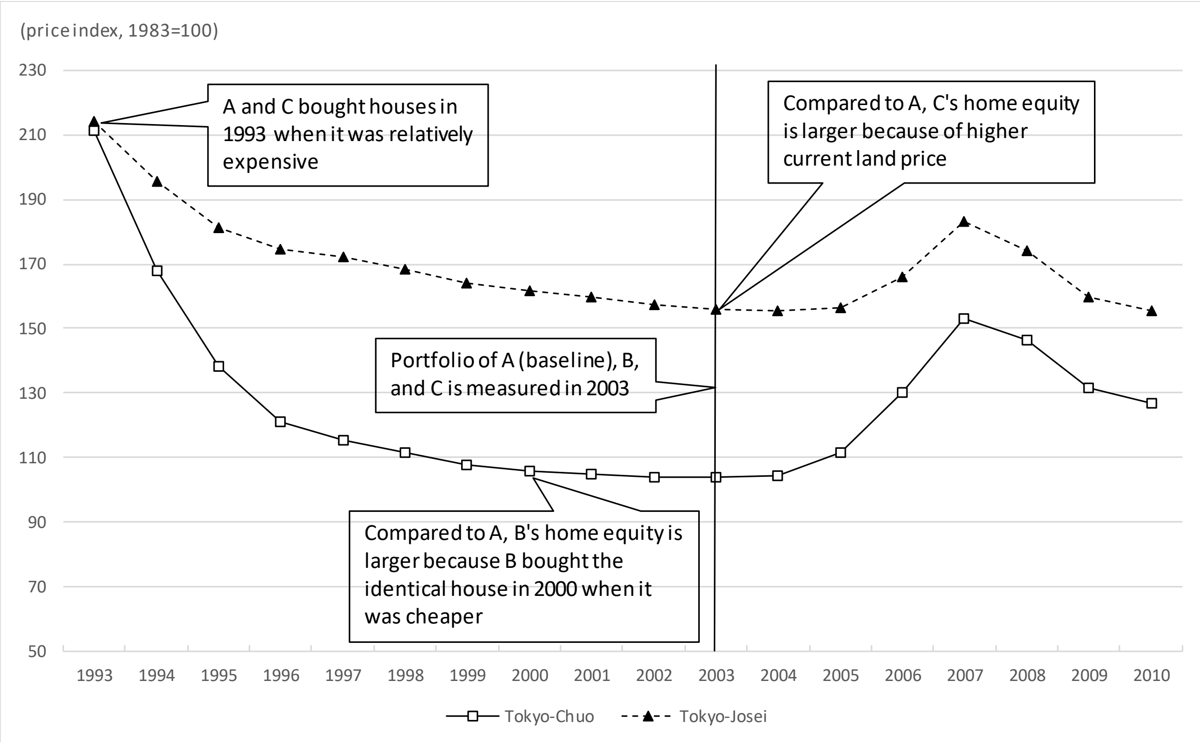

Table 1: List of 22 regions for residential land price indices

The shaded cells in this figure show the 22 regions for which we use residential land price indices as instrumental variables. The figures show the number of observations for each region, with the share of the overall number of observations in parentheses.

	Distance from Tokyo station			
Area	0–10km	10–20km	20–30km	30–40km
Tokyo-Chuo	56 (0.012)			
Tokyo-Jonan	207 (0.046)	58 (0.013)		
Tokyo-Johoku	173 (0.038)	99 (0.022)		
Tokyo-Josei	65 (0.014)	45 (0.010)		
Tokyo-Joto	255 (0.057)	66 (0.015)		
Tokyo-outer		98 (0.022)	339 (0.075)	255 (0.057)
Saitama		308 (0.069)	340 (0.076)	268 (0.060)
Chiba		278 (0.062)	345 (0.077)	236 (0.053)
Kanagawa		196 (0.044)	284 (0.063)	464 (0.103)
Ibaraki				60 (0.013)

Table 2: Definition of variables

This table presents the definitions of the variables used in our estimations (Tables 4–8).

Variable	Definition
Dependent variable	
Stock share	The ratio of a household's stock holding over total liquid financial assets in percentage points (0-100)
Stock holder	Dummy variable for a household's owning stocks
Mortgage repayment	The amount of initial mortgage debt minus current mortgage debt
Independent variables	
Land value	The current value of a household's residential land where the current value is subjectively evaluated by each household
Home equity	The current value of a household's residential land minus current mortgage debt outstanding
Initial mortgage	The initial amount of a household's residential mortgage debt
Current year	The year in which a household responds to the survey (i.e., household portfolio is measured)
Purchase year	The year in which a household bought residential land (borrowed outstanding mortgage debt)
Age dummies	Dummy variables for a householder's age categorized as follows: equal to or less than 30, 31–40, 41–50, 51–60, 61–70, 71 and over
Outside-Tokyo 23wards	Dummy variable for the location of a household; it is equals to 1 if the household lives in areas outside of Tokyo 23 wards, namely in either outer Tokyo, Saitama, Chiba, Kanagawa, or Ibaraki, and 0 otherwise
Income	Household's income before tax deduction
Financial asset	Household's total liquid financial assets including deposits, bonds, stocks, mutual funds, and foreign currency denominated assets
Instrumental variables	
Lprice_present	Average PNLP residential land price index (1983=100 for national average) of the region that a household lives in the year household portfolio is measured. The region is constructed by combining 10 area dummy variables that consist of Tokyo-Chuo, Tokyo-Jonan, Tokyo-Johoku, Tokyo-Josei, Tokyo-Joto, Tokyo-outer, Saitama, Chiba, Kanagawa, and Ibaraki with the index variable that represents the distance from Tokyo station (either 0–10km, 10–20km, 20–30km, or 30–40km). The total number of regions is 22 (see Table 1).
Lprice_purchase	Average PNLP residential land price index (1983=100 for national average) of the area that a household lives in the year a household bought residential land

Table 3: Summary statistics

This table presents summary statistics for the variables used in the estimations (Tables 4–8, Number of observations: 4,495). Definitions of these variables are provided in Table 2.

	Units	Mean	Median	S.D.	Min	Max
Dependent variable						
Stock share	%	9.003	0.000	18.795	0.000	100.000
Stock holder	dummy variable	0.302	0	0.459	0	1
Mortgage repayment	10 million yen	1.060	0.800	1.088	0.000	18.000
Independent variables						
Land value	10 million yen	3.090	2.500	2.373	0.100	30.000
Home equity	10 million yen	0.822	0.400	2.367	-9.000	28.800
Initial mortgage	10 million yen	3.328	3.000	1.762	0.300	40.000
Income	10 million yen	0.849	0.850	0.420	0.050	4.000
Financial asset	10 million yen	0.779	0.400	1.219	0.010	17.980
Outside-Tokyo 23wards	dummy variable	0.772	0	0.419	0	1
Age 30 and under	dummy variable	0.023	0	0.149	0	1
Age 31-40	dummy variable	0.274	0	0.446	0	1
Age 41-50	dummy variable	0.404	0	0.491	0	1
Age 51-60	dummy variable	0.219	0	0.414	0	1
Age 61-70	dummy variable	0.068	0	0.252	0	1
Age 71over	dummy variable	0.012	0	0.111	0	1
Instrumental variables						
Lprice_present	1983=100	87.480	74.550	40.870	24.270	264.170
Lprice_purchase	1983=100	98.870	90.590	42.140	24.600	495.690

Figure 2: Distribution of current year and purchase year

This figure shows the distribution of the current year (the year in which households responded to the survey) and the purchase year (the year in which households incurred their mortgage debt).

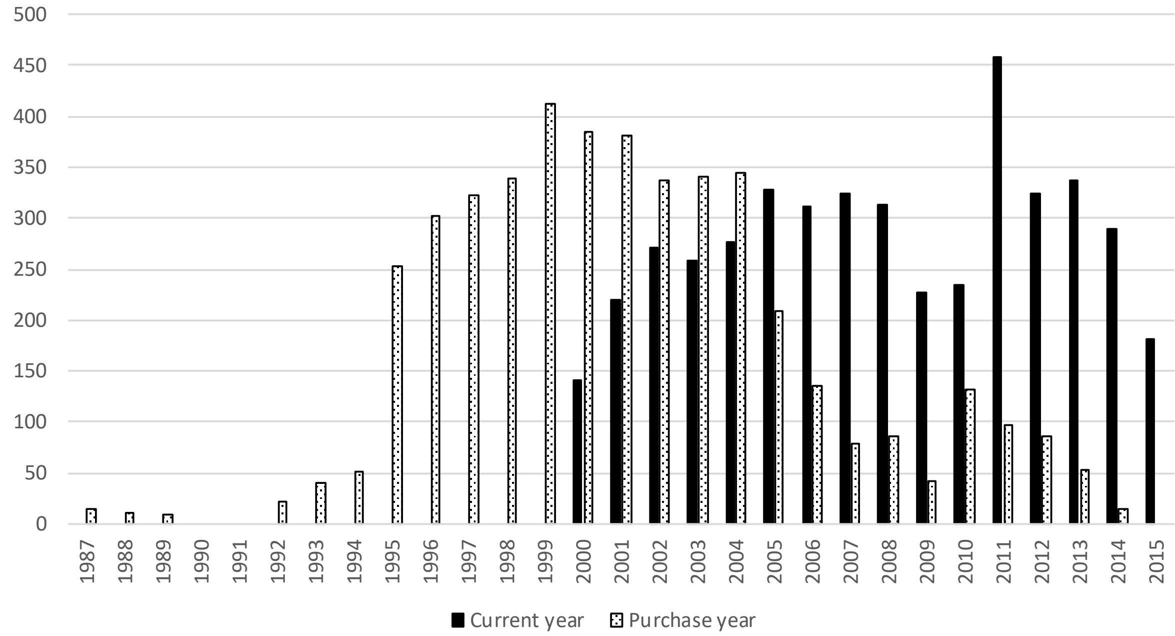

Table 4: OLS regressions for stock portfolios as a share of liquid financial wealth

This table presents the OLS regression results for the portfolio of stocks (Stock share) after controlling for various covariates and fixed effects outlined in the text. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively. Standard errors are in parentheses.

	(i)	(ii)
Estimation method:	OLS	OLS
Dependent variable:	Stock_share	Stock_share
Land value	0.832 ***	0.379 *
	[0.202]	[0.222]
Home equity	0.302	0.087
	[0.202]	[0.219]
Outside Tokyo 23wards		0.779
		[0.673]
Age 31-40		2.040
		[1.893]
Age 41-50		4.647 **
		[1.907]
Age 51-60		5.744 ***
		[1.972]
Age 61-70		11.349 ***
		[2.174]
Age 71over		8.679 ***
		[3.129]
Income		3.952 ***
		[0.767]
Financial asset		1.601 ***
		[0.252]
constant	6.184 ***	-11.260 *
	[0.570]	[6.373]
Current year dummies	YES	YES
Purchase year dummies	YES	YES
Sum of coefficients on	1.134 ***	0.466 ***
Land value and Home equity	[0.123]	[0.135]
Number of observations	4,495	4,495
R2	0.02	0.07
adj R2	0.02	0.06
F statitics	43.48	6.58
Prob > F	0.00	0.00

Table 5: Two-stage least squares regressions for stock portfolios as a share of liquid financial wealth (endogenous regressors: Land value and Home equity)

This table presents the 2SLS regression results for the portfolio of stocks (Stock share) after controlling for endogenous regressors (Land value and Home equity), various covariates, and fixed effects outlined in the text. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively. Standard errors are in parentheses.

	(i)	(ii)	(iii)
Estimation method:		2SLS	
Dependent variable:	Land value (1st stage)	Home equity (1st stage)	Stock share (2nd stage IV)
Land value			-1.997
			[2.636]
Home equity			7.235 *
			[3.919]
Lprice_present	1327.073 ***	1580.400 ***	
(x 1/100K)	[314.924]	[321.391]	
Lprice_purchase	87.058	-734.176 **	
(x 1/100K)	[300.002]	[306.162]	
Outside Tokyo 23wards	0.071	0.031	3.203 **
	[0.133]	[0.135]	[1.314]
Age 31-40	-0.031	-0.035	2.309
	[0.217]	[0.221]	[2.233]
Age 41-50	0.005	0.165	3.622
	[0.218]	[0.223]	[2.323]
Age 51-60	0.209	0.776 ***	0.772
	[0.225]	[0.230]	[3.417]
Age 61-70	1.626 ***	1.999 ***	1.019
	[0.247]	[0.252]	[4.855]
Age 71over	2.738 ***	1.965 ***	0.902
	[0.355]	[0.363]	[4.753]
Income	1.389 ***	0.510 ***	3.405
	[0.084]	[0.086]	[2.179]
Financial asset	0.228 ***	0.332 ***	-0.227
	[0.028]	[0.029]	[0.830]
constant	1.772 ***	-1.227 *	18.350
	[0.672]	[0.685]	[11.706]
Current year dummies	YES	YES	YES
Purchase year dummies	YES	YES	YES
Sum of coefficients on			5.238 ***
Land value and Home equity			[1.789]
Number of observations	4,495	4,495	4,495
F / Wald chi2 statitics	27.48	22.26	237.72
Prob > F / Chi2	0.00	0.00	0.00

Table 6: Two-stage least square regressions for stock portfolios as a share of liquid financial wealth (endogenous regressors: Land value and Initial mortgage)

This table presents the 2SLS regression results for the portfolio of stocks (Stock share) after controlling for endogenous regressors (Land value and Initial mortgage), various covariates, and fixed effects outlined in the text. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively. Standard errors are in parentheses.

	(i)	(ii)	(iii)
Estimation method:		2SLS	
Dependent variable:	Land value (1st stage)	Initial mortgage (1st stage)	Stock share (2nd stage)
Land value			5.490 ***
			[1.913]
Initial mortgage			-6.201 *
			[3.375]
Lprice_present (x 1/100K)	1327.073 ***	-241.704	
	[314.924]	[243.240]	
Lprice_purchase (x 1/100K)	87.058	961.656 ***	
	[300.002]	[231.714]	
Outside Tokyo 23wards	0.071	0.036	3.122 **
	[0.133]	[0.103]	[1.317]
Age 31-40	-0.031	-0.002	2.278
	[0.217]	[0.167]	[2.243]
Age 41-50	0.005	-0.124	4.015 *
	[0.218]	[0.168]	[2.289]
Age 51-60	0.209	-0.275	3.117
	[0.225]	[0.174]	[2.645]
Age 61-70	1.626 ***	0.276	5.016
	[0.247]	[0.191]	[3.459]
Age 71over	2.738 ***	1.456 ***	3.648
	[0.355]	[0.275]	[4.679]
Income	1.389 ***	1.488 ***	5.926 *
	[0.084]	[0.065]	[3.229]
Financial asset	0.228 ***	-0.054 **	0.127
	[0.028]	[0.022]	[0.667]
constant	1.772 ***	1.292 **	4.219
	[0.672]	[0.519]	[7.798]
Current year dummies	YES	YES	YES
Purchase year dummies	YES	YES	YES
Sum of coefficients on Land value and Initial mortgage			-0.711
			[2.019]
Number of observations	4,495	4,495	4,495
F / Wald chi2 statitics	27.48	18.65	235.52
Prob > F / Chi2	0.00	0.00	0.00

Table 7: Two-stage least square regressions for the amount of mortgage debt repayment

This table presents the 2SLS regression results for the amount of mortgage debt repayment (Mortgage repayment) after controlling for endogenous regressors (column (i): Land value and Home equity, column (ii): Land value and Initial mortgage), various covariates, and fixed effects outlined in the text. Only the second-stage regression results are reported. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively. Standard errors are in parentheses.

	(i)		(ii)	
Estimation method:	2SLS			
Dependent variable:	Mortgage repayment (2nd stage)		Mortgage repayment (2nd stage)	
Land value	0.207	*	0.034	
	[0.108]		[0.067]	
Home equity	-0.167			
	[0.161]			
Initial mortgage			0.143	
			[0.118]	
Outside Tokyo 23wards	-0.013		-0.011	
	[0.054]		[0.046]	
Age 31-40	-0.005		-0.004	
	[0.092]		[0.079]	
Age 41-50	0.063		0.054	
	[0.096]		[0.080]	
Age 51-60	0.378	***	0.324	***
	[0.140]		[0.093]	
Age 61-70	0.645	***	0.552	***
	[0.200]		[0.121]	
Age 71over	0.443	**	0.379	**
	[0.195]		[2.310]	
Income	0.407	***	0.348	***
	[0.090]		[0.113]	
Financial asset	0.057	*	0.049	**
	[0.034]		[0.023]	
constant	-2.279	***	-1.953	***
	[0.481]		[0.274]	
Current year dummies	YES		YES	
Purchase year dummies	YES		YES	
Sum of coefficients on Land value and Home equity	0.041			
	[0.074]			
Sum of coefficients on Land value and Initial mortgage			0.176	**
			[0.071]	
Number of observations	4,495		4,495	
Wald chi2 statitics	2340.76		3186.14	
Prob > Chi2	0.00		0.00	

Table 8: IV-Tobit regression for stock portfolios as a share of liquid financial wealth and IV-Probit regression for holding stocks (extensive margin)

In this table, column (i) shows the IV-Tobit regression results for the portfolio of stocks (Stock_share), while column (ii) shows the IV-Tobit regression results for the dummy variable for holding stocks (Stock holder) after controlling for endogenous regressors (Land value and Initial mortgage), various covariates, and fixed effects outlined in the text. Only the second-stage regression results are reported. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively. Standard errors are in parentheses.

	(i)	(ii)
Estimation method:	IV-Tobit	IV-Probit
Dependent variable:	Stock share (2nd stage)	Stock holder (2nd stage)
Land value	13.562 **	0.241 *
	[5.369]	[0.130]
Initial mortgage	-11.214	-0.181
	[9.546]	[0.232]
Other controls	YES	YES
Current year dummies	YES	YES
Purchase year dummies	YES	YES
Sum of coefficients on	2.347	0.059
Land value and Initial mortgage	[5.713]	[0.138]
Number of observations	4,495	4,495
F / Wald chi2 statitics	332.09	479.07
Prob > F / Chi2	0.00	0.00