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Abstract

Using Japanese household survey micro data for the period 2000–2015, this study examines the effects of home ownership on household stock-holdings. To disentangle the effect of property value and mortgage debt on households' stock-holdings as a share of their liquid financial assets, we apply the instrumental variable approach proposed by Chetty et al. (2017), which employs differences in average house price indices across regional 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 property value (while holding mortgage debt constant) is associated with an increase in stock-holdings as a share of liquid financial assets, while an increase in mortgage debt (while holding property value constant) is associated with a decrease. We also find that a simultaneous increase in property value and mortgage debt (while holding home equity constant) has no effect on households' stock-holdings but is associated with an increase in mortgage debt repayment.

Keywords: Home ownership, Mortgage debt, Home equity, Portfolio choice

JEL classification: D14, G11, R21

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1. Introduction

Since for the majority of households in developed economies real estate is the most important physical asset they are likely to own, the effect of home ownership on households' portfolio choices is an important issue. Yet, 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 empirical literature has failed to produce a clear answer on the effect of home ownership on household portfolios. On the one hand, there are studies such as those by Fratantoni (1998) and Faig and Shum (2002) suggesting that that larger mortgage payments or saving for a home lead households to hold fewer risky assets. On the other hand, Heaton and Lucas (2000), for example, find a positive relationship between mortgage debt and stock-holdings. Yet other studies have found that the relationship between home ownership and stock-holdings is non-monotonic (Yamashita 2003), that the relationship depends on the empirical proxy used for stock-holdings (Yao and Zhang 2005) or home ownership (Cocco 2005), or that there is no significant relationship (Shum and Faig 2006).[1]

Recently, Chetty et al. (2017) set forth an analytical framework to reconcile theory with the available data. Their contribution is twofold. First, they construct a tractable theoretical model of

[1] Specifically, Yamashita (2003) found a positive relationship between the house to net worth ratio and stock-holding for households with a lower house to net worth ratio and a negative relationship for households with a higher house to net worth ratio. Meanwhile, Yao and Zhang (2005) found a negative relationship between the *equity to net worth* ratio and the house to net worth ratio through a substitution effect between the two types of risky assets, i.e., real estate and equity, but a positive relationship between the *equity to liquid assets* ratio and the house to net worth ratio. They argue that the latter relationship reflects the diversification benefit accruing to home owners because of a low return correlation between home equity and stocks. Finally, Cocco (2005) found that investment in housing reduces equity market participation, especially for younger and poorer households, but that the relationship between mortgage debt and stock-holding is positive.

household portfolio choice that separates the effect of property values from the effect of home equity (i.e., the current property value minus current mortgage debt). Chetty et al. (2017) argue that their model predicts that an increase in property value while holding home equity fixed reduces a household's stock-holdings as a share of liquid wealth through three channels that are identified in the literature: (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 (i.e., through a negative wealth effect), as a higher property value while holding home equity fixed essentially means higher mortgage debt. In contrast, the model predicts that an increase in home equity while holding the property value fixed, which is equivalent to reducing mortgage debt, increases a household's stock-holdings through the positive wealth effect and the diversification effect (Yao and Zhang 2005). This implies that it is critical to distinguish between the effect of property value and the effect of home equity (or mortgage debt) on household portfolio choice. Second, Chetty et al. (2017) argue that when empirically examining the link between home ownership and stock-holding it is important to extract *exogenous* changes in property values and home equity to make causal inferences about household portfolios, since both home ownership and portfolio choices are endogenously determined and may be affected by unobserved factors. For instance, if there is measurement error in households' lifetime income, a positive relationship between home ownership, mortgage debt, and stock-holding might be observed, since 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 issue

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 home ownership on household financial portfolios by employing one of Chetty et al.'s (2017) empirical approaches. Specifically, the approach uses variations in current and time-of-purchase house price indices to instrument property values and home equity. 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 have larger mortgage debts and smaller home equity. Using these two house price indices as instrumental variables (IVs), Chetty et al. (2017) conduct two-stage least squares (2SLS) regressions. In our analysis, we start by conducting estimations employing their IV methodology, but the consistency of our results with those obtained by Chetty et al. (2017) is mixed. In particular, we find that the effect of property values (land values in our case, as will be explained in detail in Section 3.2) on households' stock-holding when holding home equity fixed is not significantly negative, which is the opposite of Chetty et al.'s (2017) result. Further, we argue that households that bought their house at a time of higher average house prices may 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, in which the property value and the amount of the *initial* mortgage debt are

the instrumented variables.[2] In addition, we conduct 2SLS regressions in which the dependent variable is the total amount of mortgage debt that a household has repaid by the time of the survey. We obtain the following two main findings. First, we find that an exogenous increase in current property value, which we obtain by using the proper IVs, holding initial mortgage debt fixed is associated with an increase households' stock-holding through a positive wealth effect, while an exogenous increase in initial mortgage debt holding current property value fixed is associated with a reduction in stock-holdings through a negative wealth effect. However, we note the negative effect of initial mortgage debt on stock-holdings is only weakly significant due to the large standard error of the effect, which suggests that it might be heterogeneous across households. Second, we find that a simultaneous increase in current property value and in initial mortgage debt holding home equity fixed does not affect households' stock-holdings, which is inconsistent with the theoretical reasoning and empirical findings of Chetty et al. (2017). However, we find that the same increase in current property value and initial mortgage debt is associated with an increase in households' total amount of mortgage debt that they have repaid. This finding suggests that the effect of the illiquidity and pricing risks of residential property on Japanese households' financial decisions is reflected in their debt repayments rather than their investment in stocks.

To the best of our knowledge, this study is the first to apply the methodology of Chetty et al.

[2] As we argue below, which two among our three variables – property value, mortgage debt, and home equity – is instrumented does not affect our estimation results, although the interpretation of the coefficients differs (also see Michielsen et al. 2016). The main point of our specification is that we use *initial* mortgage debt instead of *current* mortgage debt.

(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 produced mixed results. For instance, using data on French households, Fougère and Poulhès (2012) find that home equity and property value have significant effects on household stock-holdings, but in opposite directions. Specifically, they find that an increase in home equity increases stock-holdings, while an increase in property value reduces it. While these findings are consistent with those in Chetty et al. (2017), they also report that the former effect dominates the latter, which differs from the result obtained by Chetty et al. (2017) using US household data, who found that the effects cancelled each other out. Fougère and Poulhès (2012) argue that the reason for this difference between France and the United States probably is that fixed adjustment costs for housing (e.g., the costs of buying and selling a home) in France are higher than in the United States. On the other hand, using data on Dutch households, Michielsen et al. (2016) find that neither home equity nor mortgage debt had a significant impact on household stock-holdings. They argue that the non-significant results and the contrast with the findings for the United States and France can probably be explained by the lower stock-holding rates in the Netherlands and the fact that the investment aspect of owning a house is less important in the Dutch institutional setting. Our estimation results for stock-holdings using Japanese data are similar to those of Fougère and Poulhès (2012), which is consistent with the general perception that housing adjustment costs in Japan are higher than in other developed countries such as the United States. In addition, we provide evidence that holding residential property affect Japanese households' financial portfolios

through their mortgage debt repayment.

The remainder of the paper is organized as follows. Section 2 explains our empirical strategy. Section 3 explains our data and the way we construct our sample, while Section 4 presents the empirical results and discusses why our results differ from those in previous studies. Section 5 summarizes our findings.

2. Empirical strategy

Following Chetty et al. (2017), we first examine the effects of home ownership on households' stock-holdings by estimating the following ordinary least squares (OLS) regression:

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

where Stock share represents household *i*'s stock-holdings as a share of their total liquid financial assets, Property value represents the current value of residential property that the household owns, Home equity represents this current property value minus the household's current mortgage debt outstanding, and $\mathbf{X_{it}}$ denotes a vector of control variables. Due to data limitations described in Section 3.2, in our empirical analysis we use the value of land as a proxy for Property value rather than the value of structures and land. However, for the time being, we use the term Property value to simplify the exposition.

In equation (1), β_1 captures the effect of Property value on Stock share holding Home equity fixed, while β_2 captures the effect of Home equity on Stock share holding

Property value fixed. The theoretical model provided by Chetty et al. (2017) predicts that $\beta_1 < 0$, i.e., an increase in a household's property value reduces the optimal share of stocks, because households that own a home with a larger current value than that of other households have (i) a more illiquid asset portfolio, (ii) larger exposure to house price risk, and (iii) a higher debt burden, since a larger property value for the same level of home equity essentially implies a larger mortgage debt. On the other hand, the model predicts that $\beta_2 > 0$ because of the diversification effect identified by Yao and Zhang 2005; i.e., households with larger net worth than other households can afford to invest more in stocks. 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 effect of property value on households' stock-holdings and of the positive wealth effect of 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 Property value. For instance, if households' future labor income is unobservable and positively correlated with Property value, implying that households with a higher lifetime income own more valuable houses and take on larger mortgage debts, the OLS estimate of β_1 will be biased upward. To address this potential endogeneity, Chetty et al. (2017) propose three research designs that generate exogenous variation in property value and home equity that is orthogonal to the unobserved determinants of the stock share. In this study, we apply one of their research designs, which utilizes variations in mean house prices in the region in which a household lives as IVs.

Following Chetty et al. (2017), we use two instruments to estimate equation (1), although we use land prices instead of property prices. Specifically, we use the average price of land in the region in which a household lives, gauged in the current year (the year in which household portfolios are measured) and denoted by Lprice_current; and the average price of land in the region in the year in which the household bought its house, denoted by 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, i.e., central Tokyo), but Household B bought at a time when house prices were lower. Thus, the value of the properties of the two households will be identical, but Household B will likely have greater home equity, because the mortgage required to purchase the property will have been smaller. This effect is captured by the difference in Lprice_purchase between the two households. Next, suppose Household C bought a house for the same price and at the same time as Household A but in a different region (for instance, Tokyo-Josei, i.e., western Tokyo), and the current price of Household C's house is higher than that of Household A's house. In that case, all else being equal, the two households' mortgages will be very similar, but Household C's property value and home equity will likely be larger because of the higher current house prices in the region. This effect is captured by the difference in Lprice_present between the two households. Using these two instruments, we estimate equation (1) using a 2SLS regression of the following form:

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

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

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

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

where subscript j denotes the household's region of residence. Chetty et al. (2017) argue that given current regional prices, obtained by controlling Lprice_present in equation (2b), regional house prices at the time of purchase (Lprice_purchase) are negatively associated with property value, implying $\lambda_2 < 0$ in equation (2b), because households tend to buy smaller houses when prices are relatively higher. In contrast, the effect of Lprice_present on the current property value 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 when regional prices at the time of purchase are higher. Extracting exogenous variations in Property value and Home equity from equations (2b) and (2c) should yield consistent estimates of β_1 and β_2 in equation (2a).

In addition to applying one of the empirical approaches in Chetty et al. (2017) using Japanese data, we improve on their empirical strategy in the following ways. The empirical specifications in Chetty et al. (2017), which are essentially the same as equations (2a)–(2c), contain some ambiguity. First, in Chetty et al. (2017), the negative coefficient on Property value (β_1) in equation (2a) can be attributed to an increase in either (i) the illiquidity of household portfolios as the share of real estate property increases, (ii) households' exposure to house price risk, or (iii) mortgage debt. Thus, even if

we obtain a significant negative estimate of β_1, we cannot gauge the relative importance of these three different factors. Second, and more importantly, while Chetty et al. (2017) expect that the average house price in the year in which households bought their house (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 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.[4] In contrast, the effect of Lprice_purchase on the amount of the *initial* mortgage debt is clearly positive. In addition, if households that bought expensive houses tend to repay mortgage debt more rapidly rather than investing in stocks, the effect of mortgage debt on stock holding might also be ambiguous.

To deal with these two issues, we first estimate the following modified versions of equations (2a)–(2c) using 2SLS regressions:

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

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

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

In this specification, we expect that Lprice_present has a positive effect on Property value ($\lambda_1 > 0$), while Lprice_purchase has a positive effect on Initial mortgage ($\pi_2 > 0$). The sign of β_1'

[4] Chetty et al. (2017) argue that house prices at the time of purchase are negatively associated with home equity. As the following identity shows, their argument implicitly assumes that the repayment of mortgage debt is orthogonal to the house price index at the time of purchase:

$$\begin{aligned}\text{Home equity} &= \text{Property value} - \text{Current mortgage} \\ &= \text{Property value} - (\text{Initial mortgage} - \text{Mortgage repayment})\end{aligned}$$

depends on the illiquidity and price risk associated with higher property values, which negatively affects Stock share, and on the wealth effect, which positively affects Stock share. For example, 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 Property value and Initial mortgage on Stock share while holding home equity fixed, so that it captures, for instance, the effect of buying an expensive house. The correspondence between the coefficients in Chetty et al.'s (2017) specification given by equation (2a) and those in our specification given by equation (3a) is shown in Table 1.

Second, using 2SLS regressions, we estimate the following equations, where the dependent variable is the mortgage amount that has been repaid (i.e., current mortgage debt outstanding minus initial mortgage debt outstanding):

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

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

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

Taken together with equations (3a) to (3c), the regression results for equations (4a) to (4c) indicate whether investment in stocks and mortgage debt repayment are substitutes. For example, if households that have larger mortgage debt repay their mortgage debt more rapidly instead of investing in stocks, we expect β_2' to be insignificant and β_2^{M} to be positive.

3. Data and variables

3.1. Data and sample construction

The household data used in this study are taken from the *Nikkei Kinyu Kodo Chosa NEEDS-RADAR* (Nikkei RADAR hereafter), which is a repeated-cross section household survey of people living in the Tokyo metropolitan area, where the metropolitan area is defined as the area within a 40 km radius of Tokyo Station and includes Tokyo prefecture as well as parts of Saitama, Chiba, Kanagawa, and Ibaraki prefectures. The Nikkei RADAR survey is conducted in the fourth quarter of each calendar year, i.e., from October to December, and we use data from the years 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 Tokyo metropolitan area, average income and financial wealth are greater than the national averages.[5]

To construct average land prices for the area in which households live, i.e., Lprice_present and Lprice_purchase, we used the dataset of the "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 areas in which households reside: Tokyo-Chuo (central Tokyo), Tokyo-Jonan (southern Tokyo), Tokyo-Johoku (northern Tokyo), Tokyo-Josei (western Tokyo), Tokyo-Joto (eastern Tokyo), Outer Tokyo, Saitama,

[5] For example, mean household ordinary income before taxes 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.)

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 Tokyo Station.[7] Combining these two pieces of geographical information, we constructed 22 regions in which households were located (see Table 2 for a list of the 22 regions).[8] Accordingly, we calculated average land prices for these 22 regions for the period 1983–2015 from the PNLP and matched them with the Nikkei RADAR data. The number of household-year observations is 42,709 (approximately 2,700 households for each year).

To examine the effects of property value and home equity on stock-holdings, we exclude households that are renters, those that are homeowners but do not live in stand-alone houses (e.g., those living in apartments or condominiums), those that do not have any mortgage debt, and those that do not have any liquid financial assets, and for which the figures for liquid financial assets are likely to be mismeasured.[9] We exclude homeowners that do not live in stand-alone houses, because the Nikkei

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

[7] More precisely, the distance ranges are defined as "more than…and up to," so that, e.g., "10–20 km" means more than 10 km and up to (and including) 20 km.

[8] The total number of regions is not 40 (10×4) because Tokyo-Chuo (central Tokyo), for example, does not extend beyond a radius of 10 km from Tokyo station, while Ibaraki, for instance, is at least 30 km away.

[9] Previous empirical studies examining the effect of property value and home equity on households' stock-holdings are not unanimous regarding the sample selection criteria. Chetty et al. (2017) use homeowners and include households that do not have any mortgage debt but exclude households with negative equity. Michielsen et al. (2016) include households that are renters as well as those that do not have any mortgage debt. In contrast, Fougère and Poulhès (2012) use homeowners but exclude households that do not have any mortgage debt. They argue that if a household has no mortgage debt, property value and home equity are identical and cannot be identified. We follow the sample construction criteria of Fougère and Poulhès (2012). Regarding households with negative equity, unlike Chetty et al. (2017), we do not exclude negative equity households from our estimation sample for two reasons. First, while mortgage debt in some US states (e.g., Florida) is without recourse, so that debtor households can walk away from their debt if home equity falls below zero, mortgage debt in Japan is with recourse. Therefore, we do not think there is a strong argument for excluding negative equity households a priori. Second, as we will discuss in Subsection 3.2, our home equity variable does not account for the value of structures (houses). Therefore, even though our variable

RADAR does not contain information about the property value of these households. This leaves us with 8,491 household-year observations. For the reason explained below, we also exclude household-year observations 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) and the interest rate in the year in which the current mortgage debt was incurred by the household is 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 household-year 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. As a result, we end up with an estimation sample of 4,495 household-year observations.

3.2. Variables

Tables 3 and 4 respectively show the definitions and summary statistics of the variables used in our estimations. The main dependent variable, $Stock\ share$, represents households' stock-holdings as a share of their total liquid financial assets, where total liquid financial assets are the sum of assets held in deposits, bonds, stocks, mutual funds, and foreign currency-denominated financial assets. In our estimation sample, households on average 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

might suggest a household is in negative equity, this is not necessarily the case.

Stock holder in Table 4). The mean amount of *Mortgage amount repaid*, which is defined as the difference between initial mortgage debt and current mortgage debt, is about ¥10.6 million.

Next, turning to the independent variables, we use *Land value*, *Home equity*, and *Initial mortgage* as our main variables. *Land value* is our empirical proxy for Property value in the previous section and represents the current value of the land on which households' house sits, and is an estimate provided by respondent households in the Nikkei RADAR. Two points are worth noting. First, we do not know the value of structures for stand-alone houses so that we use the land value instead of the property value, which includes the value of structures, because the Nikkei RADAR only asks about the value of the land. From the Nikkei RADAR, we cannot obtain the property value of non-stand-alone residences, such as apartments or condominiums, and therefore 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 structures, may result in a degree of measurement error, this is unlikely to be a serious problem, because in Japan the value of structures is generally smaller than the value of the land on which they sit.[10] This reflects the fact that the durability of Japanese buildings is relatively low, so that the rate of real depreciation is high compared with Europe and the United States.[11] Second, while households' land value estimates may differ from the market value, we think that for our analysis using households' estimates is preferable to using the market value, because what matters for households'

[10] Hori and Niizeki (2017) report that approximately 85 percent of the value of residential properties derives from the value of the land on which a property sits, while the rest derives from the value of the property itself.

[11] Yoshida (2016), for instance, finds that the depreciation rate for housing in Japan is 6.2–7.0 percent, while in the United States it is only 1.5 percent.

portfolio choices is the subjectively estimated value of their property.[12] $Home\ equity$ is defined as the current land value minus the current mortgage debt. We also use $Initial\ mortgage$, which is the initial mortgage debt at the time of purchase. The averages 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 constructed from the PNLP data. To construct $Lprice\_purchase$, 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 a household took out its current residential mortgage, so that we assume that the year in which a household took out its current mortgage is the year in which it purchased the house. While we think this assumption is generally valid, we need to consider the possibility of refinancing. In Japan, the rule of thumb is that households should switch to a new mortgage if current interest rates are one percentage point or more lower than the interest rate on their existing mortgage after taking the transaction costs of refinancing into account. We therefore exclude household-year observations 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) and the interest rate in the year in which the current mortgage debt was incurred by the household is more than one percentage point. We also exclude households whose current mortgage debt is larger than the initial mortgage debt, based on the

[12] It should be noted that using households' own valuation of their property (land) potentially generates an upward bias in our estimates of the effect on stock-holdings, since households that are overly optimistic in valuing their property (land) may hold more stocks. The impact of bounded rationality and households' misconceptions regarding the value of their assets on their portfolio choice has been examined in studies such as Abel et al. (2013), Alvarez et al. (2012), and Corradin et al. (2017). Incorporating the results of recent developments in this area into our analysis is an important subject for future research.

assumption 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, the age of the household head, and the residential area (i.e., whether or not a house is located outside of the 23 Tokyo wards). Figure 2 shows the distribution of the number of households across survey years (the "current year") and of the year in which they purchased their house. Looking at the distribution of households in terms of the year in which they took out their mortgage, a substantial drop in the number of observations can be observed from around 2005 onward. This reflects the fact that mortgage interest rates declined during this period and we exclude households that likely refinanced their mortgage, i.e., households for which the difference between mortgage interest rates in the current year and the purchase year is more than one percentage point.[13] Turning to households' characteristics, most of the households in our sample have a head in their 30s, 40s, or 50s, presumably because we restrict our sample to homeowner households. 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 of total liquid financial assets is ¥7.8 million.

4. Results

[13] Using aggregate statistics (website: http://www.mlit.go.jp/report/press/house01_hh_000082.html), we find that the aggregate amount of new mortgages loans provided for refinancing in Japan indeed increased from 2006 to 2011 (result not reported). This observation is consistent with the fact that there is a substantial drop in the number of households that took out their mortgage from around 2005 onward in Figure 2.

4.1. Main results

Table 5 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 significant positive coefficient for $Land\ value$, which is inconsistent with the theoretical prediction that an increase in property value while holding home equity fixed reduces stock-holdings. The coefficient for $Home\ equity$ is positive but statistically insignificant. In column (ii), we include the control variables outlined in the previous section. We find that the coefficient on $Land\ value$ remains positive, as in column (i), but the value of the point estimate becomes smaller and its statistical significance weaker. The coefficient on $Home\ equity$ 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 stock-holdings is unstable, which is consistent with the empirical findings of Chetty et al. (2017) and other studies.

Next, Table 6 reports 2SLS regression results using equations (2a) to (2c), which correspond to the equations used by Chetty et al. (2017). Columns (i) and (ii) report the first-stage regressions for $Land\ value$ and $Home\ equity$, respectively, while column (iii) reports the second-stage 2SLS estimates for $Stock\ share$. Comparing our 2SLS estimation results to those obtained by Chetty et al. (2017), several differences can be noticed. First, regarding the first-stage regression for $Land\ value$ in column (i), while Chetty et al. (2017) obtain a significantly negative coefficient for the average regional price in the year the house was purchased, we do not obtain a negative coefficient for

$Lprice\_purchase$. That is, while Chetty et al. (2017) argue that US households tend to buy smaller (cheaper) houses when house prices are high, we find that a comparable pattern is not observed for Japanese households. On the other hand, similar to Chetty et al.'s (2017) results for property value, we find that the effect of the average current land price ($Lprice\_present$) on $Land\ value$ is positive and significant.[14] The first-stage regression result for $Home\ equity$ in column (ii) is also in line with Chetty et al.'s (2017) result: 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, we also find notable differences in the second-stage regression results. Specifically, for $Stock\ share$ in column (iii), we obtain, as expected, a positive and (albeit weakly) significant coefficient for $Home\ equity$, which is consistent with Chetty et al.'s (2017) results. However, unlike them, we do not obtain a significantly negative coefficient for property value ($Land\ value$). Moreover, the sum of the coefficients for $Land\ value$ and $Home\ equity$ is significantly positive, while the sum of the coefficients for property value and home equity is insignificant in Chetty et al. (2017). This result suggests that in Japan the positive impact of an exogenous increase in home equity outweighs the negative impact of an increase in exposure to housing risks. In summary, the consistency of our results

[14] In addition to the average land price ($Lprice\_present$, $Lprice\_purchase$), $Land\ value$ may also be positively correlated with the average floor space of residential houses. On the other hand, the direction of correlation of $Home\ equity$ ($Land\ value - Current\ mortgage$) with the average floor space may be indeterminate, because $Current\ mortgage$ is likely to be positively correlated with the average floor space as well. To check whether floor space plays a role, we run 2SLS regressions that include the average floor space of residential houses as an additional instrumental variable. The average floor space is constructed from the 2003, 2008, and 2013 editions of the "Housing and Land Survey" by the Statistics Bureau, Ministry of Internal Affairs and Communications. The estimation results (not shown) indicate that, as expected, the average floor space has a positive effect on $Land\ value$, while the effect on $Home\ equity$ is not statistically significant. The second stage regression results for $Stock\ share$ are essentially the same as those reported in Tables 5 in the text. We thank Jiro Yoshida for the suggestion.

with those of Chetty et al. (2017) is mixed.

Next, Table 7 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 for $Land\ value$ and $Initial\ mortgage$, respectively, while column (iii) reports the second-stage regression for $Stock\ share$. Consistent with our prediction, we find that the effects of $Lprice\_present$ on Land value in column (i) and of $Lprice\_purchase$ on $Initial\ mortgage$ in column (ii) are positive and significant. Turning to the second-stage regression in column (iii), we find that the coefficient on $Land\ value$ is positive and significant, which suggests that the positive effect of an increase in home equity on stock-holdings (while holding property value fixed) is larger than the negative effect of the increased risk associated with holding more housing assets (while holding home equity fixed). In contrast, we find that the link between $Initial\ mortgage$ and stock-holdings is negative and weakly significant at the 10 percent level.[15] The point estimate of the coefficient on $Land\ value$ indicates that a ¥1 million increase in the value of land households own is associated with an increase in stock-holdings of 0.5 percentage points, while that on $Initial\ mortgage$ indicates that a ¥1 million increase in initial residential mortgage debt is associated with a 0.6 percentage point reduction in stock-holdings, so that the two effects almost cancel each other out. Consistent with these point estimates, the sum of the coefficients on $Land\ value$ and $Initial\ mortgage$ is insignificant.

[15] When we divide our sample into two subsamples consisting of households whose $Initial\ mortgage$ falls below and above the median and rerun the 2SLS regressions, the coefficient on $Initial\ mortgage$ is significantly negative for the larger (above-the-median) $Initial\ mortgage$ subsample but insignificant for the smaller (below-the-median) subsample (results not shown).

All of the second-stage regression results are qualitatively similar to those obtained in Table 6 using Chetty et al.'s (2017) regression form.

Finally, Table 8 reports 2SLS estimates using equations (4a)–(4c), where the dependent variable is $Mortgage\ amount\ repaid$. 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, when holding home equity constant, there is a positive link between the mortgage amount households had repaid and the value of their land as well as the size of their mortgage while holding home equity fixed. This result contrasts with the regression results for stock-holdings in Tables 6 and 7, where we do not find any significant relationships between households' stock-holdings and the values of their land as well as the size of their mortgage. Taken together, these results suggest that when Japanese households hold more housing assets and liabilities, they tend to repay mortgages more aggressively but there is no significant effect on their investment in stocks.

4.2. Extensions

In this subsection, we conduct two additional exercises. First, using the same dependent and independent variables as in the 2SLS regressions, we estimate an IV-Tobit model, since about 70 percent of the households in our sample do not hold any stocks, so that the dependent variable is left-censored at zero. As an alternative exercise to deal with the fact that the dependent variable is left-censored at

zero, we also estimate an IV-Probit regression model in which the dependent variable is a dummy variable for owning stocks (i.e., the extensive margin of stock-holding). The estimation results are presented in Table 9. Second, we examine the possibility that the effect on stock-holding differs when we distinguish between direct investment in stocks and indirect investment through equity mutual funds. To this end, we estimate a 2SLS regression model in which the dependent variable is $Mutual\ fund\ share$, which is defined as the ratio of a household's holding of mutual funds in total liquid financial assets.[16] The estimation result for this second exercise is presented in Table 10. In our sample, 10.4 percent of households hold mutual funds, and the mean of $Mutual\ fund\ share$ is 2.2 percent, while the proportion of households holding stocks directly is 30.2 percent and the mean of Stock share is 9.0 percent (Table 4).

Table 9 shows estimation results for the first exercises. Specifically, column (i) shows the estimation results of the IV-Tobit regression. We find that the coefficient on $Land\ value$ is positive and significant, while the coefficient on $Initial\ mortgage$ is negative but insignificant. The reason for the latter result is that the standard error of $Initial\ mortgage$ is about twice as large as that of $Land\ value$, which suggests that there is significant heterogeneity among households regarding the effects that holding a mortgage has on their stock-holding. Column (ii) of Table 9 shows the estimates of the IV-Probit regression for the extensive margin of stock-holdings. We find that the coefficient on $Land\ value$ is positive and significant, while the coefficient on $Initial\ mortgage$ is negative but

[16] Money management funds, money reserve funds, and mid-term government bond funds are excluded from our $Mutual\ fund\ share$ variable.

insignificant. Taken together, these results confirm the estimation results in the previous subsection that households' land values (while holding mortgages fixed) have a positive impact on their stock-holdings. In contrast, initial mortgage debt (while holding land value fixed) only has a weak effect on stock-holdings.

Table 10 shows the 2SLS estimates for $Mutual\ fund\ share$. We find that the coefficient on $Land\ value$ is positive and significant, but the absolute value of the point estimate is smaller and its statistical significance lower than for $Stock\ share$ in Table 7. We also find that the coefficient on $Initial\ mortgage$ is negative but insignificant. These results suggest that the effect of home ownership on stock-holding is stronger in the case of direct stock-holding than indirect holding via mutual funds. A possible explanation for this finding is that households try to limit the volatility of their total assets by investing in individual stocks rather than mutual funds, since the former are likely to be less correlated with real estate prices.

4.3. Discussion

Let us consider our results in relation to previous studies. To start with, our estimation results differ from those of Chetty et al. (2017) in two regards. First, unlike Chetty et al. (2017), we do not find a negative effect of property value (while holding home equity fixed) on portfolio holdings. Second, we find that the positive effect of an increase in home equity (either an increase in land value or a decrease in mortgage debt) on stock-holdings is larger than the negative effect of greater exposure to house price

risk. In Chetty et al. (2017), these positive and negative effects cancel each other out.

While it is beyond the scope of this study to examine the reasons for the different empirical results in detail, several possible explanations suggest themselves. Regarding the first difference, our analysis suggested that a possible reason why the effect of property value (while holding home equity fixed) on stock-holding is insignificant in Japan is that households with a larger property value tend to repay their mortgage more aggressively. That is, our results suggest that Japanese households view the repayment of mortgage debt and investment in stocks as substitutes. A possible explanation is the way that residential mortgages in Japan work. In Japan, residential mortgage debt is with recourse, meaning that households cannot walk away from their mortgage debt even if their property falls into negative equity. This differs from some US states such as California, where mortgage debt is without recourse. Therefore, because Japanese households cannot escape their mortgage debt if they fall into negative equity, they may be more inclined to repay their mortgage debt rather than invest in stocks when they have greater housing exposure.

Regarding the second finding that the positive effect of an increase in home equity on stock-holdings is larger than the negative effect of an increase in property value, our result is qualitatively similar to that in Fougère and Poulhès (2012) using French data. To provide a possible explanation for the discrepancy of their findings with those of Chetty et al. (2017), Fougère and Poulhès (2012) present numerical simulations to show that if housing adjustment costs are sufficiently large, the absolute value of the impact of property value on stock-holdings will be smaller than that of the impact of home equity

on stock-holdings. There is a good chance that this line of reason applies to Japan. That is, compared to the United States, for example, Japan's housing market is relatively illiquid, as evidenced, for instance, by the fact that in Japan the share of used houses in the housing market is only 13.5 percent compared to 77.6 percent in the United States, suggesting that it is likely more difficult and costly to buy and sell a house in Japan.[17]

5. Summary

Employing micro data for households in Japan for the period 2000–2015, this study investigated the effect of home ownership on households' stock-holdings. To disentangle the effects of property value and mortgage debt on households' stock-holdings, we employed the instrumental variable approach proposed by Chetty et al. (2017), which utilizes variations in house price indices in the region in which a household lives as IVs. Our empirical analyses yielded the following results. First, an exogenous increase in current property values (land values in our case) holding initial mortgage debt fixed leads households to increase their stock-holdings. This finding suggests that the positive effect of an increase in property values on households' stock-holdings through the wealth effect is quantitatively larger than the negative effect through the risk effect (i.e., a more illiquid asset portfolio and larger exposure to house price risk). Second, we find that an increase in initial mortgage debt holding current land values fixed leads households to decrease their stock-holdings, which provides further evidence of the wealth

[17] Figures from Ministry of Land, Infrastructure, Transport, and Tourism, http://www.mlit.go.jp/common/000135252.pdf (in Japanese).

effect. However, we found that the negative effect of initial mortgage debt on stock-holdings is only weakly significant, which suggests that the effect might be heterogeneous across households. Third, we found that a simultaneous increase in current land values and initial mortgage debt holding home equity fixed does not affect households' stock-holdings, but the same increase leads households to increase the amount of mortgage debt that they repay. This finding suggests that the effect of the illiquidity and pricing risks of residential property on Japanese households' financial decisions is reflected in their debt repayments rather than their investment in stocks.

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Figure 1: Residential land price indices for 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 for Household A it was 1993. Household C bought a house for the same price as Household A in the same year, 1993, but the house is located in a different area (Tokyo-Josei).

Source: Authors' calculations based on data from the "Public Notice of Land Prices," Land Appraisal Committee of the Ministry of Land, Infrastructure, Transport and Tourism.

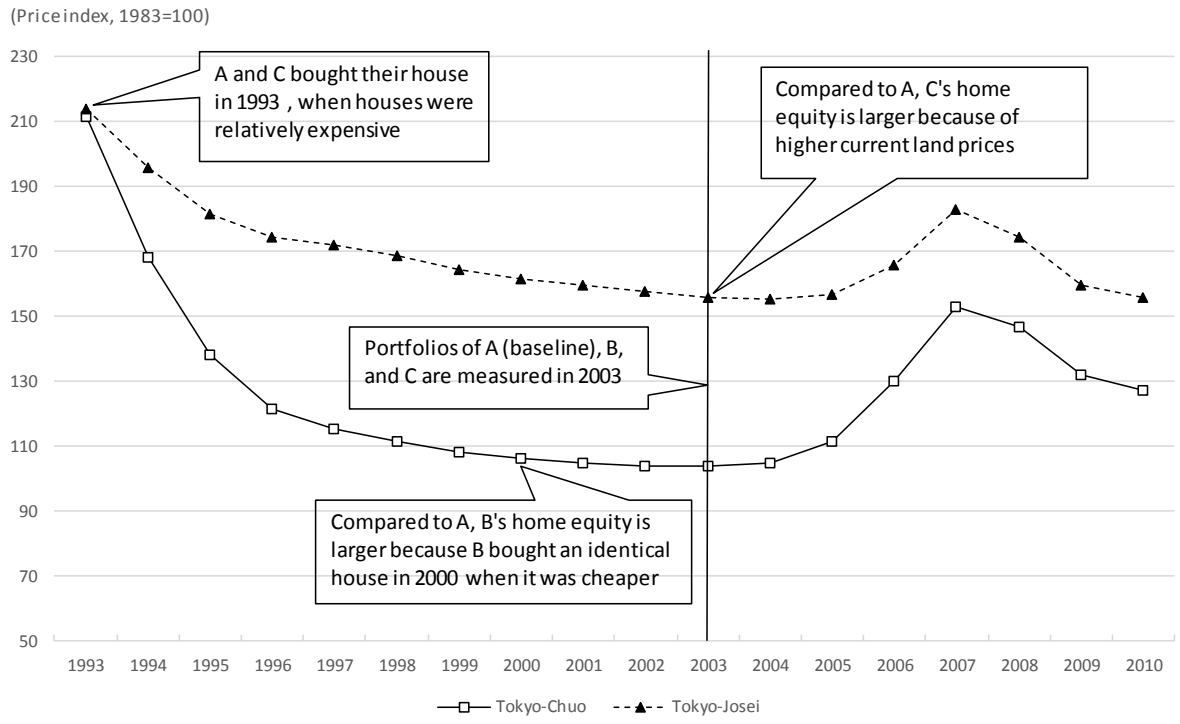

Table 1: Correspondence between the coefficients in equations (3a) and (2a)

The first two rows show the correspondence between the coefficients in Chetty et al.'s (2017) specification in equation (2a) and those in our modified specification in equation (3a). The third row provides their economic interpretations.

Equation (3a)	β_1'	β_2'	$\beta_1'+\beta_2'$
Equation (2a)	$\beta_1 + \beta_2$	$-\beta_2$	β_1
Interpretation	Positive wealth effect and negative risk effect	Negative wealth effect	Negative risk effect

Table 2: List of the 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 in the overall number of observations given in parentheses.

	Distance from Tokyo Station			
	0–10km	10–20km	20–30km	30–40km
Area				
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)		
Outer Tokyo		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 3: Definition of variables

This table presents the definitions of the variables used in our estimations (Tables 5 to 10).

Variable	Definition
Dependent variable	
Stock share	The ratio of a household's stock-holdings to total liquid financial assets in percent (0-100)
Stock holder	Dummy variable for households owning stocks
Mortgage amount repaid	Initial mortgage debt amount minus current mortgage debt amount
Mutual fund share	The ratio of a household's mutual fund holdings (excluding money management funds, money reserve funds, and mid-term government bond fund) to total liquid financial assets in percent (0-100)
Independent variables	
Land value	Households' estimate of the current value of the land on which their house sits
Home equity	The current value of a household's property (land) minus current mortgage debt outstanding
Initial mortgage	Initial mortgage taken out by the household
Current year	The year in which a household responds to the survey (i.e., the household's portfolio is measured)
Purchase year	The year in which a household bought its property (land) (borrowed outstanding mortgage debt)
Age dummies	Dummy variables for household head age categories: up to 30, 31–40, 41–50, 51–60, 61–70, and over 70
Outside 23 Tokyo wards	Dummy variable for households living outside the 23 Tokyo wards, that is, in Outer Tokyo, Saitama, Chiba, Kanagawa, or Ibaraki
Income	Households' income before taxes
Financial assets	Households' total liquid financial assets including deposits, bonds, stocks, mutual funds, and foreign currency denominated assets
Instrumental variables	
Lprice_present	The average PNLP residential land price index (1983=100 for the national average) of the region in which a household lives in the year the household portfolio is measured. The regions are constructed by combining 10 area dummy variables (Tokyo-Chuo, Tokyo-Jonan, Tokyo-Johoku, Tokyo-Josei, Tokyo-Joto, Outer Tokyo, Saitama, Chiba, Kanagawa, and Ibaraki) with an index variable representing the distance from Tokyo Station (0–10km, 10–20km, 20–30km, or 30–40km). The total number of regions is 22 (see Table 2).
Lprice_purchase	The average PNLP residential land price index (1983=100 for the national average) of the area in which a household lived in the year the household bought their property (land)

Table 4: Summary statistics

This table presents summary statistics for the variables used in the estimations (Tables 5 to 10). The number of observations is 4,495. Definitions of the variables are provided in Table 2.

	Unit	Mean	Median	S.D.	Min.	Max.
Dependent variable						
Stock share	%	9.003	0.000	18.795	0.000	100.000
Stock holder	Dummy	0.302	0	0.459	0	1
Mortgage amount repaid	10 million yen	1.060	0.800	1.088	0.000	18.000
Mutual fund share	%	2.225	0.000	9.130	0.000	97.847
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 assets	10 million yen	0.779	0.400	1.219	0.010	17.980
Outside 23 Tokyo wards	dummy variable	0.772	0	0.419	0	1
Aged up to 30	Dummy	0.023	0	0.149	0	1
Aged 31-40	Dummy	0.274	0	0.446	0	1
Aged 41-50	Dummy	0.404	0	0.491	0	1
Aged 51-60	Dummy	0.219	0	0.414	0	1
Aged 61-70	Dummy	0.068	0	0.252	0	1
Aged over 70	Dummy	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 number of households across survey years and year in which they purchased their house

This figure shows the distribution of the number of households across survey years ("current year") and the year in which they took out their mortgage ("purchase year").

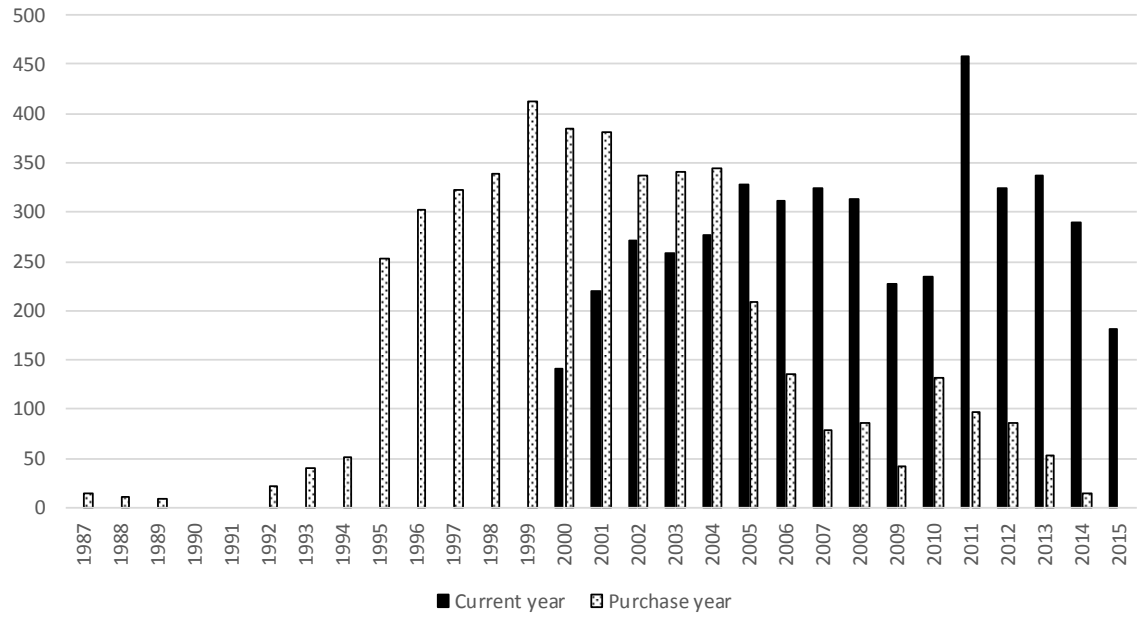

Table 5: OLS regressions for stock-holdings as a share of liquid financial wealth

This table presents the OLS regression results for stock-holdings (*Stock share*) after controlling for the various covariates and fixed effects outlined in the text. ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively. Standard errors are in brackets.

	(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 23 Tokyo wards			0.779	
			[0.673]	
Aged 31-40			2.040	
			[1.893]	
Aged 41-50			4.647	**
			[1.907]	
Aged 51-60			5.744	***
			[1.972]	
Aged 61-70			11.349	***
			[2.174]	
Aged over 70			8.679	***
			[3.129]	
Income			3.952	***
			[0.767]	
Financial assets			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	
R^2	0.02		0.07	
Adj. R^2	0.02		0.06	
F-statistic	43.48		6.58	
Prob > F	0.00		0.00	

Table 6: Two-stage least squares regressions for stock-holdings as a share of liquid financial wealth (endogenous regressors: *Land value* and *Home equity*)

This table presents the 2SLS regression results for stock-holdings (*Stock share*) after controlling for the 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 percent levels, respectively. Standard errors are in brackets.

	(i)	(ii)	(iii)
Estimation method:	2SLS		
Dependent variable:	*Land value* (1st stage)	*Home equity* (1st stage)	*Stock share* (2nd stage)
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 23 Tokyo wards	0.071	0.031	3.203 **
	[0.133]	[0.135]	[1.314]
Aged 31-40	-0.031	-0.035	2.309
	[0.217]	[0.221]	[2.233]
Aged 41-50	0.005	0.165	3.622
	[0.218]	[0.223]	[2.323]
Aged 51-60	0.209	0.776 ***	0.772
	[0.225]	[0.230]	[3.417]
Aged 61-70	1.626 ***	1.999 ***	1.019
	[0.247]	[0.252]	[4.855]
Aged over 70	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 assets	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 Land value and Home equity			5.238 ***
			[1.789]
Number of observations	4,495	4,495	4,495
F / Wald chi2 statistic	27.48	22.26	237.72
Prob > F / Chi2	0.00	0.00	0.00

Table 7: Two-stage least square regressions for stock-holdings as a share of liquid financial wealth (endogenous regressors: *Land value* and *Initial mortgage*)

This table presents the 2SLS regression results for stock-holdings (*Stock share*) after controlling for the 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 percent levels, respectively. Standard errors are in brackets.

	(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	1327.073 ***	-241.704	
(x 1/100K)	[314.924]	[243.240]	
Lprice_purchase	87.058	961.656 ***	
(x 1/100K)	[300.002]	[231.714]	
Outside 23 Tokyo wards	0.071	0.036	3.122 **
	[0.133]	[0.103]	[1.317]
Aged 31-40	-0.031	-0.002	2.278
	[0.217]	[0.167]	[2.243]
Aged 41-50	0.005	-0.124	4.015 *
	[0.218]	[0.168]	[2.289]
Aged 51-60	0.209	-0.275	3.117
	[0.225]	[0.174]	[2.645]
Aged 61-70	1.626 ***	0.276	5.016
	[0.247]	[0.191]	[3.459]
Aged over 70	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 assets	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 statistic	27.48	18.65	235.52
Prob > F / Chi2	0.00	0.00	0.00

Table 8: Two-stage least square regressions for the mortgage amount repaid

This table presents the 2SLS regression results for the amount of mortgage debt repaid (*Mortgage amount repaid*) after controlling for the 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 percent levels, respectively. Standard errors are in brackets.

	(i)	(ii)
Estimation method:	2SLS	
Dependent variable:	*Mortgage amount repaid* (2nd stage)	*Mortgage amount repaid* (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 23 Tokyo wards	-0.013	-0.011
	[0.054]	[0.046]
Aged 31-40	-0.005	-0.004
	[0.092]	[0.079]
Aged 41-50	0.063	0.054
	[0.096]	[0.080]
Aged 51-60	0.378 ***	0.324 ***
	[0.140]	[0.093]
Aged 61-70	0.645 ***	0.552 ***
	[0.200]	[0.121]
Aged over 70	0.443 **	0.379 **
	[0.195]	[2.310]
Income	0.407 ***	0.348 ***
	[0.090]	[0.113]
Financial assets	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	0.041	
Land value and Home equity	[0.074]	
Sum of coefficients on		0.176 **
Land value and Initial mortgage		[0.071]
Number of observations	4,495	4,495
Wald chi2 statistic	2340.76	3186.14
Prob > Chi2	0.00	0.00

Table 9: IV-Tobit regression for stock-holdings as a share of liquid financial wealth and IV-Probit regression for holding stocks (endogenous regressors: *Land value* and *Initial mortgage*)

In this table, column (i) shows the IV-Tobit regression results for stock-holdings (*Stock_share*), while column (ii) shows the IV-Probit regression results for the dummy variable for holding stocks (*Stock holder*) after controlling for the 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 percent levels, respectively. Standard errors are in brackets.

	(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 Land value and Initial mortgage	2.347 [5.713]	0.059 [0.138]
Number of observations	4,495	4,495
Wald chi2 statistic	332.09	479.07
Prob > F / Chi2	0.00	0.00

Table 10: Two-stage least square regressions for mutual fund holdings as a share of liquid financial wealth (endogenous regressors: *Land value* and *Initial mortgage*)

This table presents the 2SLS regression results for mutual fund holdings (*Mutual fund share*) after controlling for the 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 percent levels, respectively. Standard errors are in brackets.

	(ii)
Estimation method:	2SLS
Dependent variable:	*Mutual fund share* (2nd stage)
Land value	1.438 *
	[0.830]
Initial mortgage	-0.709
	[1.465]
Other controls	YES
Current year dummies	YES
Purchase year dummies	YES
Sum of coefficients on Land value and Initial mortgage	0.729 [0.877]
Number of observations	4,495
Wald chi2 statistic	173.99
Prob > Chi2	0.00