The Effect of Housing Prices Decline on Households' Behaviors in Japan

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1 Introduction

Since aging population has become a major issue for advanced economies, effects of aging population on social systems have been scrutinized for past several decades. There is also a large body of research attempting to understand how demographies affect the housing market, identifying the negative relationships between housing prices and aging population in several literatures. However, the welfare consequences of housing prices decline triggered by aging population have been often overlooked in these literatures, as their main focuses tend to be directed toward the impact of aging society on housing prices.

Housing choices have tremendous effects on households' lifetime utilities since houses are the most variable assets for the most of the households as well as the important consumption goods in their lives. Hence, examining the welfare consequences of aging population through housing market seems worthwhile to conduct. This paper investigates the effect of housing prices decline on households' behaviors among various cohorts living in Japan.

Mankiw and Weil (1989) investigated the relationship between the change of demographic composition and the house prices fluctuations in the United States. They concluded that the demographic composition is one of the major determinants of house price changes in the United States. A bold prediction was also made that the house price would decline 47% in the United States by 2007 due to the decline of working population. Although the prediction was not realized, the idea of linking demographic compositions to house prices has attracted research interest over the years.

Nishimura and Takáts (2012) presented the theoretical frameworks to show that demographic changes have prominent effects on real property prices and money demands. That relationship was also confirmed by the data from 22 advanced economies for the 1950-2010 period. Saita et al. (2014) predicted that aging would keep placing downward pressure on real estate prices in Japan for next 30 years based on the results of the regional panel regression and population forecast.

As further declining of house prices in Japan seems inevitable unless the housing demand is drastically altered by unexpected events, it is worthwhile to assess the effect of declining house prices on households. Because of the dual features of houses as consumption goods and important components of asset for households, the extent each household affected by house price fluctuation differs depending on respective life stage they are in. For example, the house prices decline may be beneficial for young generations as it means cheaper residential acquisition costs, while it may be harmful for old generations as they suffer from the loss of part of their assets. Li and Yao (2007) assessed the welfare consequences of house prices change in life cycle settings, incorporating the dual roles of housing in their model. They pointed out that the impacts of house prices decline on individual's consumption and welfare varies significantly depending on the life stage of the households. The non-housing consumption of old and young households are more sensitive to the house prices fluctuations than middle-age households. Attanasio et al. (2012) also investigated the effect of housing prices decline on the behaviors of households in the life consumption and saving framework. They also confirmed the results aligned with Li and Yao (2007): the positive house prices shock leads increased consumption among the old, while it discourages consumptions and housing demands among the young. Those researches indicated the effect of house prices decline on households depends on their housing position and ages.

The main focus of this paper is to investigate the effect of assets meltdown in housing market in Japan by the life cycle consumption and saving framework. In particular, this research reveals how households at different life stages would adjust their behaviors in response to housing prices decline. The rest of the paper is organized as follows: Section 2 introduces the literatures related to the research. Section 3 explains the structures of the model economy. Section 4 presents the calibration procedures of the model. Section 5 shows the effect of negative housing prices decline on households. Section 6 concludes.

2 Literature Review

Two realms of literatures are particularly relevant to the research. The first group of literatures covers empirical research exploring the relationship between demographies and housing prices. This group of literatures are rooted from Mankiw and Weil (1989) and extended to several directions. The second group of literatures encompasses the research investigating the effect of house prices changes in life cycle saving and consumption models. These literatures provide the theoretical frameworks to investigate the households' behaviors in response to negative housing prices shock.

2.1 Demography and Housing Price

Since the seminal work by Mankiw and Weil (1989), a large body of research have emerged exploring the relationship between demographies and housing prices. Hendershott (1991) countered the result of Mankiw and Weil (1989), arguing that the equation used in their study had poor fit to the data and it should not be applied to make a future prediction. Engelhardt and Poterba (1991) also questioned the methodology of Mankiw and Weil (1989) since the same model estimated by Canadian data leads to a completely different conclusion: demographic demand has negative effect on house prices. Ohtake and Shintani (1996) investigated the relationship between demographies and housing prices in Japan based on the model of Mankiw and Weil (1989) and concluded that demographic compositions affect housing prices through short-run adjustments process as housing supplies are inelastic in short-run, even though demographies do not have effects on housing prices in the long-run where housing supplies are elastic to housing prices fluctuation.

The subsequent researches based on Mankiw and Weil (1989) failed to incorporate long-run adjustments process into their models. Nishimura and Takáts (2012) presented the simple overlapping generations model, in which young agents are assumed to buy houses and they can sell it to supplement their incomes after the retirements, to investigate the relationship between demographies and property prices in the long-run equilibrium, and showed that demographies are the main factors determining the level of money demands and property prices. Takáts (2012) empirically examined this relationship using the data for 21 countries, confirming the statistically significant correlation between demographic changes and property prices. Saita et al. (2014) found that real estate prices are negatively correlated with old age dependency ratio (i.e. the ratio of aged population to young population) by regional panel regressions for the U.S. and Japan.

2.2 Life Cycle and Housing Choices

Housing have the dual features as a consumption good and investment: housing decisions have crucial effects on households' utilities directly thorough being a big consumption goods as well as indirectly through being the most variable assets for them. This characteristic of housing complicates analysis and has to be taken into account in a model. Cocco (2005) is one of the earlier literatures examining the effect of housing position on portfolio allocations of liquid assets between bonds and stocks by incorporating the dual dimensions of housings. Li and Yao (2007) constructed life-cycle model in which households are assumed to derive utilities from non-durable consumptions and housing services, showing that house prices change have different effects on households utilities depending on life-stages. This result indicated that how each household is affected by housing prices change is crucially dependent on their age and home ownership status.

Yang (2009) presented the overlapping generation model, aiming to replicate hump-shape consumption profiles for non-durable goods and housing. The research found that borrowing constraint explains housing stock accumulations early stage of life while transaction costs play import roles for generating slow downsizing of housing stocks later in life.

Attanasio et al. (2012) investigated the features of housing demand over life-cycle and aggregate level, confirming the important results from Li and Yao (2007): house prices change have different effects on households among cohorts. There are two novel features of the model. First, they incorporate "housing ladder" behaviors, which means that a household who starts his life as a renter purchases an flat when he is young and moves to a bigger house if it is affordable for him, in the model by discretizing the choices of residences (i.e. houses or a flats). The discretized housing choices prohibits households from continuously adjusting their housing position and, as a result, generates housing ladder behaviors. Second, households are required to satisfy the borrowing constraints only when they purchase residences or re-mortgage. This implies households can have outstanding debts which exceed the values of collaterals as far as they service interest payments, when housing prices decline.

3 Model

The main structures of the model economy in this paper is similar to that of Attanasio et al. (2012). While main frameworks of the model is close to Attanasio et al. (2012), there are two novel features that distinguish the model used here from theirs. First, the model incorporates the stickiness of housing rents in Japan. Shimizu et al. (2010) showed that housing rents exhibit very strong stickiness than that of the United States. They also pointed out the occurrence of rent adjustments does not depend on the deviation of housing rents from its optimal level. Their findings indicates that there is no one-to-one relationship between housing price and housing rents in the current period. The model incorporates the stickiness of housing rents in Japan by assuming the housing rent in period t is the function of housing prices in period t and housing rents in the past periods $(t-1, ..., 1)$.

Second, the model discretizes the housing choices by types of housings: apartments and houses. In Attanasio et al. (2012), they discretized housing choices by the sizes of houses. This modification reflects the households' strong preferences for houses in Japan. MLIT (2017b) revealed that 53% of the households living in Tokyo metropolitan area prefer houses to apartments, while 16.7% of the households prefer apartments to houses. In order to incorporate their strong preference to houses, the model discretizes the housing choices by the types of housing rather than the sizes of houses.

The details of the model follows Attanasio et al. (2012), except for the two modifications of the model explained.

3.1 Household's Utility Maximization Problem

A household lives for T periods and maximizes lifetime utility by optimizing non-durable consumption c_t and housing services h_t. The utility from housing services depends on the type housing he lives in. A household can access to housing services either by renting or owning the residence, and he can choose an apartment or a house if he decided to own the residence. The choice of housing at time t can be represented as $h_t = \{0,\ 1,\ 2\}$ in which zero indicates renting, one indicates owning an apartment, and two indicates owing a house. A household can also buy an asset that pays an interest rate

r_{t+1} between period t and t + 1, and earns labor income w_t each period before retirement. After retirement, a household receives a fraction of earning he made at the last period before retirement as a pension. The household utility maximization problem can be expressed as follows:

$$\max_{c_t,h_t} \frac{c_t^{1-\gamma}}{1-\gamma}\exp(\theta\phi(h_t)) + \mu\phi(h_t) \begin{cases} \phi = 0 & \text{if } h_t = 0 \\ 0 \leq \phi \leq 1 & \text{if } \ h_t = 1 \\ \phi = 1 & \quad \text{if } \ h_t = 2 \end{cases} \tag{1}$$

subject to

$$A_{t+1} = (1+r_t) \begin{cases} A_t + w_t - c_t - \kappa p_t(1+F)I(h_t = 1) & \\ \quad -p_t(1+F)I(h_t = 2) - q_t I(h_t = 2) & \text{if } \ h_{t-1} = 0 \\ A_t + w_t - c_t + \kappa p_t(1-F)I(h_t \neq 1) & \\ \quad -p_t(1+F)I(h_t = 2) - q_t I(h_t = 0) & \text{if } \ h_{t-1} = 1 \\ A_t + w_t - c_t - \kappa p_t(1+F)I(h_t = 1) & \\ \quad +p_t(1-F)I(h_t \neq 2) - q_t I(h_t = 0) & \text{if } \ h_{t-1} = 2 \end{cases} \tag{2}$$

where $I(\cdot)$ is the indicator function which is equal to one when condition in the parenthesis holds and zero otherwise: A_t is asset stocks at the beginning of period t: p_t is the prices of a house: F is the proportional fixed costs incurred when buying and selling a house or an apartment: q_t is the housing rental costs which is set to be a function of current housing prices and housing rents in the past.

In the model, the prices of an apartment are assumed to be a fraction of a house which is expressed by κ. The wage and the house prices follow the stochastic processes while the interest rate is assumed to be a constant across time.

3.2 Housing Prices and Housing Rents

Because of the absence of proper financial products, households cannot insure themselves against the housing prices fluctuations. In this model, housing prices shocks are aggregate and common to all households. The housing prices process is modeled in the same way as Attanasio et al. (2012): house prices evolve as AR(1) process with deterministic trend components.

$$\ln p_t = d_0 + d_1 t + \rho_h \ln p_{t-1} + \varepsilon_t, \quad \varepsilon_t \sim N(-\frac{\sigma_\varepsilon^2}{2}, \sigma_\varepsilon^2) \tag{3}$$

The prices of an apartment is a proportional to a house prices. This proportion, κ, is set constant across the time and the same for all households regardless of their age.

Housing rents are modeled as a function of housing prices in the same period and housing rents in the past, nevertheless Attanasio et al. (2012) assumed one-to-one relationship between the housing rents and current housing prices. They set the housing rents as the fraction of housing price in the same period, abstracting the housing rents stickiness. As Shimizu et al. (2010) pointed out that Japanese housing rents exhibit particularly strong stickiness compared to other countries, ignoring the rents stickiness may result in serious flaws of the model. In order to incorporate the rents stickiness in the model, housing rents are influenced from housing prices in the same period and also housing rents in the pase.

$$q_t = \pi_r q_{t-1} + (1 - \pi_r)\alpha_r p_t \tag{4}$$

where π_r is the probability of no rent adjustments: α_r represents the proportion of housing rents to house prices. This formulation of housing rents reflects the fact that rents adjustments are time-dependent rather than state-dependent in Japan as shown in Shimizu et al. (2010).

3.3 Income Process

Following Attanasio et al. (2012), income shocks are assumed to be idiosyncratic shocks and uncorrelated with housing prices shocks in the model. Income process is modeled as follows:

$$\ln w_t = a_t + v_t \quad \text{where} \quad v_t = v_{t-1} + \xi_t, \quad \xi_t \sim N(-\frac{\sigma_\xi^2}{2}, \sigma_\xi^2), \quad \rho_\xi = 1 \tag{5}$$

where a_t represents the deterministic components of income process which is assumed to have an hump shape ($a_t = a_1 t + a_2 t^2$): v_t represents the permanent income shock. After retirement, households receive the fraction of their last annual income as their pensions.

3.4 Financial Markets

Households are subject to various constraints when borrowing money. They are abstracted to several simplified constraints nonetheless there are numerous factors affecting households' borrowing constraints. In this model, only collateralized debts are allowed: households are able to have negative financial assets only if they possess properties. When households do not own either houses or apartments, their total assets have to satisfy the following condition.

$$A_{t+1} \geq 0 \tag{6}$$

Although house owners and apartment owners are allowed to have negative financial assets, they are subject to both implicit and explicit constraints.

Implicit constraint refers to a terminal asset condition: households are not allowed to have negative assets after the terminal period, $A_{T+1} = 0$. This implicit constraint prevents households from borrowing more than they can repay with probability one. Households are also subject to two explicit constraints. The first one is in regard to the down-payment requirement. Households are able to borrow up to the some fractions of the value of houses or apartments. This constraint is expressed as:

$$A_{t+1} \geq -\eta_h \kappa p_t, \quad \kappa = \begin{cases} 0 < \kappa < 1 & \text{if} \quad h_t = 1 \\ 1 & \text{if} \quad h_t = 2 \end{cases} \tag{7}$$

where (1 - η_h) is the down-payment requirement.

The second explicit constraint is relevant to the earnings. The amounts households can borrow are capped by the multiples of households' earnings:

$$A_{t+1} \geq -\eta_w w_t \tag{8}$$

If households hold outstanding debts, they need to service the interest payments on the mortgages in each period. This interest payments in period t is defined as:

$$m_t = r_t A_{t+1} \tag{9}$$

These two explicit constraints are applied only when households buy properties or re-mortgage. In other words, households do not need to satisfy the explicit constraints as long as they service the interest payments on the outstanding debts. If households cannot pay the interests, they have to re-mortgage. Households can remortgage without incurring any cost, however, they need to satisfy the two borrowing constraints discussed above.

4 Model Calibration

There are a number of the parameters involved in the model developed in the last section. These parameters are grouped into two categories: the external parameters and the calibrated parameters. The external parameters refer to the parameters that can be estimated directory from the data or can be obtained from other literatures, on the other hand, the calibrated parameters are obtained through calibrations. The parameter values used in the simulations are summarized in the Table. 1.

4.1 External Parameters

4.1.1 House Prices Process

Urban Land Price Index for six major cities from 1956 to 2018 published by Japan Real Estate Institute is used to estimate the Eq.3. Fig.1 shows

Parameter	Value	Source
House price process		
d_1	-0.0002	Japan Real Estate Institute (2018)
ρ_h	0.96	Japan Real Estate Institute (2018)
σ_ε^2	0.0086	Japan Real Estate Institute (2018)
κ	0.9	MLIT (2017a)
Housing rents		
π_r	0.89	Shimizu et al. (2010)
α_r	0.019	MIC (2013)
Income process		
a_1	0.065	MHLW (2017)
a_2	-0.0011	MHLW (2017)
σ_ξ^2	0.049	Lise et al. (2014)
replacement rate	0.64	MHLW (2016)
Financial Markets		
η_h	0.8	Kobayashi (2016)
η_w	5	Kobayashi (2016)
F	0.05	Attanasio et al. (2012)
Interest Rate	0.00167	MOF (2018)
Utility function		
γ	3.8	Okubo (2011)
θ	0.23	Calibration
ϕ	0.90	Calibration
μ	0.15	Calibration

Table 1: The values of parameters in the model

the evolution of land prices in six major cities (Tokyo, Yokohama, Nagoya, Osaka, Kyoto, Kobe) from 1956 to 2018. The land price in six major cities had been upward trend from 1950s to 1980s and it surged at the end of 1980s. Following the burst of the bubble economy in the beginning of 1990s, the land price declined sharply in 1990s. This downward trend in 1990s has been turned around in the beginning of 2000s and has settled down after 2000s.

Fig.2 shows the evolutions of land prices for residential area, the cost of constructing houses, and Consumer Price Index in Tokyo metropolitan are from 1975 to 2016. The land prices exhibit strong upward trend in 1970s and 1980, achieving more than 400% increase at the end of 1980s compared to 1975, while it collapsed after 1990s. On the contrary, the construction costs

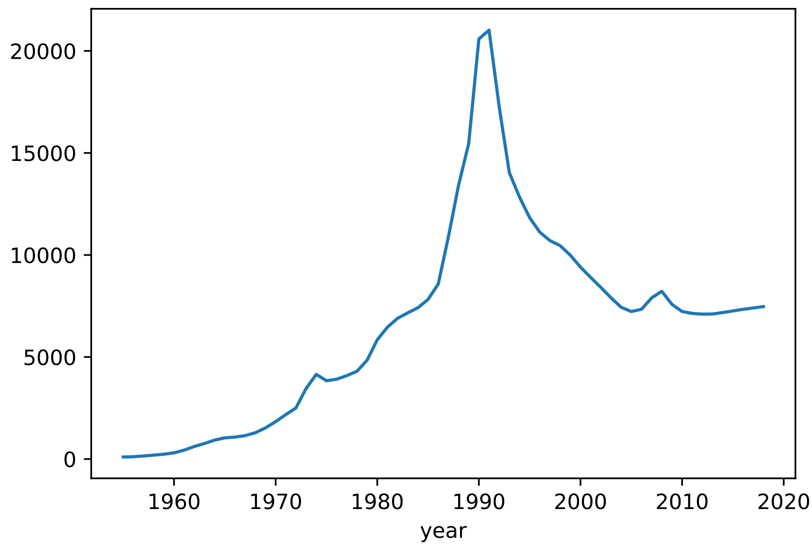

Figure 1: Land Prices in Six Major Cities (1955 = 100)

have shown much less volatility over the time, and it moves closely with Consumer Price Index. It indicates that the fluctuations of the housing prices in Japan stems from the fluctuations of the land prices, justifying the use of land prices as proxies for housing prices in Japan.

The ratio of the apartment prices to the house prices, κ, is calculated as the proportion of the average prices of new apartments to the average price of new houses in Tokyo metropolitan area from 1996 to 2017. The data is obtained from Housing Economy data published by MLIT in 2017.

4.1.2 Housing Rents

The parameters in Eq.4 are obtained either from other literatures or the data. The value of π_r is set to 0.89 following the result from Shimizu et al. (2010), which estimated the probability of no rent adjustment in the area of 23 special wards of Tokyo in 2007. The value of α_r is calculated as the proportion of the housing rents to the house prices in Tokyo in 2013, using the data from Housing and Land Survey published by Ministry of Internal Affairs and Communication of Japan (hereafter MIC).

4.1.3 Income Process

The deterministic components of income process in Eq.5 are estimated directly from the data in Basic Survey on Wage Structure in 2017 by Min-

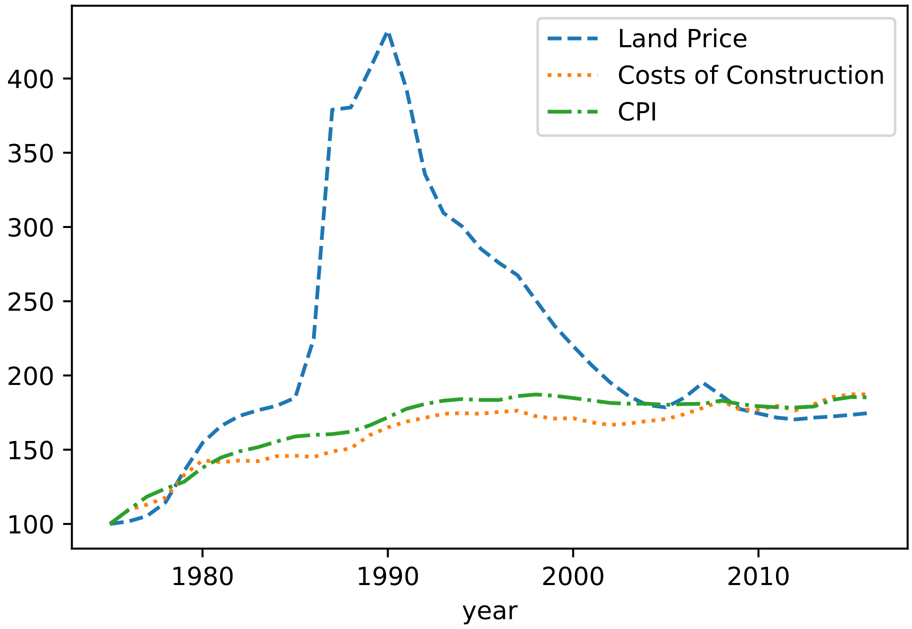

Figure 2: Land Prices and Costs of Construction (1975 = 100)

Note:Data is obtained from "Housing economy data" publish by MLIT. `http://www.mlit.go.jp/statistics/details/t-jutaku-2_tk_000002.html`

istry of Health, Labour and Welfare of Japan (MHLW). The variance of permanent income shocks follows the result from Lise et al. (2014). The replacement rate in the model is calculated as the proportion of annual pension payments that the standard household receives to the average labour incomes of 65 years old male in Tokyo. The data is from Survey on the Insured of National Pension by MHLW.

4.1.4 Financial Markets

The parameter values of η_h in Eq.7 and η_w in Eq.8 are obtained from Kobayashi (2016). The interest rate in the model is the average interest rates of newly issued Japanese government bonds from 1990 to 2018. The fixed cost incurred when buying and selling a house or apartment, F, is set to the same value used in Attanasio et al. (2012).

4.1.5 The Parameters in the Utility Function

Most of the parameters in the utility function are obtained through calibrations except the preference parameter γ in Eq.1. The parameter value of γ is set to match the consumption elasticity of intertemporal substitution in Japan. Following the estimate of Okubo (2011), which estimated the intertemporal substitution in Japan, the curvature parameter γ is set to 3.82 for the within-period utility function.

4.2 Calibrated Parameters

The parameter values for θ, ϕ, and μ in the Eq.1 are pinned down through calibrations. The values of parameters are chosen such that the model reproduces the similar features of life cycle home ownership profiles for 20 to 65 years old in Tokyo area in 2013. The calibration proceeds in such a way that it minimizes the squared deviation between the moments calculated in the data and the moments generated by the model. The moments used in the calibration are the average home ownership rate for 20 $\sim$ 40 years old, the average home ownership rate for 40 sim 65 years old, and house ownership rate from 20 $\sim$ 65 years old. As θ and μ are more relevant to the home ownership rates rather than the house ownership rates, these two parameters are calibrated such that the average home ownership rates for 20 $\sim$ 40 and 40 $\sim$ 65 generated from the model match the corresponding moments in the data. Since the value of ϕ determines the relative utility of apartments to that of houses, it is calibrated to match the average house ownership rates for 20 $\sim$ 65 calculated in the model to the average house ownership rate in the data. Table.4.2 shows the result of the calibration.

Because the model abstracts bequest motives, it is always optimal for households to sell all of their assets and allocate them to consumptions before the terminal period. This limitation of the model results in the lower home ownership rates in the model than in the data after 50s. However, in spite of these limitations, the model tracks the life cycle movement of home ownership rates and house ownership rates in the data generally well.

4.3 The Effect of Rents Stickiness on Home Ownerships

To investigate the effect of housing rents on households' behaviors, the percentage deviations of home ownership rates for the high rents stickiness case and the no rents stickiness case from the baseline case are investigated. In the high stickiness case, the rents stickiness parameter, π_r, is set to 0.95, while it is set to 0 in the no stickiness case. Table 3 shows the outcomes.

The results show that the high rent stickiness promotes home ownerships nevertheless the low rent stickiness has negative effects on home ownership rates. The size of the effect is the largest around 40s and weakened afterwards. This result coincides with the intuition. Since the housing prices are on a downward trends in the model, rents become more expensive

	Model	Data
Home Ownership Rate		
20 ∼ 39 years old	15.6%	16.5%
40 ∼ 64 years old	50.6%	57.3%
65 ∼ 80 years old	40.2%	68.0%
House Ownership Rate		
20 ∼ 39 years old	5.38%	5.70%
40 ∼ 64 years old	30.4%	28.3%
65 ∼ 80 years old	33.8%	43.7%
Apartment Ownership Rate		
20 ∼ 39 years old	10.3%	10.7%
40 ∼ 64 years old	20.2%	27.6%
65 ∼ 80 years old	6.5%	22.0%

Table 2: The result of the calibration

	High Stickiness Case ($\pi_r = 0.95$)	Low Stickiness Case ($\pi_r = 0$)
20 ∼ 34 years old	0.23%	-0.46%
35 ∼ 49 years old	0.37%	-0.49%
50 ∼ 64 years old	0.19%	-0.12%

Table 3: The percentage differences of home ownership from baseline case

relative to housing prices in the high stickiness case, encouraging households to buy residential properties.

5 The Effect of House Prices Decline

The effects of house prices decline on households' behaviors during the life cycle is examined through the simulations. This exercise is performed by calculating the effect of 1% decline of house price in a particular period in their life cycles on the choices of housing and the consumptions. Specifically, the effects of the house prices shocks occurring at the age of 30, 40, and 50 are examined. To compute the effect on housing price shocks, 10 simulation runs are performed for each case; for example, to calculate the effect of housing prices shock occurring at the age of 30, 10 different stochastic housing price processes are generated in which the 1 % negative price shock hits when t = 30. In each run, the optimization problems for ex ante identical 5000 households who face the same housing prices process are solved.

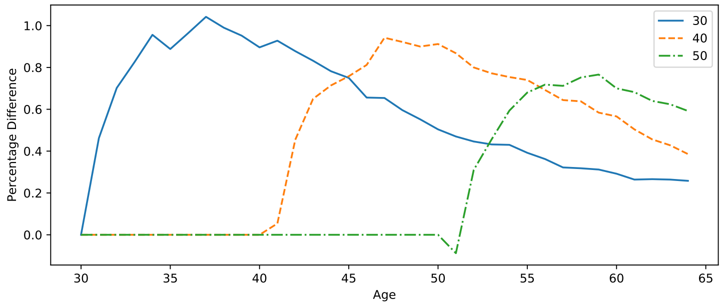

Figure 3: The effect of negative 1% house price shocks on home ownerships

5.1 The Effect on Ownerships

The effect of housing prices decline on home ownership rates is shown in Fig.3. This figure shows the percentage differences of home ownership rates of the simulation results from the benchmark result. While there is a slight fall in home ownership rates for the cohort who are exposed to the housing prices shock when they are 50, the negative housing prices have the positive effect on the home ownership rates overall. The size of the effect on home ownership rates is the largest for the youngest cohort. This results comes from the loosened borrowing constraints by the negative house price shocks. As young households face stricter borrowing constraints due to the lower income profiles and the insufficient financial assets for down payments, the loosened borrowing constraints benefits young households the most. Alternatively, as old households generally have higher income profiles and more financial assets than younger households, their home ownership rates are less sensitive to the negative house prices shocks. The slight fall of home ownership rates of the cohort of age 50 could be attributed to the early liquidations of housing properties. Some households in this cohorts moves their liquidation schedule of housing properties forward, predicting the lower housing prices in the future.

Fig.4 and Fig.5 show the effect of 1% negative house prices shocks on apartment ownership rates and house ownership rates for each cohort. For the house ownership rates, the negative house prices shocks increase the house ownership rates of all cohorts in every period. However, the apartment ownership rates of cohorts of age of 40 and 50 react differently from the cohort of age of 30. Their apartment ownership rates decline for the first few periods and bounce back to the higher levels.

Fig.6 shows the contribution to house demand change triggered by the negative price shock occurring the age of 40 from the households with various home statuses. For example, "From Apartment Owner" in Fig.6 represents the contribution to the demand increase from the households who owns

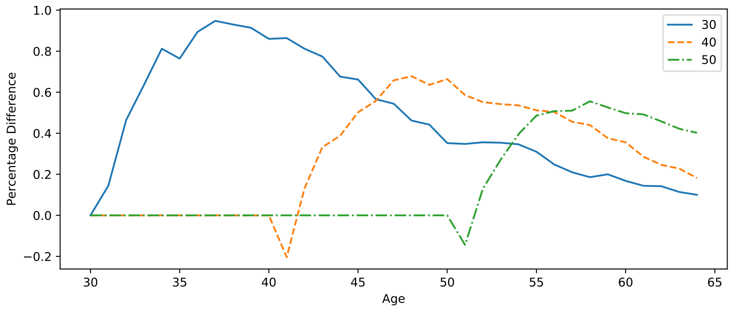

Figure 4: The effect of negative 1% house price shocks on apartment ownership rate

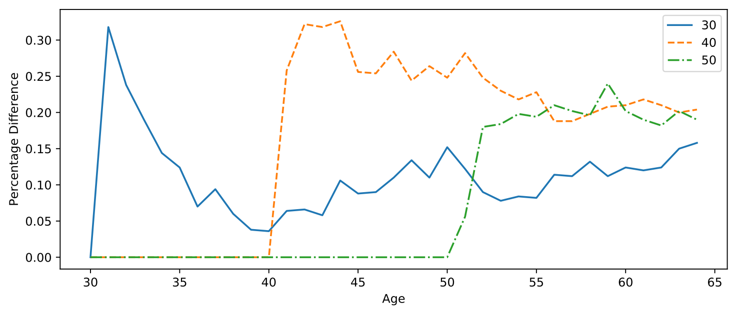

Figure 5: The effect of negative 1% house price shocks on house ownership rate

apartment when the negative house price shock hits. This graph indicates that the apartment owners are the main driver force of the house demand increase after the negative prices shock hits the economy for the first 10 years. After 10 years the negative prices shock hits the economy, the renters become the main contributor to the house demand increase. Similarly, Fig.7 represents the contributions to house demand change triggered by the negative price shock at the age of 40. This graph shows that, after the negative shock hits, the renters increase the demand for apartments while the apartment owners sells the apartments.

These results reveal that the negative house price shock encourages the renters to acquire apartment ownerships in the short run and house ownerships in the long run, while the price shock stimulates house ownerships among the apartment owners. These outcomes implies that the negative house prices shock promotes households to move up ”housing ladder” earlier than they would have without the price shock.

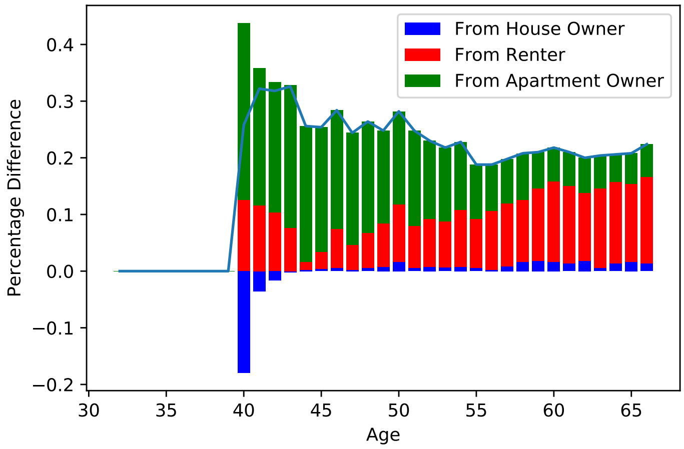

Figure 6: The contributions to the house demand change after the price shock

5.2 The Effect on Consumptions

The effect of negative prices shock on consumptions for each cohort is shown in Figure.8. The graph shows that the negative prices shock stimulates the consumptions for each cohort in general except the first few period for the cohort of age of 50. The size of the impact on consumptions is larger for the younger cohort, indicating that house prices decline benefits the younger generations more. This is caused by reduced down payment requirements for renters and apartment owners. Because of the "housing ladder" behavior of the households, the reduced housing prices benefits the younger generations who are at the bottom of the housing ladders. On the contrary, for the households who already own houses, the negative housing price shock erodes their property values and results in reduced consumption.

Fig.9 shows the contribution to the consumption change trigger by the negative house price shock for the cohort at the age of 50. The notation of this graph is the same as Fig.6 and Fig.7. The graph gives supports to the argument in the previous paragraph; because of the "housing ladder" behavior of households, the negative prices shock leads to smaller expenses on residential properties for renters and apartment owners in the future who plan to move up the housing ladder, while house owners lose their property values by the negative prices shock and reduce their consumption. [1]

[1]The negative house price shock also erodes the values of apartments too. However, for apartment owners who plan to buy houses in the future, the loss of the value of apartments can be complemented by the lower house prices in the future.

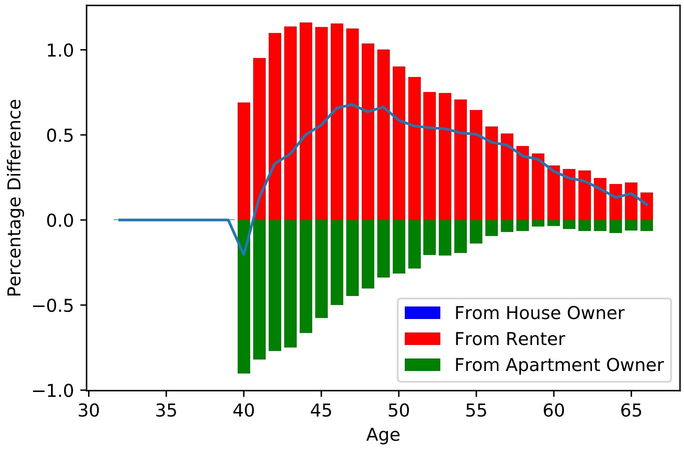

Figure 7: The contributions to the apartment demand change after the price shock

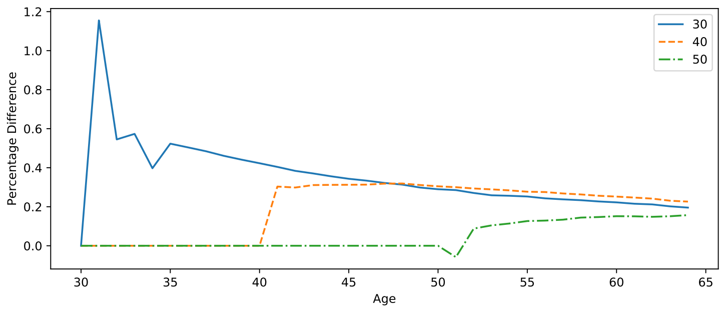

Figure 8: The effect of negative 1 % house price shock on consumption

6 Conclusion

In this paper, the effect of housing prices decline on households' behaviors in the presence of housing rents stickiness is investigated. Three important implications could be drawn from the research. First, the negative housing prices shock stimulates home ownerships, particularly for young households. The loosened borrowing constraints due to the housing prices decline benefits young households who have the lower income profiles and insufficient accumulation of financial assets compared to the older cohorts. The declined housing prices also prompt some households of the old generations to move the liquidation schedule of housing properties forward. These results indicate that hosing prices decline encourage households move up the "housing ladder" earlier than they would have planned.

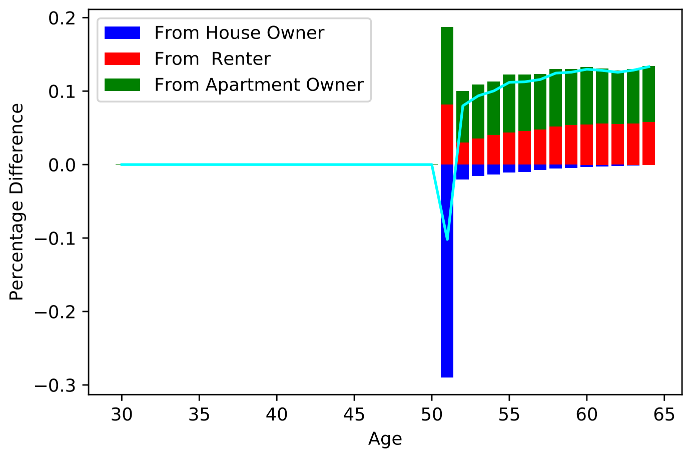

Figure 9: The contributions to the consumption change after the price shock

Second, the housing prices decline increases the consumptions for renters and apartment owners, while it discourages the consumptions for house owners. For renters and apartment owners, the negative housing prices shock reduces the expenses on housing properties later in their lives. It leads consumption boom among them. On the contrary, the housing prices decline erodes the values of houses and forces house owners to reduce their consumptions. The negative housing prices shock also reduces the values of the properties for apartment owners, however, the loss of the value of apartments could be complemented by lower house prices in the future. It enables them to allocate more money to the consumptions.

Third, the overall effects of the housing prices decline on households' home ownerships and consumptions are positive. This outcome could be attributed to the lower house ownership rate. The average house ownership rate from 40 $\sim$ 64 years olds are around 30% and never exceeds 50% in their lifetimes in Tokyo. It indicates that the majority of households spend their lives in either apartments or rented houses. Thus, the negative housing prices shocks benefits the majority of households and resulting in the overall positive effects on home ownerships and consumptions.

These results might provide the optimistic views for housing prices decline triggered by aging population. The results of the model suggests that we could take advantage of housing prices decline due to aging population to improve households' welfares in Japan.

For future works, the model could be extended to incorporate the supply side of housing markets so that it could analyze the endogenous price adjustment mechanisms.

References

Attanasio, O. P., Bottazzi, R., Low, H. W., Nesheim, L., and Wakefield, M. (2012). Modelling the demand for housing over the life cycle. *Review of Economic Dynamics*, 15:1–18.

Cocco, J. F. (2005). Portfolio Choice in the Presence of Housing. *The Review of Financial Studies*, 18(2).

Engelhardt, G. V. and Poterba, J. M. (1991). House prices and demographic change Canadian evidence. *Regional Science and Urban Economics*, 21:539–546.

Hendershott, P. H. (1991). Are real house prices likely to decline by 47 percent? *Regional Science and Urban Economics*, 21:553–563.

Japan Real Estate Institute (2018). Urban Land Price Index.

Kobayashi, M. (2016). The Housing Market and Housing Policies in Japan. *ADBI Working Paper Series*, 558.

Li, W. and Yao, R. (2007). The Life-Cycle effects of House Price Changes. *Journal of Money, Credit and Banking*, 39(6).

Lise, J., Sudo, N., Suzuki, M., Yamada, K., and Yamada, T. (2014). Wage, income and consumption inequality in Japan, 1981-2008: From boom to lost decades. *Review of Economic Dynamics*, 17:582–612.

Mankiw, N. G. and Weil, D. N. (1989). THE BABY BOOM, THE BABY BUST, AND THE HOUSING MARKET. *Regional Science and Urban Economics*, 19:235–258.

MHLW (2016). Survey on the Insured of National Pension. `https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/nenkin/nenkin/toukei/index.html`.

MHLW (2017). Basic survey on wage structure. `https://www.mhlw.go.jp/toukei/itiran/roudou/chingin/kouzou/z2017/index.html`.

MIC (2013). Housing and land survey. `https://www.stat.go.jp/english/data/jyutaku/index.html`.

MLIT (2017a). Housing economy data. `http://www.mlit.go.jp/statistics/details/t-jutaku-2_tk_000002.html`.

MLIT (2017b). Public Awareness Survey on Land Issues. `http://www.mlit.go.jp/common/001242752.pdf`.

MOF (2018). Historical Data for Interest Rate. https://www.mof.go.jp/english/jgbs/reference/interest_rate/index.htm.

Nishimura, K. G. and Takáts, E. (2012). Aging, property prices and money demand. *BIS Working Papers*, 385.

Ohtake, F. and Shintani, M. (1996). The effect of demographics on the Japanese housing market. *Regional Science and Urban Economics*, 26:189–201.

Okubo, M. (2011). The Intertemporal Elasticity of Substitution : An Analysis Based on Japanese Data. *Economica*, 78:367–390.

Saita, Y., Shimizu, C., and Watanabe, T. (2014). Aging and Real Estate Prices: Evidence from Japanese and US Regional Data. *TCER Working Paper Series*.

Shimizu, C., Nishimura, K. G., and Watanabe, T. (2010). Residential rents and price rigidity: Micro structure and macro consequences. *Journal of The Japanese and International Economies*, 24:282–299.

Takáts, E. (2012). Aging and house prices. *Journal of Housing Economics*, 21:131–141.

Yang, F. (2009). Consumption over the life cycle: How different is housing? *Review of Economic Dynamics*, 12:423–443.