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Real Estate Market and Consumption: Macro and Micro Evidence of Japan

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1. Introduction

The real estate market in Japan has been turbulent over three decades. Figure 1 shows the urban land price index of residential land of six major cities and other than six major cities. The residential land price of six major cities soared from 1986 September to 1990 September of the bubble period at 22.5 percent per annum. After the land price peaked in 1990 September, the bubble burst. The land price plummeted from 1990 September to 1993 September at 15.9 percent per annum. The land price kept on falling for 15 consecutive years. Although fall of the land price came to an end in 2005 March, the subsequent growth rate of land price is only 0.3% per annum. The residential land price other than six major cities exhibits a similar trend, but its fluctuations are far milder.

It has been argued that excessive fluctuations of land price affected the performance of the Japanese economy to a large extent. In fact the annual real GDP growth rate from 1986 to 1990 was 5.5 percent annum, but it fell sharply to only 1.0 percent from 1990 to 2018. The purpose of this study is to investigate the extent to which a shock in the real estate market affected consumption spending. The first panel of Figure 2 shows the market value of land assets held by Japanese households from 1994 to 2007 and the second panel shows the revaluation account (capital gains or losses) of land assets. The Japanese households incurred large capital losses in the late 1990s to the early 2000s. The simple correlation coefficient between the rate of change in residential land price and revaluation account is 0.8472. Therefore it is quite likely that an adverse shock in real estate market had large negative effects on consumption.

This study contributes to the literature twofold. One is to pin down the channel through which a shock in the real estate market is propagated to consumption spending. There are two competing channels through which a shock in the real estate market or change in land price affects consumption.[1] One channel is well known as *wealth effect channel*. The life cycle permanent income hypothesis of consumption (LCY-PIH) states that the total wealth, which consists of financial wealth, tangible wealth and human wealth, is an important determinant of consumption. A shock in land price affects consumption by changing tangible wealth. The other channel is called *collateral channel*. It is well known that the balance sheet conditions of debtors affect the cost of raising external funds under capital market imperfections. When there exists asymmetric information between debtors and creditors, it will drive a wedge between the cost of external finance and

[1] There is a third explanation for positive correlation between house prices and consumption, which is called common factor hypothesis. King (1990) and Pagano (1990) argue that an upward revision to expected future incomes simultaneously increased the demand for housing services and consumption in the U.K.. This common factor hypothesis is not tested in this study. See Attanasio et al. (2009) for more details of this hypothesis.

internal finance, called *external finance premium*. External finance premium reflects the creditor's cost of collecting the debtor's information and monitoring the debtor's behavior and the cost arising from lemon problem or moral hazard problem. The premium for external funds influences the cost of external funds and thereby affects economic activities of the debtor. Furthermore, the external finance premium is inversely associated with the borrower's collateralizable net worth. Therefore an adverse shock in land price has negative effects on the consumer's net worth, which raises the external finance premium and reduces borrowings as well as consumption.[2] Using quarterly time series data, we estimate VAR model to examine which channel is more important in propagating a shock in land price to consumption.

The other contribution is to quantify the effects of a shock in land price on consumption with precision. Use of time series data prevents us from measuring precisely the extent to which a shock in land price affects consumption due to multicollinearity. Therefore we use panel data of households to quantify the effects of a shock in land price market on consumption by estimating consumption function.

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[2] Some studies argue that collateral channel plays an important role in explaining the long stagnancy of investment by Japanese firms in the 1990s. The borrowing of Japanese firms increased enormously in the late 1980s secured by land. Land used to be perfect for collateral in Japan under the expectation that the land price would never fall. In other words land was a useful device to reduce the external finance premium. In fact, based upon the aggregated time-series data, Ogawa et al. (1996a) finds that the external finance premium is reduced by appreciation of land value in the late 1980s for non-manufacturing industries that are composed of a number of small firms. Contrary to the expectations, land price fell sharply in the1990s, which eroded the firm's collateralizable net worth with the loan outstanding almost intact, which raised the external finance premium considerably and thereby decreased investment. Ogawa and Suzuki (1998) finds a nonlinearity in this effect with the panel data of Japanese listed companies in the machinery sector from 1970 to 1993. Gan (2007) finds evidence that the firms with larger land holdings before the burst of the land-price bubble in Japan faced a more severe credit constraint in the subsequent period based on the dataset of Japanese listed companies. By employing a unique dataset on firms' land transactions and overall investment in Japan during the period of 1997-2006, Hazama and Uesugi (2015) find that the fixed tangible asset investment is positively associated with the growth rate of land prices, which is the evidence for collateral channel. Using the dataset on Japanese SMEs in the 1980s and 1990s, Ogura (2015) shows that the collateral constraint is binding when the price of a collateralizable asset is declining, whereas it is not when the price is rising.

Let us preview our findings. First, we estimate five-variate VAR model including consumption and residential land price, using the quarterly data from 1980 to 2018. We find that a positive shock in the land price gives rise to a persistent increase in consumption. However, once consumer borrowings are taken as exogenous in estimating VAR model, the effects of a shock in the land price on consumption was dampened to a large extent. This evidence shows that the channel through which a shock in land price is transmitted to consumption is collateral channel. Second, we re-estimate the VAR model with the same specification by dividing the sample period into two: 1980 to 2002 and 2003 to 2018. The former subsample corresponds to the turbulent period including the bubble and the lost decades, while the latter corresponds to the period when non-performing loans problem is somehow overcome after the financial revitalization program in 2002. For the former period, we still find that collateral channel was at work, but not for the latter period.

To estimate the effect of a shock in land price on consumption with precision, we use the panel data of the Japan Household Panel Survey (KHPS/JHPS) collected by the Panel Data Research Center at Keio University. The sample period covers nine years from 2009 to 2017. Our estimates of the marginal propensity to consume (MPC) out of housing wealth is from 0.0097 to 0.0146, within the range of the estimates of the previous studies. Moreover, we find that the housing wealth has a significantly positive effect on consumption of young households, but the effect of housing wealth on consumption of old households was insignificant in some cases. Our evidence shows that collateral channel is still at work for young households even after the non-performing loan problem is worked out. We failed to detect collateral channel from aggregate time series data due to heterogeneous response of household consumption to housing wealth.

This study is organized as follows. The next section is a literature survey of the past studies that examined the effects of the performance of real estate market on consumption in Japan. Section 3 estimates the effect of residential land price on consumption based on VAR model, using aggregate time series data. Section 4 estimates the consumption function of LCY-PIH type, using panel data of households and measures the effect of house wealth on consumption. Section 5 concludes this study.

2. Literature Survey: Relationship between Real Estate Market and Consumption in Japan

In the past literature researchers have investigated the relationship between the performance of real estate market and consumption by estimating consumption function with housing wealth as one of the explanatory variables. Ogawa et al. (1996b) estimates the LCY-PIH type consumption function with different types of wealth as explanatory

variables. Their concern is what types of wealth are relevant in consumption decision of households. They estimate consumption function, using the pooled data of prefectural cross-sections at three different years (1980, 1985 and 1990). They construct their data set mainly from *Annual Report of Prefectural Accounts* reported by Cabinet Office. Their estimates of MPC out of tangible wealth are not significant and sometimes take negative value.

Hori and Shimizutani (2004) also measure the MPC out of the real asset capital gains for the individual house owner and the condominium owners. They use micro-level data from *the Japanese Panel Survey of Consumption* conducted by the Institute of Household Economy (Kakei-Keizai-Kenkyu-Sho) in 1993 to 1999. Their estimates of the MPC out of the real asset capital gains are about 0.1 and 0.05, respectively, but none are significant.

Ogawa and Wan (2007) estimate the consumption functions of total expenditure with several wealth variables. They use re-sampled micro data from *the National Survey of Family Income and Expenditure* (NSFIE). The NSFIE is conducted every five years and their study is based on the waves from 1989, 1994, and 1999. The virtue of using the data in these three waves is coverage of two entirely different periods: the bubble and the lost decades. Their wealth variables are liquid wealth, total wealth and net wealth. Total wealth is the sum of the savings balance, land equity and home equity at market prices. The MPC out of total wealth and net wealth is statistically significant but their estimates are quite small, 0.0002 to 0.0003.

Muellbauer and Murata (2011) and Aron et al. (2012) estimate consumption function with real land price, using the aggregate SNA data from 1961 to 2008. They find that real land price had significantly negative effects on consumption. They argue that in countries where consumer access to credit is restricted, these restrictions can enhance the negative effect of higher house prices on consumption because saving for a housing deposit needs to be higher.

Naoi (2014) estimates the consumption function derived from reference-dependent preferences, using the KHPS/JHPS of eight years from 2004 to 2011. His evidence supports the theoretical prediction that consumption response to household wealth is larger when optimal consumption levels are lower than reference points. Their estimates of the effects of housing wealth on consumption are significant and ranges from 0.0065 to 0.0079 when consumption levels are below reference points, but are insignificant and much lower when consumption levels are above reference points.

Hori and Niizeki (2017) is the most comprehensive study to estimate the MPC of housing wealth from consumption function. They use cross-sectional data of *the Japanese Family Income and Expenditure Survey* (FIES) over the period of 1983 to 2012. The data

covers about 500,000 households. They made painstaking effort to construct individual housing wealth. For example, they estimate the value of residential land assets owned by individual households by multiplying the land area (square meters) of their home reported in the FIES by the price of residential land at the closest survey location in the *Land Market Value Publication* (Chika-koji) provided by the Ministry of Land, Infrastructure, Transport and Tourism. They find that the MPC out of housing wealth is approximately 0.0059−0.0082 for total consumption. Following the methodology of Campbell and Cocco (2007), they further find that the consumption response of older households to housing wealth is larger than that of younger households, which they argue supports the pure wealth effects hypothesis. Hori and Niizeki (2017) is the only study that compares the validity of pure wealth effect and collateral effect of housing wealth.

To sum up, the effects of housing wealth on consumption have been estimated to be low in the past literature in Japan. Our estimates presented here are consistent with the previous ones. As for the channel through which a shock in land price is propagated to consumption, our evidence differs from Hori and Niizeki (2017) in that collateral channel is at work throughout our sample period.

3. Time Series Evidence: Real Estate Market and Consumption

To the best of the author's knowledge, there are no studies that investigate the relationship between the performance of the real estate market and consumption in Japan, based on VAR model. The virtue of VAR model is that we can identify the channels through which a shock in the real estate market is propagated to a change in consumption. We estimate the VAR model that consists of five variables: total consumption, disposable income, liquid wealth, consumer borrowings and residential land price. Disposable income and liquid wealth are two important determinants of consumption. Residential land price affects consumption in two ways. First, a change in residential land price changes housing wealth of households, which in turn affects consumption (wealth effect). Second, a rise in residential land price mitigates the borrowing constraints of households and increases consumption (collateral effect). Note that in the latter channel consumer borrowings increase at the same time. We test the validity of collateral channel by comparing two VAR models. In one model consumer borrowing is endogenous and in the other consumer borrowing is exogenous. If the effect of land price on consumption is weakened when consumer borrowings are exogenous, then collateral channel is at work. However, if the effect of land price on consumption remains unaltered, then wealth effect channel is at work.

Let us describe the variables we use in estimation. Consumption is real final consumption expenditure of households. Disposable income is real net disposable income of households. Consumption and disposable income are taken from *Annual Report of National Accounts*. Liquid wealth is the sum of cash currency, deposits, trust, securities investment trusts and securities. Consumer borrowings are borrowings from private financial institutions. Liquid wealth and consumer borrowings are taken from *Flow of Funds Accounts* of the Bank of Japan. All the variables are deflated by final consumption expenditure deflator and seasonally adjusted. Residential land price is urban land price index of residential land in six major cities, taken from Japan Real Estate Institute. The original land price series is available only on March and September, so that we interpolate the land price index on June and December. The sample period is from the first quarter of 1980 to the first quarter of 2018.

Table 1 shows the results of ADF unit root test and Phillips-Perron test of five variables in the VAR model. The null hypothesis that the variable contains a unit root is not rejected at the conventional significance level for any variables. Table 1 also shows the results of unit root test of five variables in terms of growth rate. This time the null hypothesis is rejected decisively. Therefore we estimate the VAR model in terms of growth rate of variables.[3] The optimal lag order is chosen using the three model selection criteria for VAR models. The three criteria are the Akaike information criteria (AIC), the Bayesian information criteria (BIC) and the Hannan- Quinn information criteria (HQIC). We finally choose the lag length to be two.

First, we estimate a basic five-variate VAR model for the whole sample. The stability condition of the VAR model is satisfied.[4] The order of five variables is residential land price, consumer borrowings, disposable income, liquid wealth and consumption.[5]

Table 2 shows the variance decomposition of consumption. The fraction of 10-year ahead forecast-error variance of consumption that can be attributed to both disposable income and liquid wealth is about 19 percent each, while the fraction attributed to residential land price is 8.2 percent Table 3 shows the variance decomposition of consumer borrowings. About 40 percent of 10-year ahead forecast-error variance of consumer borrowings is explained by residential land price. These results imply that

[3] We cannot detect any cointegration relations among five variables. Therefore we do not estimate the VEC model.

[4] Note that a VAR model is stable if all moduli of the eigenvalue of the estimated models are strictly less than unity. See Hamilton (1994, pp. 260-261).

[5] The five-variate VAR model is also estimated by reordering the variables as follows: disposable income, consumer borrowings, residential land price, liquid wealth and consumption. The estimated results remain essentially unaltered.

collateral channel is important in propagating a shock in land price to consumption by way of consumer borrowings. Figure 3 depicts the impulse response of consumption to a one standard deviation shock to residential land price together with the associated 95 percent confidence intervals.[6] [7] Consumption is increased by 0.11 percentage-points two years after a positive unexpected shock to residential land price and the positive effect persists for even ten years after the shock. Figure 3 also depicts the impulse response of consumption to a one standard deviation shock to other three variables: disposable income, consumer borrowings and liquid wealth.[8] A rise in consumption is statistically significant after a positive shock of each variable. Consumption increases by 0.42 percentage-points two years after a positive shock to disposable income, 0.22 percentage-points five years after a positive shock to consumer borrowings and 0.36 percentage-points three years after a positive shock to liquid wealth, respectively.

Now we estimate the four-variate VAR model with consumer borrowings exogenous. This exercise can test the validity of collateral channel. If the impulse response of consumption to a one standard deviation shock to residential land price is lower than the case with consumer borrowings endogenous, then collateral channel plays an important channel through which a shock in residential land price is propagated to consumption. However, if the impulse response of consumption to a shock to residential land price remains unaltered, housing wealth effect à la LCY-PIH is at work. Figure 4 depicts the impulse response of consumption to a one standard deviation shock to residential land price when consumer borrowings are exogenous.[9] An increase in consumption is insignificant and much smaller than the case with consumer borrowings endogenous. This evidence shows that collateral channel plays a vital role in propagating a shock in residential land price to consumption.[10]

Our sample period covers nearly four decades and includes a variety of events that affected the real estate market, such as asset bubble, lost decades, global financial crisis and Abenomics. Therefore it is an interesting exercise to examine whether there is a structural break where transmission mechanism of a shock in residential land price to consumption changed. For that purpose we reestimate the five-variate VAR model for two subsamples. The former subsample covers the most turbulent periods including the

[6] Confidence intervals are estimated from 5,000 bootstrap replications of the estimated VAR model.
[7] A one standard deviation shock to residential land price is 1.26 percentage-points.
[8] A one standard deviation shock to disposable income, consumer borrowings and liquid wealth is 1.45 percentage-points, 1.33 percentage-points and 2.49 percentage-points, respectively.
[9] A one standard deviation shock to residential land price is 1.27 percentage-points.
[10] Collateral channel is also supported in other countries. For example, see the evidence of U.S. by Cooper(2013) and of Australia and Canada by Atalay et al. (2014) and Windsor et al. (2015).

bubble period and the lost decades, while the latter subsample corresponds to the recovery phase of the real estate market. We break the whole sample period into two by the year of 2002 when the financial revitalization program took place under Koizumi Administration and the non-performing loan ratio of large financial institutions fell thereafter.

Table 4 shows the variance decomposition of consumption for the former subsample. The fraction of 10-year ahead forecast-error variance of consumption that can be attributed to residential land price is 18.8 percent, much higher than the case of the whole sample period and the fraction attributed to disposable income and liquid wealth is 6.0 percent and 14.5 percent, much lower than the case of the whole sample period. Table 5 shows the variance decomposition of consumer borrowings. More than half (51.6 percent) of 10-year ahead forecast-error variance of consumer borrowings is explained by residential land price. These results confirm that collateral channel is important in propagating a shock in land price to consumption in the former subsample.

Table 6 shows the variance decomposition of consumption for the latter subsample. The fraction of 10-year ahead forecast-error variance of consumption that can be attributed to residential land price is only 7.9 percent, much lower than the case of the former subsample period and the fraction attributed to disposable income is 22.4 percent, much higher than the case of the former subsample period. Table 7 shows the variance decomposition of consumer borrowings for the latter subsample period. The 10-year ahead forecast-error variance of consumer borrowings cannot be explained by residential land price. The contribution of residential land price to the 10-year ahead forecast-error variance of consumer borrowings is only 1.8 percent. Thus we can conclude that residential land price affects consumption by way of wealth effect in the latter subsample.

Our evidence above shows that collateral channel plays an important role in propagating a shock in residential land price to consumption in the former subsample. We can also confirm this evidence by comparing the impulse response of consumption to a shock to residential land price when consumer borrowings are endogenous with the impulse response pattern when consumer borrowings are exogenous.

Figure 5 depicts two impulse response patterns of consumption to a one standard deviation shock to residential land price for the former subsample. One is the case where consumer borrowings are endogenous and the other is the case where consumer borrowings are exogenous.[11] When consumer borrowings are endogenous, consumption is increased by 0.20 percentage-points four years after a positive shock to residential land

[11] A one standard deviation shock to residential land price is 1.55 percentage-points.

price and the positive effect persists for even ten years after the shock. On the other hand, when consumer borrowings are exogenous, an increase in consumption is almost nil.

Figure 6 compares two impulse response patterns of consumption to a one standard deviation shock to residential land price for the latter subsample.[12] The impulse response patterns of two cases are very similar. Response of consumption to a shock in residential land price is not so large. The largest response of consumption, which is 0.24-0.25 percentage-points, comes three years after a positive shock to residential land price and is dampened quick thereafter.

4. Panel Data Evidence: the Real Estate Market and Consumption

We estimate the effects of a change in the real estate market on consumption, using panel data oh households. Use of panel data enables us to obtain precise estimates of the effects of a change in housing wealth on consumption since panel data set is free from multicollinearity. We use the panel data of the KHPS/JHPS. The KHPS has been implemented every year since 2004 on 4,000 households and 7,000 individuals nationwide. An additional survey on a cohort of about 1,400 households and 2,500 individuals started from 2007 to compensate for sample dropout. The JHPS is a new survey targeting 4,000 male and female subjects nationwide in parallel with the KHPS.

The KHPS and JHPS are suitable for estimating the effect of a change in housing wealth on consumption since they record the self-reported market value of land plot and residential building. We use the KHPS/JHPS for the period of 2009 to 2017 since after-tax annual income is available only after 2009. The total number of households who own their house and report the market value of their house and land plot as well as their housing loan outstanding is 8,396.

The consumption function we estimate is a LCY-PIH type with two wealth variables, liquid financial wealth and housing wealth including residential house and land. We also add socio-economic variables to the list of explanatory variables. The consumption function is specified as follows:

$$\left(\frac{C}{Y}\right)_{it} = \alpha_0 + \alpha_1 \left(\frac{1}{Y}\right)_{it} + \alpha_2 \left(\frac{LW}{Y}\right)_{it} + \alpha_3 \left(\frac{HW}{Y}\right)_{it} + \sum_{j=1}^{n} \beta_j Z_{jt} + u_{it} \qquad (1)$$

Explanations of the variables used in estimation are in order. The total consumption expenditure $(C)_{it}$ is the real total consumption expenditure of household *i* in January of

[12] A one standard deviation shock to residential land price is 0.44 percentage-points.

year *t* multiplied by 12 to obtain annual figure and divided by the final consumption expenditure deflator. The after-tax annual income $(Y)_{it}$ is the real after-tax annual income of the household in the previous year *t-1*. The liquid financial wealth $(LW)_{it}$ is the sum of deposits and securities divided by the final consumption expenditure deflator. The housing wealth $(HW)_{it}$ is the sum of the self-reported market value of housing and land plot, which is divided by the final consumption expenditure deflator. The socio-economic variables $(Z)_{it}$ include the following household attributes: household size and the binary working status of no paid work, self-employed, professional, work without any employee relationship and non-regular wage worker. Finally we add year dummies to represent common shocks that hit the sampled households.[13]

We discard the households whose consumption-income ratio, liquidity-wealth-income ratio and housing-stock-income ratio are smaller than the 1th percentile or greater than the 99th percentile. The total number of households used for estimation is 7,481. Table 8 shows the descriptive statistics of the major variables. The self-reported market value of land plot and housing is 15.0 million yen and 10.1 million yen, respectively and the mortgage loan balance is 16.9 million yen. The proportion of households who have negative equity is 31.0%.

We estimate eq. (1) under two different statistical models to see the robustness of the estimation results, especially the coefficient estimates of housing wealth. The statistical specifications we employ are panel regression and panel IV regression. The first panel of Table 9 shows the estimation results for the whole sample.[14] In the third and fourth columns, we estimate the MPCs out of liquid financial wealth separately for the households likely to be liquidity constrained and the unconstrained households.[15] The coefficient estimate of liquid financial wealth is significantly positive for possibly liquidity constrained households, irrespective of model specifications. The coefficient estimate of housing wealth is estimated with high precision. The MPC out of housing wealth is from 0.0097 to 0.0119. Our estimates of the MPC out of housing wealth are consistent with those in the previous studies.

In the previous section we could not detect collateral channel after 2002 by aggregate time series data. Failure to detect collateral channel might be due to heterogeneity in the response of household consumption to land price. To pursue this issue further, we estimate the consumption function separately for younger households

[13] We do not include age variable as explanatory variables since linear combination of year dummies are closely correlated with the age variable.

[14] The coefficient estimates of year dummies are not shown in the table to save space.

[15] The households likely to be liquidity constrained are those with working status of no work, work without any employee relationship and non-regular wage worker.

and older households. When the pure housing wealth channel is at work, older households with shorter remaining life horizons over which to annuitize housing wealth should have a larger MPC out of housing wealth than younger households. The second and third panel of Table 9 shows the estimation results of consumption function for younger households and older households, respectively. Younger household is defined as the household whose head is below 50 years old. The housing wealth exerts a significantly positive effect on consumption of younger households, irrespective of model specification. In contrast the response of consumption of older households to housing wealth is insignificant in all the specifications. This evidence indicates that younger households are likely to face borrowing constraints and housing wealth plays a collateral role in mitigating borrowing constraints. Weak response of consumption to housing wealth for older households might suggest that housing wealth is viewed as a bequest by older household.

5. Concluding Remarks

This study is an empirical attempt to investigate the relationship between the performance of the real estate market and consumption in Japan. The contribution of this study to the literature is twofold. First, we investigate the channel through which a change in residential land price affects consumption. Using the quarterly time series over nearly four decades from 1980 to 2008, we estimate the VAR model including a change in land price and consumption to find the transmission mechanism of a change in land price to consumption. We find that collateral channel plays an important role in propagating a shock in land price to consumption by way of consumer borrowings in the bubble period and the lost decades.

The other contribution is to estimate the effect of housing wealth on consumption with high precision, using the panel data of households. Using the panel data of the KHPS/JHPS from 2009 to 2017, we estimate the consumption function with two wealth variables: liquid wealth and housing wealth. Our estimates of MPC out of housing wealth is 0.0097 to 0.0146, consistent with the estimates obtained in the past studies.

Moreover, we find that the housing wealth had a significantly positive effect on consumption of younger households, but the effect of housing wealth on consumption of older households was insignificant in some specifications. Our evidence shows that collateral channel is still at work for younger households even after the non-performing loan problem was worked out.

Overall evaluation of the effects of the performance of the real estate market on the Japanese economy needs additional investigation into the channel through which a shock in land price is propagated to firms' activities. The past studies show that collateral

channel played a vital role in propagating a shock in land price to corporate investment. Reexamination of collateral channel in the corporate sector after the lost decades would be an interesting avenue of future research.

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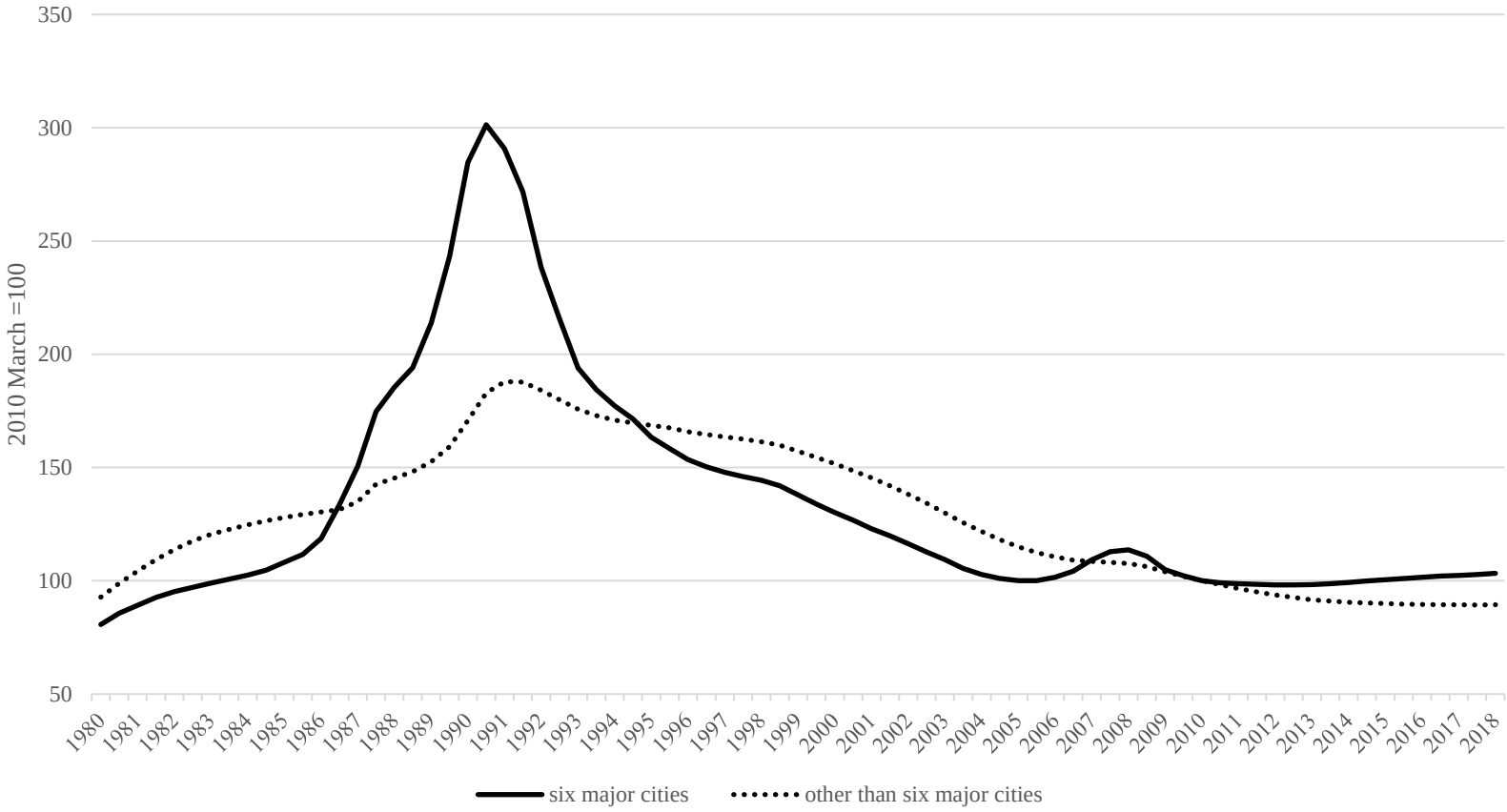
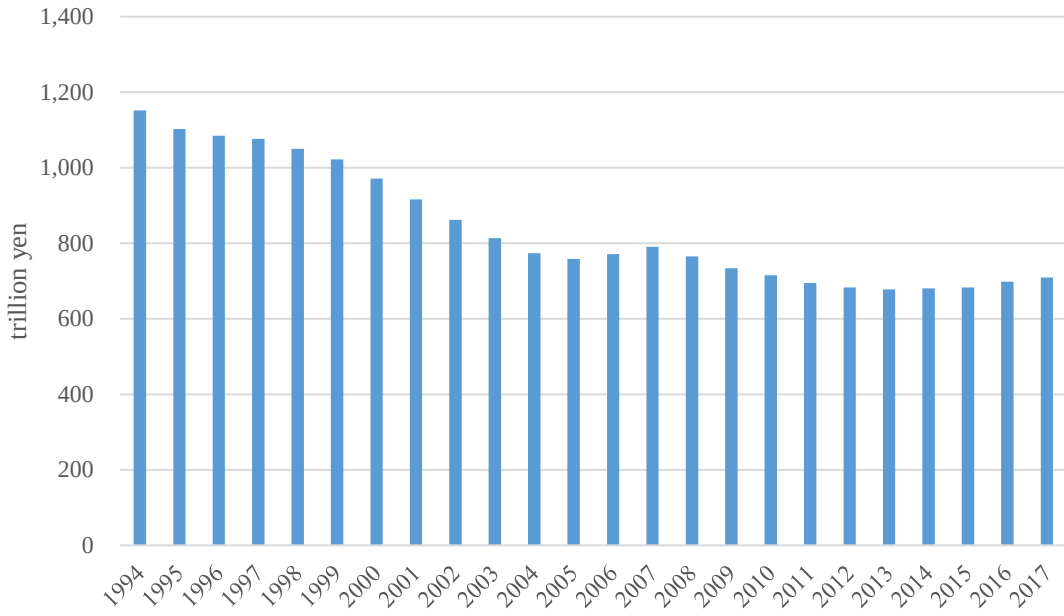
Figure 1 Urban Land Price Index: Residential Land



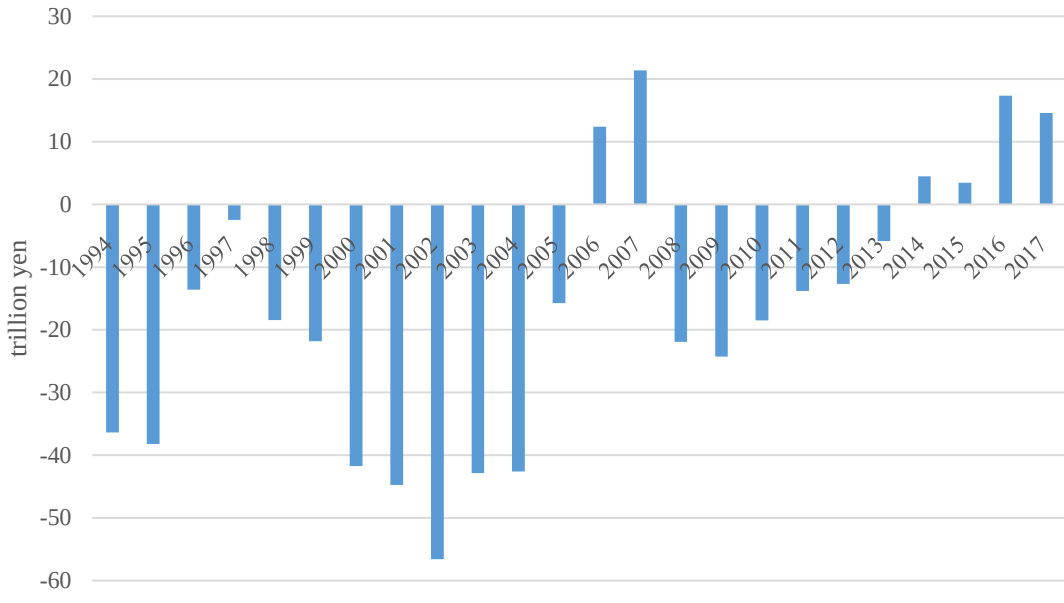
Data source: Japan Real Estate Institute, *Urban Land Price Index*.

Figure 2 Land Wealth of Household Sector

(1) End-of-Period Market Value

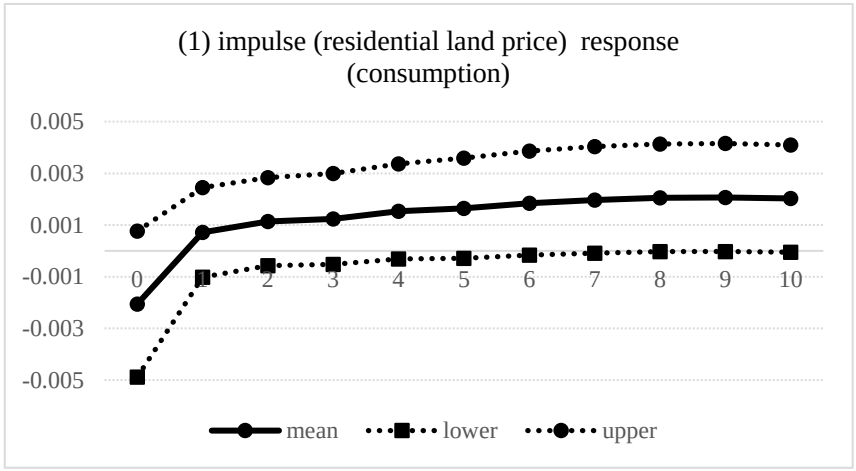


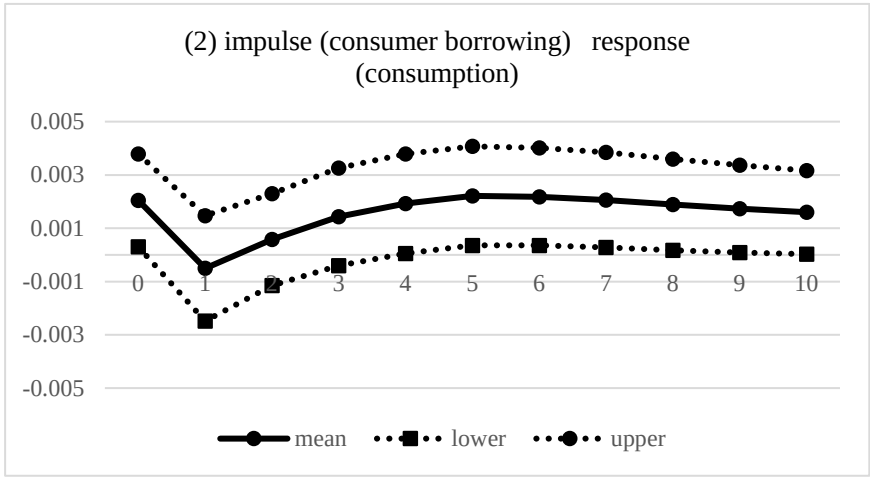
(2) Revaluation Accounts of Land Wealth of Household Sector

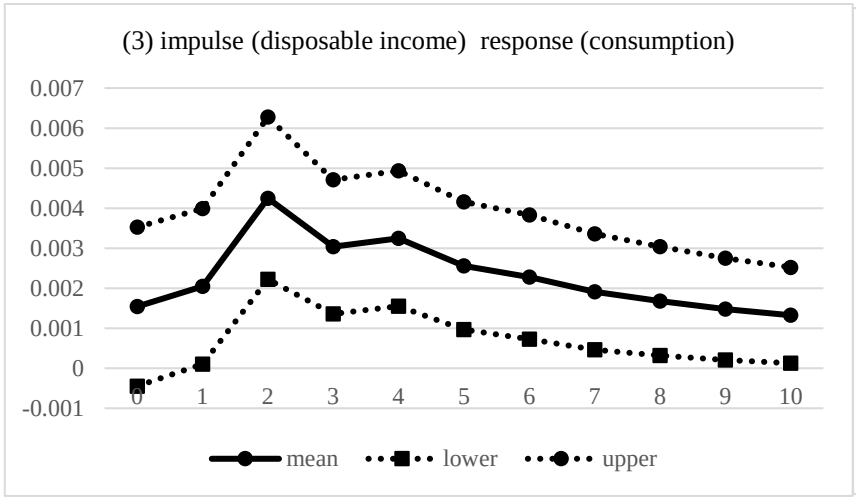


Data source: Economic and Social Research Institute, *Annual Report of National Accounts.*

Figure 3 Impulse Response Functions: 1980:1-2018:1







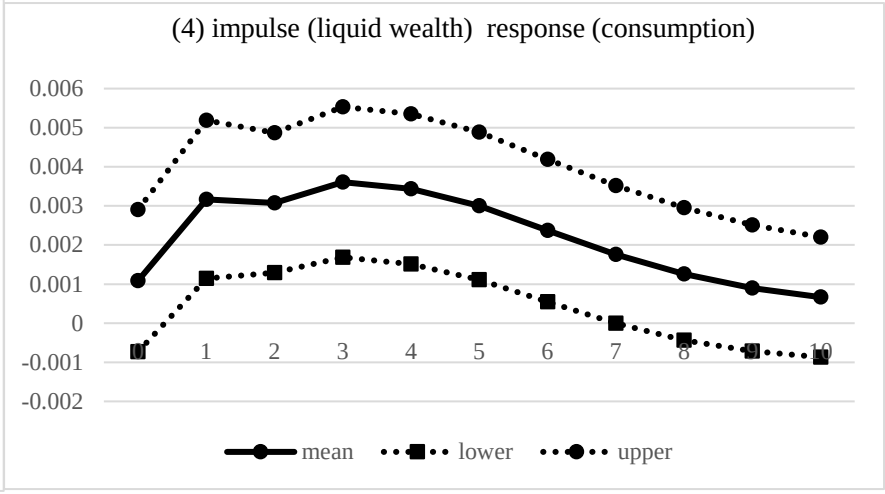
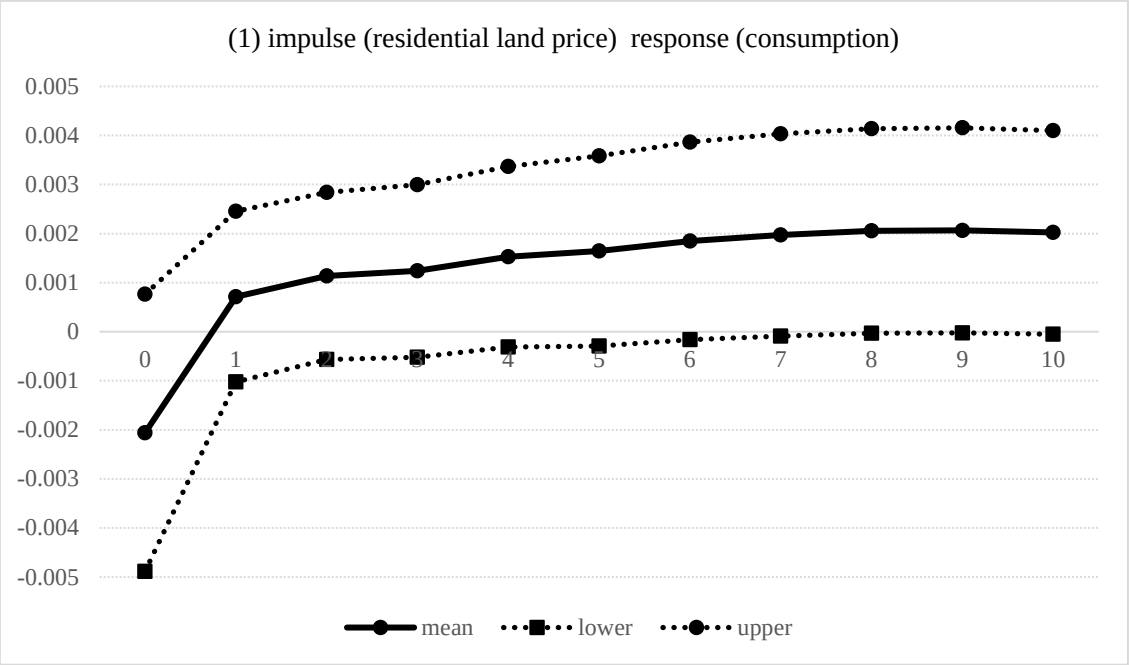


Figure 4 Impulse Response Functions: 1980:1-2018:1

(1) Consumer borrowing is endogenous



(2) Consumer borrowing is exogenous

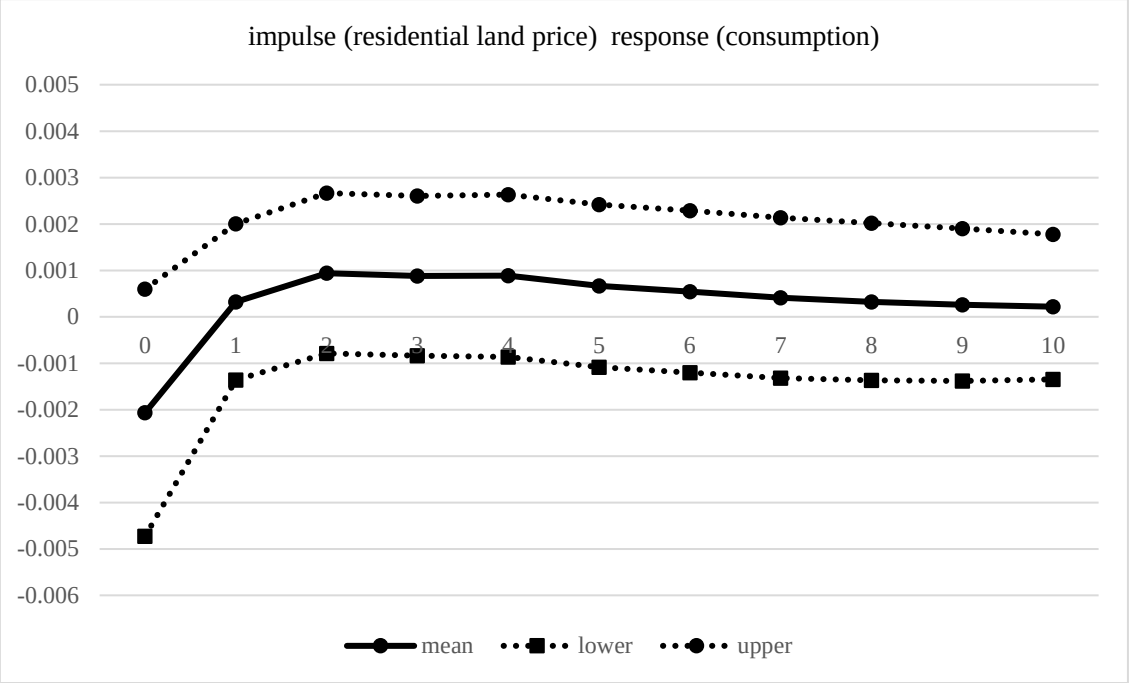
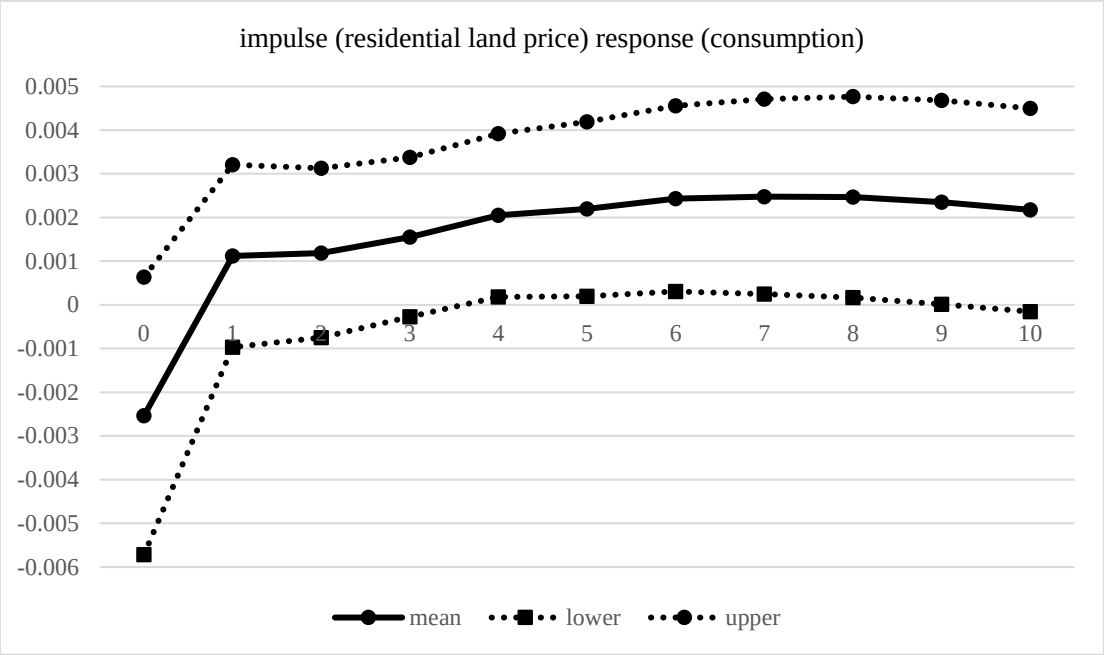


Figure 5 Impulse Response Functions: 1980:1-2012:4

(1) Consumer borrowing is endogenous



(2) Consumer borrowing is exogenous

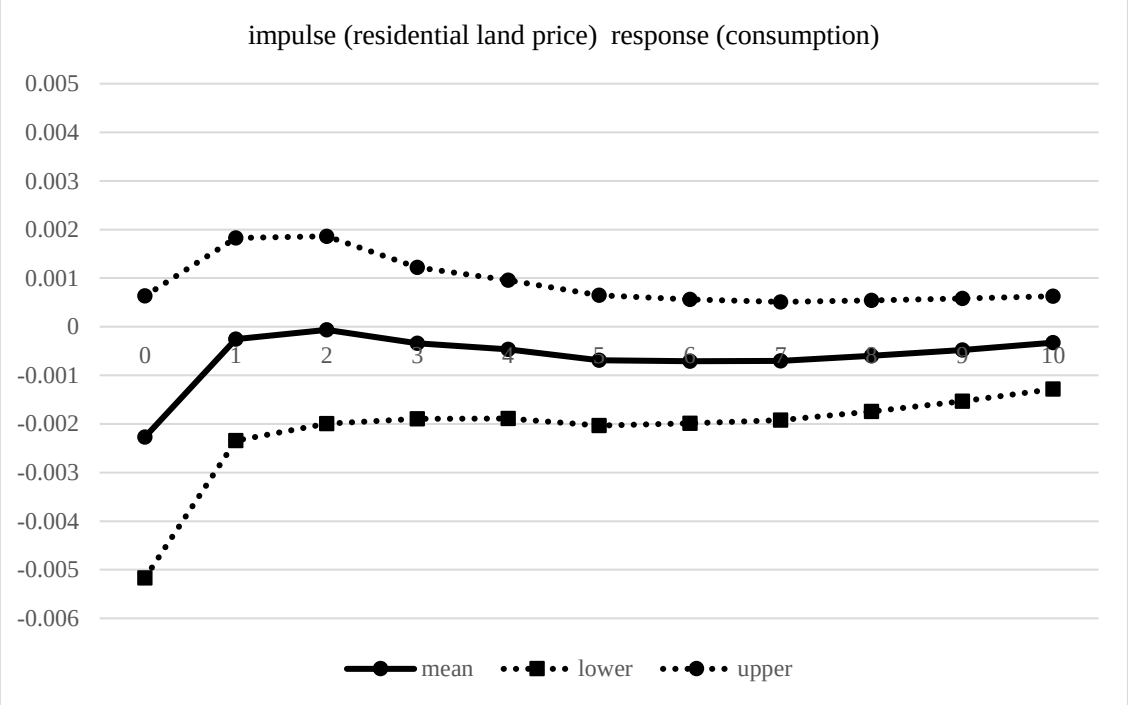
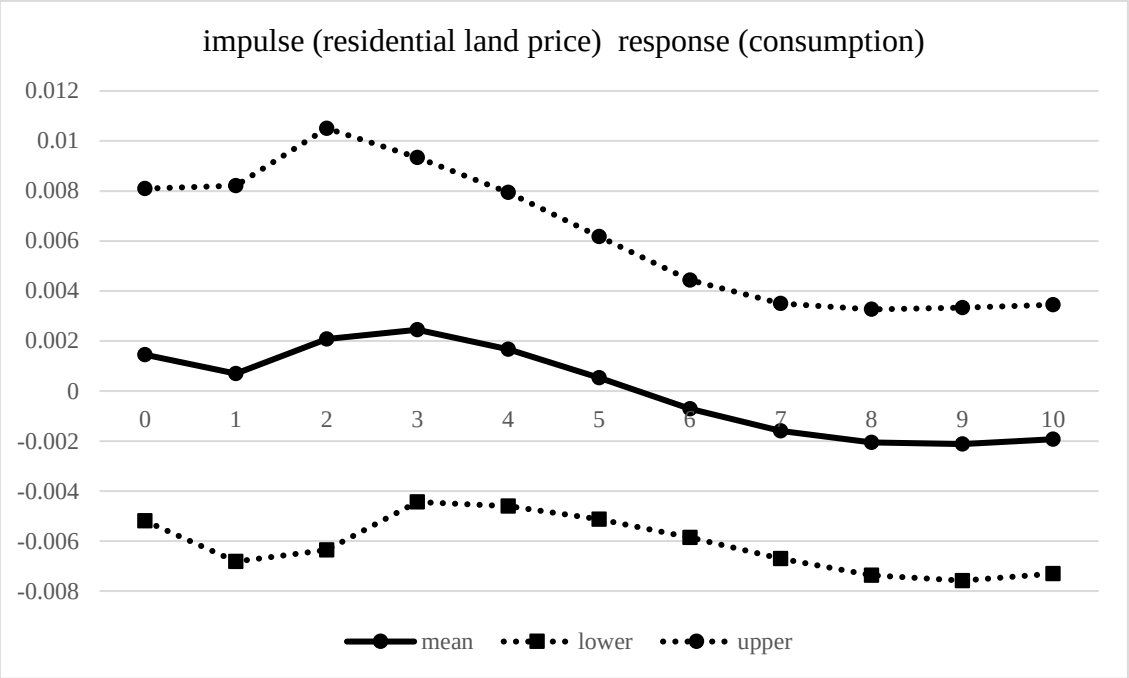


Figure 6 Impulse Response Functions: 2013:1-2018:1

(1) Consumer borrowing is endogenous



(2) Consumer borrowing is exogenous

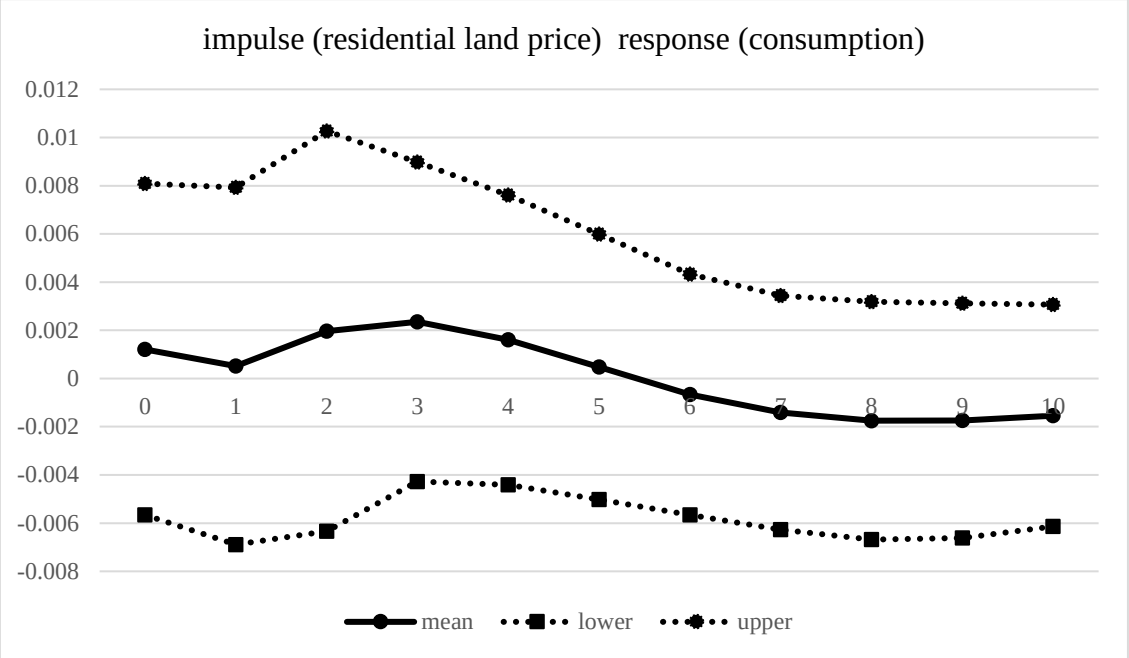


Table 1

Results of ADF Unit Root Test and Phillips-Perron Test

	ADF test	Phillips-Perron Z_t test
level		
residential land price	-3.277*	-1.832
consumer borrowing	-1.796	-1.452
disposable income	-1.593	-1.452
liquid wealth	-3.008	-2.625
consumption	-0.970	-0.885
growth rate		
residential land price	-4.243***	-2.209
consumer borrowing	-3.530**	-3.051
disposable income	-3.779**	-8.590***
liquid wealth	-4.645***	-4.200***
consumption	-4.982***	-6.566***

Notes: Lag order is taken as two. A trend term is included in the regression.

*, **, *** : significant at the 10%, 5%, 1% level, respectively.

Table 2 Variance Decomposition of Consumption: 1980:1 - 2018:1

year	consumption	residential land price	consumer borrowing	disposable income	liquid wealth
1	91.8%	2.9%	2.9%	1.6%	0.8%
2	85.1%	2.6%	2.5%	3.6%	6.2%
3	73.7%	2.8%	2.2%	11.5%	9.7%
4	65.9%	3.2%	2.8%	14.1%	14.0%
5	58.9%	3.7%	3.9%	16.5%	16.9%
6	54.3%	4.3%	5.3%	17.4%	18.7%
7	50.9%	5.2%	6.5%	18.0%	19.3%
8	48.6%	6.1%	7.5%	18.3%	19.4%
9	46.9%	7.2%	8.3%	18.5%	19.2%
10	45.5%	8.2%	8.9%	18.6%	18.8%

Table 3 Variance Decomposition of Consumer Borrowing: 1980:1 - 2018:1

year	consumption	residential land price	consumer borrowing	disposable income	liquid wealth
2	0.0%	1.6%	90.7%	0.9%	6.7%
3	0.0%	6.0%	81.5%	3.2%	9.2%
4	0.2%	12.4%	73.7%	4.6%	9.1%
5	0.2%	19.5%	66.3%	5.9%	8.1%
6	0.2%	25.8%	59.9%	6.8%	7.2%
7	0.2%	30.9%	54.8%	7.6%	6.5%
8	0.2%	34.6%	50.9%	8.2%	6.1%
9	0.2%	37.2%	48.1%	8.7%	5.8%
10	0.3%	38.9%	46.2%	9.1%	5.6%

Table 4 Variance Decomposition of Consumption: 1980:1 - 2002:4

year	consumption	residential land price	consumer borrowing	disposable income	liquid wealth
1	82.0%	2.0%	15.8%	0.1%	0.1%
2	82.2%	2.7%	14.6%	0.1%	0.4%
3	77.3%	3.8%	14.6%	3.3%	1.0%
4	72.2%	5.6%	15.0%	3.6%	3.6%
5	65.8%	8.0%	14.9%	4.8%	6.4%
6	60.3%	10.5%	15.1%	5.1%	9.0%
7	55.5%	13.0%	15.0%	5.5%	11.0%
8	51.6%	15.2%	14.9%	5.7%	12.5%
9	48.4%	17.2%	14.9%	5.9%	13.6%
10	45.8%	18.8%	14.8%	6.0%	14.5%

Table 5 Variance Decomposition of Consumer Borrowing: 1980:1 - 2002:4

year	consumption	residential land price	consumer borrowing	disposable income	liquid wealth
2	0.2%	11.1%	75.5%	0.2%	13.1%
3	1.0%	24.7%	55.4%	2.2%	16.7%
4	0.8%	35.1%	43.4%	2.8%	17.9%
5	0.7%	42.8%	34.8%	3.5%	18.1%
6	0.7%	47.7%	29.3%	4.1%	18.2%
7	0.7%	50.4%	25.8%	4.7%	18.4%
8	0.7%	51.7%	23.7%	5.2%	18.8%
9	0.7%	52.0%	22.5%	5.6%	19.2%
10	0.8%	51.6%	21.9%	6.0%	19.6%

Table 6 Variance Decomposition of Consumption: 2003:1 - 2018:1

year	consumption	residential land price	consumer borrowing	disposable income	liquid wealth
1	93.5%	0.5%	0.4%	5.0%	0.5%
2	74.9%	0.7%	3.6%	13.6%	7.3%
3	61.0%	0.8%	4.3%	22.5%	11.4%
4	57.9%	2.6%	4.2%	23.2%	12.1%
5	58.3%	3.7%	4.0%	22.3%	11.6%
6	58.2%	3.9%	4.0%	22.2%	11.7%
7	57.3%	3.9%	3.9%	22.7%	12.1%
8	56.1%	4.7%	3.9%	23.0%	12.4%
9	55.0%	6.2%	3.8%	22.8%	12.3%
10	54.0%	7.9%	3.7%	22.4%	12.1%

Table 7 Variance Decomposition of Consumer Borrowing: 2003:1 - 2018:1

year	consumption	residential land price	consumer borrowing	disposable income	liquid wealth
2	0.0%	0.4%	94.8%	1.8%	3.0%
3	0.5%	0.3%	92.7%	2.1%	4.3%
4	0.5%	0.3%	92.6%	2.5%	4.1%
5	0.5%	0.3%	91.7%	2.5%	5.0%
6	0.6%	0.4%	89.6%	2.5%	6.9%
7	0.8%	0.5%	88.0%	2.4%	8.3%
8	0.9%	0.7%	87.3%	2.4%	8.7%
9	1.1%	1.1%	86.8%	2.4%	8.6%
10	1.1%	1.8%	85.9%	2.5%	8.7%

Table 8 Descriptive Statistics of Major Variables in Panel Data Set

item	mean	median	standard deviation
age	48.2	47	11.15
household size	3.8	4	1.29
market value of housing (ten thousand yen)	1009.9	900	808.47
market value of plot (ten thousand yen)	1502.4	1000	1431.90
mortgage loan balance (ten thousand yen)	1689.5	1500	1280.85
market value of liquid assets (ten thousand yen)	555.5	300	1085.58
after-tax annual income (ten thousand yen)	602.1	550	308.71
annual consumption expenditure (ten thousand yen)	387.9	330	296.60
proportion of respondents who have spouse (%)	89.7		
proportion of respondents who performed paid work (%)	82.7		
self-employed (%)	7.5		
professional (%)	1.0		
worker at family business (%)	2.4		
working at home, consigned worker or subcontractor (%)	2.2		
wage worker (%)	70.5		
full-time, regular employee (%)	46.6		
non-regular employee (%)	23.3		
proportion of respondents who have negative equity (%)	31.0		
proportion of respondents who have no liquid wealth (%)	19.7		

Data source: The Panel Data Research Center at Keio University, *the Japan Household Panel Survey.*

Table 9 Estimation Results of Consumption Function by Panel Data

	Whole sample				**Younger household**				**Older household**			
	panel regression	panel regression (IV)	panel regression	panel regression (IV)	panel regression	panel regression (IV)	panel regression	panel regression (IV)	panel regression	panel regression (IV)	panel regression	panel regression (IV)
1/income	233.9554***	216.2932***	233.8587***	216.3534***	238.0735***	222.5142***	236.7256***	221.7525***	225.3602***	207.4953***	226.7929***	207.2576***
	(51.61)	(53.26)	(51.65)	(53.27)	(48.58)	(50.08)	(48.23)	(50.23)	(23.55)	(26.38)	(23.66)	(26.38)
liquid wealth/income	0.0319***	0.01784**			0.0119	0.0202			0.0418***	0.0150		
	(4.89)	(2.12)			(1.14)	(1.37)			(4.46)	(1.41)		
liquid wealth/income			0.0096	0.0131			-0.0174	0.0040			0.0240*	0.0068
(unconstrained households)			(1.11)	(1.16)			(-1.28)	(0.23)			(1.89)	(0.47)
liquid wealth/income			0.0510***	0.0281**			0.0452***	0.0531**			0.0548***	0.0312*
(constrained households)			(6.26)	(2.20)			(3.16)	(2.19)			(4.89)	(1.94)
housing wealth/income	0.0117***	0.0100***	0.0119***	0.0097**	0.0143***	0.0111*	0.0146***	0.0100*	0.0070	0.0089	0.0070	0.0083
	(4.06)	(2.59)	(4.13)	(2.50)	(3.83)	(1.93)	(3.92)	(1.89)	(1.44)	(1.50)	(1.45)	(1.40)
household size	0.0302***	0.0370***	0.0309***	0.0376***	0.0151	0.0177***	0.0161	0.0201***	0.0377***	0.0511***	0.0387***	0.0523***
	(3.38)	(7.29)	(3.46)	(7.35)	(1.19)	(2.61)	(1.28)	(3.08)	(2.57)	(6.48)	(2.64)	(6.60)
working status												
no paid work	-0.0153	-0.0328*	-0.0482*	-0.0477*	-0.0255	-0.0073	-0.0615*	-0.0423	0.0186	-0.0632**	-0.0175	-0.0953**
	(-0.56)	(-1.86)	(-1.69)	(-1.94)	(-0.80)	(-0.36)	(-1.84)	(-1.41)	(0.36)	(-2.15)	(-0.32)	(-2.28)
self-employed	0.0188	0.0325	0.0210	0.0341	-0.0157	0.0926**	-0.0152	0.0980***	0.0782	-0.0304	0.0786	-0.0269
	(0.39)	(1.25)	(0.44)	(1.31)	(-0.26)	(2.52)	(-0.25)	(2.75)	(0.92)	(-0.80)	(0.92)	(-0.71)
professional	-0.1264	-0.0890	-0.1216	-0.0891	0.1009	0.0007	0.1081	-0.0008	-0.7091***	-0.1960*	-0.7010***	-0.1981*
	(-1.09)	(-1.32)	(-1.05)	(-1.32)	(0.76)	(0.01)	(0.82)	(-0.01)	(-3.14)	(-1.85)	(-3.11)	(-1.87)
work without any employee relationship	-0.0035	-0.0148	-0.0036	-0.0262	0.0282	0.0527	-0.0139	0.0279	-0.0491	-0.1260*	-0.0788	-0.1502**
	(-0.08)	(-0.39)	(-0.80)	(-0.65)	(0.52)	(1.17)	(-0.25)	(0.57)	(-0.63)	(-1.92)	(-1.00)	(-2.15)
non-regular worker	-0.0099	-0.0342**	-0.0382	-0.0458**	-0.0126	-0.0151	-0.0433	-0.0445*	-0.0095	-0.0667**	-0.0402	-0.0923**
	(-0.41)	(-2.23)	(-1.50)	(-2.21)	(-0.44)	(-0.87)	(-1.44)	(-1.79)	(-0.21)	(-2.46)	(-0.83)	(-2.54)
constant	0.1140***	0.1033***	0.1263***	0.1053***	0.1656***	0.1203***	0.1808***	0.1251***	0.1088	0.1484***	0.1180*	0.1529***
	(2.84)	(3.43)	(3.14)	(3.46)	(2.99)	(3.22)	(3.26)	(3.36)	(1.64)	(2.94)	(1.77)	(3.01)
R-squared	0.3362	0.3857	0.3934	0.3860	0.4062	0.4823	0.4079	0.4813	0.2501	0.2966	0.2520	0.2982
Sargan statistics†		8.684 (0.12)		8.631 (0.12)		7.910 (0.16)		7.918 (0.16)		11.77 (0.04)		11.54 (0.04)
stochastic model	fixed effect	random effect	fixed effect	random effect	fixed effect	random effect	fixed effect	random effect	fixed effect	random effect	fixed effect	random effect

Notes: The number in parenthesis is t-value. The coefficient estimates of year dummies are suppressed. †The number in parenthesis of Sargan statistics is p-value.

The instruments we use for liquid-wealth-income ratio and housing-wealth-income ratio are one year lagged liquid wealth, housing wealth and five dummy variables for firm size of the workplace of the household head.