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Disentangling the effect of housing on household stock holdings: Evidence from Japanese micro data[†]

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Disentangling the effect of housing on household stock holdings: Evidence from Japanese micro data

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Abstract

Using Japanese household micro survey data during 2000–2015, this paper examines the effects of housing on household stock holdings. To disentangle the effect of home equity and mortgage debt on households' portfolio share of stocks out of liquid financial assets, we apply and modify the instrumental variable approach by Chetty et al. (2017) that distinguish exogenous variations in home equity wealth and mortgage debt by using differences in average land price indices across housing markets in the year in which household portfolios are measured (the instrument for home equity wealth) and those in the year in which the house was purchased (the instrument for mortgage debt). Our estimates suggest that an increase in land value increases the portfolio share of stocks, while an increase in initial mortgage debt reduces it.

JEL classifications: D14, G11, R21

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

1. Introduction

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

Recently, Chetty et al. (2017) set forth an analytical framework to reconcile the theory with data. Their contributions are two-fold. First, they construct a theoretical model of household portfolio choice that separates the effects of property value from the effects of home equity (current property value minus current mortgage debt). Their model predicts that an incremental increase in property value

[1] Yamashita (2003) finds that there is a positive relationship between house-to-net worth ratio and stock share for households with lower house-to-net worth ratio and a negative relationship for households with higher house-to-net worth ratio. Yao and Zhang (2005) find that the relationship between *equity-to-net worth* ratio and house-to-net worth ratio is negative (substitution effect), while the relationship between *equity-to-liquid assets* and 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 stockholdings is negative.

while holding home equity fixed reduces the stock share of liquid wealth through three channels: by (1) increasing illiquidity of household portfolio (Grossman and Laroque 1990, Chetty and Szeidl 2007), (2) increasing exposure to house price risk (Flavin and Yamashita 2002), and (3) increasing mortgage debt (negative wealth effect) as higher property value holding fixed home equity essentially means higher mortgage debt. In contrast, the model predicts that incremental increase in home equity holding property value fixed, which is equivalent to reducing mortgage debt, increases the stock share of liquid wealth through 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) argues that it is important to extract *exogenous* changes in property value and home equity in order to make a causal inference on household portfolio, because both housing and portfolios choice are endogenous that 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 housing, mortgage debt, and stock holding because households with higher future income tend to buy larger houses, have larger 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 the theory.

Using more than 4,000 households' micro data in Japan during 2000–2015, this paper examines the effect of housing on household financial portfolio by employing one of the empirical methodologies in Chetty et al. (2017), which instruments for the property value and home equity using variations in the current and time-of-purchase house price index. Chetty et al. (2017) argues that the current house price index is a strong predictor of property value but it also positively affects home equity. To separate the effect of current house price on property value from that on home equity, they use a second instrument, the house price index at the time of purchase because households who 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 (IV), 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 value (land value in our case) on households' portfolio share on stocks when holding home equity fixed is not significantly negative as in Chetty et al (2017). We also note the possibility that households who bought houses when the average price was higher might have repaid mortgage debt more aggressively, which might make the effect of 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 *initial* mortgage debt as the instrumented variables. Using this specification, we obtain an empirical result that is basically consistent with the theoretical prediction of Chetty et al. (2017). That is, we find that an exogenous increase in current land value holding initial mortgage debt fixed increases households' portfolio share of stocks (positive wealth effect) while an increase in initial mortgage debt holding current land value fixed reduces the share of stocks (negative wealth effect). We note, however, that the negative effect of initial mortgage debt on the share of stocks is not robust when we employ IV-Tobit model that takes into account of the fact that many households do not possess any stocks. Finally, we do not find evidence for the negative effect of owning illiquid housing assets that entail price risk on households' stock share.

To the best of our knowledge, this paper is the first to apply the methodology of Chetty et al. (2017) to Japan and examine the causal effect of housing on household stock holdings. Previous studies that replicate Chetty et al. (2017) to other countries find mixed results. Fougère and Poulhès (2012) use data on French households and find that home equity and mortgage debt have significant, opposite-signed effects on households' portfolio. Quantitatively, they report 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 cancel out quantitatively in Chetty et al. (2017) that use data on the U.S. households. In contrast, Michielsen et al. (2016) use data on Dutch households and find that both home equity and mortgage debt do not have a significant impact on the share of 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 our findings.

2. Empirical strategy

As in Chetty et al. (2017), we first examine the effects of housing on households' portfolio share in stocks by estimating 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 a household i's share of stocks in total liquid financial assets, Land value represents the current value of residential land that a 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 data limitation described in Section 3, we use Land value instead of the property value that include the value of constructions as well as lands. In equation (1), β_1 captures the effect of land value on Stock share holding home equity fixed, while β_2 captures the effect of home equity on Stock share holding land value fixed. The theoretical model in Chetty et al. (2017) predicts that $\beta_1 < 0$, because incremental increase in a household's land value increases (i) illiquidity of household portfolio (Grossman and Laroque 1990, Chetty and Szeidl 2007), (ii) its exposure to house price risk (Flavin and Yamashita 2002), and (iii) increases its debt burden, as higher land value for the same level of home equity essentially implies higher mortgage debts. In contrast, the model in Chetty et al. (2017) predicts $\beta_2 > 0$ because of the diversification effect (Yao and Zhang 2005) in which a household seeks to diversify its increased net worth and maintain a constant share of risky assets. Note also that higher home equity given constant land value is equivalent to lower mortgage debts, which increases the share of risky financial assets.

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

Following Chetty et al. (2017), we use two instruments in estimating equation (1): the average land price of the region that 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 that households bought houses, denoted as $\mathrm{Lprice\_purchase}$. The idea is as follows (Figure 1).[2] Suppose that two households, Household A and B, bought identical houses in the same region (Tokyo-Chuo) but Household B bought at the time when the house price was lower. Then, Household A and B have the same current $\mathrm{Land\ value}$, but Household B is likely to have larger $\mathrm{Home\ equity}$ because of smaller initial mortgage debt incurred. This effect is captured by the difference in $\mathrm{Lprice\_purchase}$. Next, suppose there is Household C who bought the house for the same price at the same time as Household A did, but the one Household C bought is located in a different region (for instance, Tokyo-Josei) and its current price is higher than the one Household A owns. Then, Household A and C is likely to have the same amount of initial mortgage debt but Household C is likely to have larger $\mathrm{Land\ value}$

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

and $\mathrm{Home\ equity}$ because of the higher current land price. This effect is captured by the difference in $\mathrm{Lprice\_present}$. Using these two instruments, we estimate equation (1) by two-stage least squares (2SLS) of the following form:

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

$$\mathrm{Land\ value}_{it} = \delta + \lambda_1 \mathrm{Lprice\_present}_j + \lambda_2 \mathrm{Lprice\_purchase}_j + \eta \mathbf{X_{it}} + u_1 \tag{2b}$$

$$\mathrm{Home\ equity}_{it} = \zeta + \sigma_1 \mathrm{Lprice\_present}_j + \sigma_2 \mathrm{Lprice\_purchase}_j + \theta \mathbf{X_{it}} + u_2 \tag{2c}$$

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

Not only replicating Chetty et al. (2017) using data in Japan, we also improve their empirical strategy in this paper. Empirical specifications in Chetty et al. (2017) contain some ambiguity. First, in Chetty et al. (2017), the negative coefficient of $\mathrm{Land\ value}$ (β_1) in equation (2a) can be attributed to either an increase in (i) illiquidity of housing asset, (ii) households' exposure to house price risk, or (iii) mortgage debt. While (i) and (ii) stem from the risk associated with housing asset, (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. Second, while Chetty et al. (2017) expects that the average land price in the year that households bought houses (Lprice_purchase) negatively affects their home equity ($\sigma_2 < 0$), this may not be the case if households who bought expensive houses are the ones that repay 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 current land value minus *current* mortgage debt, is ambiguous. In contrast, the effect of Lprice_purchase on the amount of *initial* mortgage debt is clearly positive.

To deal with these two problems, we estimate the following modified version of equations (2) using 2SLS:

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

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

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

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 housing asset that negatively affects Stock share and on the net worth effect that 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 being negative.

3. Data and variables

3.1. Data and sample selection

The household data mainly used in this study are taken from the *Nikkei Kinyu Kodo Chosa NEEDS-RADAR* (Nikkei RADAR hereinafter), which is a household survey for those that live in the Metropolitan area of Japan. To be more precise, the Metropolitan area is defined as within 40 km-radius from the Tokyo station in Tokyo, Saitama, Chiba, Kanagawa, and Ibaragi prefectures, and individuals that make financial decisions including saving, investment, and borrowing for the household are asked to respond to the survey questionnaire. Nikkei RADAR's survey is implemented in the fourth quarter (from October to December) of each year, and we use for the period 2000–2015. To construct average land prices of residential areas that households live, Lprice_present and Lprice_purchase as instruments, we use 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 can identify the following 10 residential areas that households reside at: 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 Ibaragi.[3] In

[3] Precise definitions of 6 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, Tokyo-Joto (eastern part) consists of Taito, Sumida, Koto, Arakawa, Adachi, Katsushika, and Edogawa. Tokyo-outer includes cities other than 23 wards.

addition, we can identify whether a household lives in one of the followings: 0–10km, 10–20km, 20–30km, and 30–40km distance from the Tokyo station. By combining these two pieces of geographical information, we construct 22 regions that households live (see Table 1 for a list of 22 regions).[4] Accordingly, we construct average land prices of these 22 regions during 1983–2015 from PNLP and match them with Nikkei RADAR data. The number of observations is 42,709 (about 2,700 in each year).

To examine the effects of land value and home equity on stocks, 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 debts, and those that do not have any liquid financial assets.[5] We exclude homeowners that do not live in stand-alone houses because 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 survey (i.e., the year that household portfolios is measured) is lower than the interest rate in the year of borrowing current mortgage debts by more than 1 percentage point. We also exclude households whose current mortgage debt outstanding is larger than the initial outstanding. This exclusion leaves us with 5,574 observations.

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[4] 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 0–10km distance from Tokyo station.

[5] Previous empirical studies that examine the effect of property value and home equity on households' portfolio share of stocks are not unanimous on the sample selection criteria. Chetty et al. (2017) differ from ours in that they include households that do not have any mortgage debts and that they exclude households with negative equity. We do not exclude negative equity households because our home equity variable does not account for the value of constructions (houses) so that negative equity households should not be viewed as outliers. Regarding mortgage debt, we follow Fougère and Poulhès (2012) which also exclude households that do not have any mortgage debts. They argue that if the household has no debt, property value and 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 debts.

Finally, we exclude households for which we cannot obtain data for one of dependent variables, independent variables, and instrumental variables described in the next subsection. We end up with 4,495 observations, which constitute our estimation sample.

3.2. Variables

Tables 2 and 3 respectively reports definition and summary statistics of the variables used in estimations. The dependent variable, Stock share, is calculated as the share of stock holdings to 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, households hold on average 9% of total liquid financial assets in stocks. This is mainly due to the fact that 70% of the households do not hold any stocks. Next, turning to housing variables, we use Land value, Home equity, and Initial mortgage as our main variables. Land value represents the current value of residential land, where the current value is subjectively evaluated by respondent households in Nikkei RADAR. Due to data limitation, we do not know the value of constructions for stand-alone home-owners. In addition, we do not know the property value of non-stand-alone houses such as an apartment or condominium, and thus excludes households that do not live in stand-alone houses from our estimation sample. Home equity is defined as the current land value minus current mortgage debt outstanding. We also use Initial mortgage, which is the amount of *initial* mortgage debts outstanding at the time of borrowing. The average amounts of Land value, Home equity, and Initial mortgage are respectively ¥30.9 million, ¥8.2 million, and ¥33.3 million.

As explained above, instrumental variables Lprice_present and Lprice_purchase are constructed from PNLP data. In constructing Lprice_purchase, we need information about the year of purchasing houses. Nikkei RADAR does not provide this information, but it does provide the year in which each household borrowed current residential mortgages, and we assume that the year households incurred current mortgage debt is the same as the year they purchased houses. 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 1 percentage point or more lower than the interest rate on an existing mortgage contract, which takes into account of transaction costs for refinancing. Hence, we exclude households for which the difference between the national average mortgage interest rate in the year of survey is lower than the mortgage interest rate in the year of obtaining existing mortgage debts by more than 1 percentage point.[6] We also exclude households whose current mortgage debt outstanding is larger than the initial mortgage debt outstanding presuming that they refinanced their loans in the past 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 the house is located outside of the Tokyo 23-wards or not). In Figure 2, we show the distribution of the current year and the purchase year. Regarding the

[6] We use the standardized interest rate of the fixed mortgage loan provided by the Japan Housing Finance Agency, the government sponsored agency.

distribution of purchase year, we note that the number of observations for households that bought houses after 2007 are smaller, because mortgage interest rate continued to decline during this period and we exclude those observations for which the difference in mortgage rates between the current year and purchase year is more than 1 percentage point. Turning to the characteristics of households, our sample mainly consists of household heads whose age is 30s, 40s, or 50s, i.e., those that are likely to have current mortgage outstanding. To control for the heterogeneity among households, we also include households' annual income and the amount of total liquid financial assets held as additional dependent variables. The median income in our sample is ¥8.5 million, while the median total liquid financial assets is ¥4 million.

4. Results

4.1. Main results

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

Next, Table 5 reports 2SLS regression results of equations (2a)–(2c) that replicate Chetty et al. (2017). Columns (i) and (ii) respectively reports the first-stage regressions of Land value and Home equity, while column (iii) reports the second-stage 2SLS estimates of Stock share. Compared to 2SLS estimates in Chetty et al. (2017), we notice several differences. First, regarding the first-stage regression for Land value equation in column (i), we do not obtain a negative coefficient on average regional land prices in the year of purchase, Lprice_purchase, as Chetty et al. (2017) do. The result suggests that Japanese households do not buy smaller (cheaper) houses when house prices are high. 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 equation in column (ii) is also in line with that in Chetty et al. (2017); we find that the effect of current land price index on Home equity is significantly positive while the effect of land price index in the year of purchase is significantly negative. Second, turning to the second-stage regression for Stock share equation in column (iii), we obtain positive and significant (albeit weak) coefficient on Home equity as expected, but we do not obtain significantly negative coefficient on Land value. In sum, we obtain mixed results in terms of consistency with Chetty et al. (2017).

Finally, Table 6 reports 2SLS estimates of equations (3a)–(3c) that modified the empirical specification in Chetty et al. (2017). Columns (i) and (ii) respectively reports the first-stage regressions on Land value and Initial mortgage while column (iii) reports the second-stage regression on Stock share. Consistent with the prediction, we find that the effect 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 on Land value is significantly positive, which suggests that the positive effect of an increase in home equity on the portfolio share of stocks is larger than the negative effect of increased risk associated with housing assets. In contrast, we find that the effect of an exogenous increase in Initial mortgage on the portfolio share of stocks is significantly (albeit weakly) negative. The point estimates of the coefficient on Land value indicates that a ¥1 million increase in the value of residential land increases a household's portfolio share of stock by 0.5 percentage points, while that of Initial mortgage indicates that a ¥1 million increase in initial residential mortgage debt reduces the stock share by 0.6 percentage points. Note, however, that the standard error of Initial mortgage is about as twice large as that of Land value, which suggests that there might exist significant heterogeneity among households regarding the effect of residential mortgage on their portfolio choice.

4.2. Extensions for future research

In this subsection, we conduct two additional exercises for future research. First, to take into 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 dependent and independent variables are the same as those in the 2SLS regression. Second, the 2SLS regressions we conduct assume that variables that affect the extensive margin of stock holding (i.e., participation in the stock market) are the same as those that affect the intensive margin (i.e., the stock share conditional on participating in the stock market). To examine the validity of this assumption, we estimate the IV-Probit regression model in which the dependent variable is the dummy variable for owning stocks. If changes in Land value and Initial mortgage significantly affect stock market participation rates, then we need to control for the selection effect to obtain consistent estimates for the effect on stock shares conditional on participating in the stock market.

Table 7 reports the estimates of the IV-Tobit regression. In column (iii), we find that the coefficient on Land value is significantly positive, while the coefficient on Initial mortgage is negative but insignificant. The latter result suggests that the impact of mortgage debt on households' portfolio share of stocks may be heterogeneous among households and/or non-monotonic, which need to be addressed in future research. Table 8 reports the estimates of the IV-Probit regression for the extensive margin of stock holdings. Similar to the result in Table 6, we find that the coefficient on Land value is significantly positive, while the coefficient on Initial mortgage is negative but insignificant. This result indicates that the 2SLS estimates on the subgroup of only stock market participants likely yield biased estimates due to a sample selection problem. In order to obtain consistent estimates for the intensive margin of stock holding, we need an additional exogenous variable that affects households' participation in the stock market but does not affect the stock share in their portfolios.[7]

5. Summary

Employing a micro survey data of households in the Metropolitan area of Japan during the period 2000–2015, this study investigated the effects of housing on household's portfolio share of stocks. To disentangle the effects of land value on household portfolio from those of mortgage debt, 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 led to an increase in households' portfolio share 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 find that an increase in initial mortgage debt led to a decrease in the stock share, providing further evidence for the wealth effects. We note, however, that the statistical significance on the effect of residential mortgage on households' stock holdings is relatively weaker than that of land value. This result suggests that there might exist significant heterogeneity among Japanese households on the effect of mortgage debt, which we would like to address in future research.

[7] As instruments for the 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.

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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. Portfolio of households A (baseline), B, and C is measured in 2003. Household B bought the identical house as A's in Tokyo-Chuo but B's year of purchase is 2000 while it is 1993 for A. Household C bought the house for the same price as A's in the same year, 1993, but the house is located in different area (Tokyo-Josei).

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

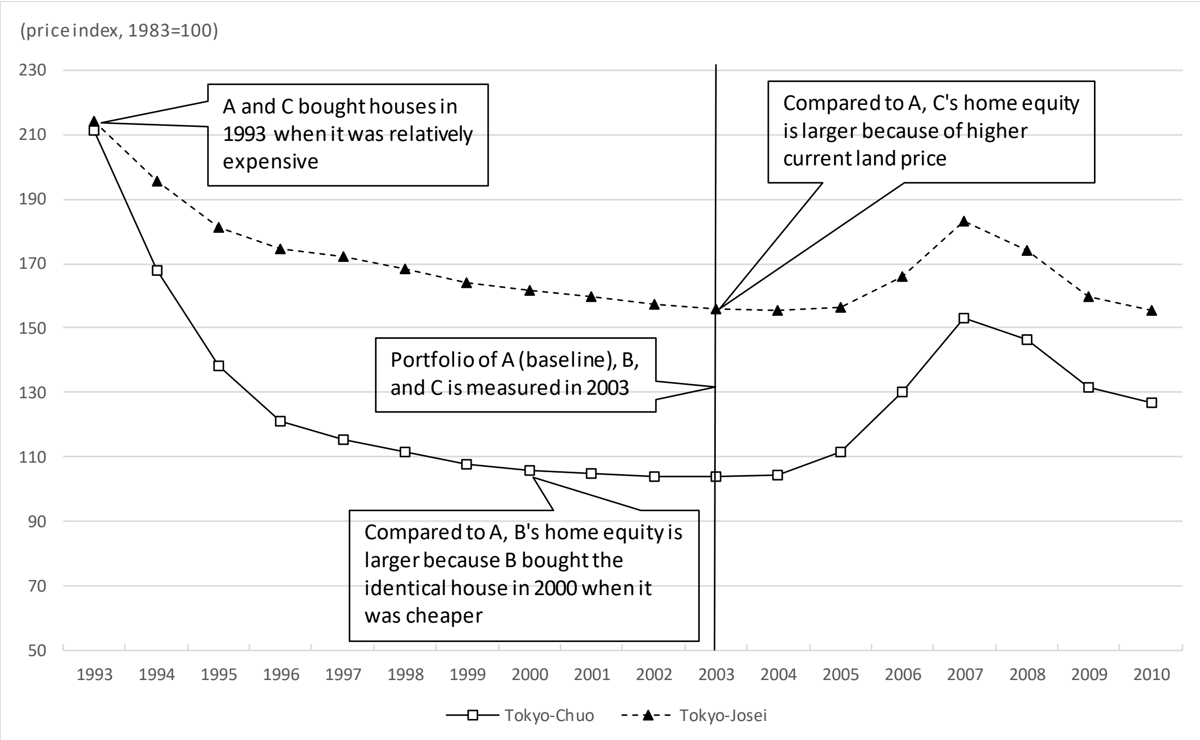

Table 1: List of 22 regions for residential land price indices

The shaded cells in this figure show 22 regions for which we use residential land price indices as instrumental variables. The figures show the number of observations for each region and the shares 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)				
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)
Ibaragi							60	(0.013)

Table 2: Definition of variables

This table presents the definition of variables used in estimations (Tables 4, 5, and 6).

Variable	Definition
Dependent variable	
Stock share	The ratio of a household's stock holding over total liquid financial assets in percentage points (0-100)
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 Ibaragi 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 of the variables used in the main estimations (Table 3–5, Number of observations: 4,495). Definitions of variables are provided in Table 1.

	Units	Mean	Median	S.D.	Min	Max
Dependent variable						
Stock share	%	9.003	8.299	18.795	0.000	100.000
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	0.000	0.419	0	1
Age 30 and under	dummy variable	0.023	0.000	0.149	0	1
Age 31-40	dummy variable	0.274	0.000	0.446	0	1
Age 41-50	dummy variable	0.404	0.000	0.491	0	1
Age 51-60	dummy variable	0.219	0.000	0.414	0	1
Age 61-70	dummy variable	0.068	0.000	0.252	0	1
Age 71over	dummy variable	0.012	0.000	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 of the purchase year (the year in which households borrowed the current mortgage debt).

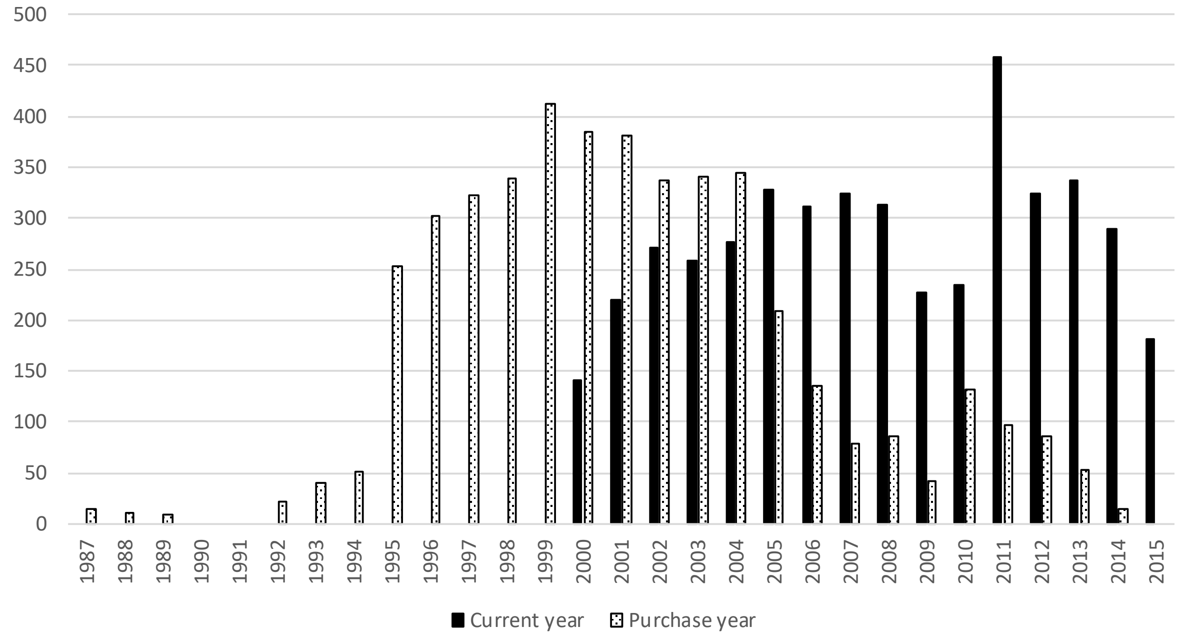

Table 4: OLS regressions for stock shares in liquid financial wealth

This table presents the OLS regression results on the portfolio share of stocks (Stock share) controlling for various covariates and fixed effects outlined in the text. ***, **, * indicate significance at the 1, 5, and 10% level, 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
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 square regressions for stock shares in liquid financial wealth (Endogenous regressors: Land value and Home equity)

This table presents the 2SLS regression result on the portfolio share of stocks (Stock share) controlling for endogenous regressors (Land value and Home equity), various covariates, and fixed effects outlined in the text. ***, **, * indicate significance at the 1, 5, and 10% level, 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 (x 1/100K)	1327.073 ***	1580.400 ***	
	[314.924]	[321.391]	
Lprice_purchase (x 1/100K)	87.058	-734.176 **	
	[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
Number of observations	4,495	4,495	4,495
R2	0.24	0.20	-
adj R2	0.23	0.19	-
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 shares in liquid financial wealth (Endogenous regressors: Land value and Initial mortgage)

This table presents the 2SLS regression result on the portfolio share of stocks (Stock share) controlling for endogenous regressors (Land value and Initial mortgage), various covariates, and fixed effects outlined in the text. ***, **, * indicate significance at the 1, 5, and 10% level, 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
Number of observations	4,495	4,495	4,495
R2	0.24	0.17	-
adj R2	0.23	0.16	-
F / Wald chi2 statitics	27.48	18.65	235.52
Prob > F / Chi2	0.00	0.00	0.00

Table 7: IV-Tobit regressions for stock shares in liquid financial wealth

This table presents the IV-Tobit regression result on the portfolio share of stocks (Stock_share) controlling for endogenous regressors (Land value and Initial mortgage), various covariates, and fixed effects outlined in the text. ***, **, * indicate significance at the 1, 5, and 10% level, respectively. Standard errors are in parentheses.

	(i)	(ii)	(iii)
Estimation method:		IV-Tobit	
Dependent variable:	Land value (1st stage)	Initial mortgage (1st stage)	Stock share (2nd stage)
Land value			13.562 **
			[5.369]
Initial mortgage			-11.214
			[9.546]
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]	
Other controls	YES	YES	YES
Current year dummies	YES	YES	YES
Purchase year dummies	YES	YES	YES
Number of observations	4,495	4,495	4,495
R2	0.24	0.17	-
adj R2	0.23	0.16	-
F / Wald chi2 statitics	27.48	18.65	332.09
Prob > F / Chi2	0.00	0.00	0.00

Table 8: IV-Probit regressions for holding stocks (extensive margin)

This table presents the IV-Tobit regression result on the dummy variable for holding stocks (Stock holder) controlling for endogenous regressors (Land value and Initial mortgage), various covariates, and fixed effects outlined in the text. ***, **, * indicate significance at the 1, 5, and 10% level, respectively. Standard errors are in parentheses.

	(i)	(ii)	(iii)
Estimation method:		IV-Probit	
Dependent variable:	Land value (1st stage)	Initial mortgage (1st stage)	Stock holder (2nd stage)
Land value			0.241 *
			[0.130]
Initial mortgage			-0.181
			[0.232]
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]	
Other controls	YES	YES	YES
Current year dummies	YES	YES	YES
Purchase year dummies	YES	YES	YES
Number of observations	4,495	4,495	4,495
R2	0.24	0.17	-
adj R2	0.23	0.16	-
F / Wald chi2 statitics	27.48	18.65	479.07
Prob > F / Chi2	0.00	0.00	0.00