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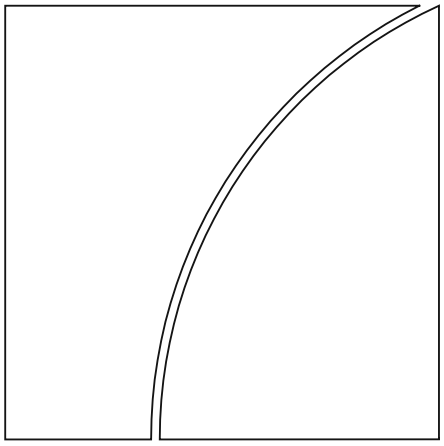

BIS Working Papers

No 736

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Monetary and Economic Department

July 2018

JEL classification: D14, D81, D84, E21, G11

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This publication is available on the BIS website (www.bis.org).

ISSN 1020-0959 (print)
ISSN 1682-7678 (online)

The role of household debt heterogeneity on consumption: Evidence from Japanese household data[†]

Jouchi Nakajima[*]

Abstract

This paper estimates the impact of household debt on consumption behaviour using data from the Japanese Preference Parameters Study. Covering the 2005-13 period, the survey is the first of its kind for Japan. It features responses to forward-looking questions about key risks to income, shedding light on the motives for household savings behaviour. The analysis finds that household marginal propensities to consume (MPCs) were significantly higher for highly-indebted Japanese households than for those with little-to-no debt – a type of variation that is consistent with findings for other countries. The evidence points to a significant precautionary saving motive by Japanese households, with savers particularly concerned about (unlikely) future unemployment spells and longevity risks.

JEL classification: D14, D81, D84, E21, G11

Keywords: household debt, marginal propensity to consume, precautionary saving motive.

[†] I would like to thank Stefan Angrick, Ryan Banerjee, Stijn Claessens, Mathias Drehmann, Egemen Eren, Andrew Filardo, Leonardo Gambacorta, Francesco Lippi, Marco Lombardi, Dubravko Mihaljek, Mamoru Nagano, Phurichai Rungcharoenkitkul, Hyun Song Shin, Nao Sudo, Wataru Takahashi, Dora Xia, and seminar participants at the Second Annual Conference of the Japan Economy Network and at the Bank for International Settlements for their insightful comments. This research utilizes the micro data from the Preference Parameters Study of Osaka University's 21st Century COE Program 'Behavioral Macrodynamics Based on Surveys and Experiments' and its Global COE project 'Human Behavior and Socioeconomic Dynamics'. I acknowledge the program/project's contributors: Yoshiro Tsutsui, Fumio Ohtake, and Shinsuke Ikeda. The views expressed here are those of the author and do not necessarily reflect those of the Bank for International Settlements.

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1. Introduction

Household debt has risen sharply around the globe in the past two decades, and that debt is seen as playing a more prominent role in economic decisions. The rapid declines in consumption by highly indebted households in the wake of the Global Financial Crisis (GFC) highlighted this role. And since the GFC, debt levels have continued to hit new highs. These experiences have naturally spurred considerable research into the relationship between household debt and consumption behaviour from both theoretical and empirical perspectives.

One strand of the literature has highlighted the significant macroeconomic impact of aggregate household debt on the economy. Mian and Sufi (2010) show that the growth in household leverage in the pre-GFC period explains a large fraction of the drop in consumption during the GFC (see also IMF (2017), Mian et al (2017), Mian and Sufi (2011, 2018)). Lombardi et al (2017) provide empirical evidence that even if household debt boosts the economy in the short run, it tends to impede growth in the long run. Drehmann and Juselius (2012) and Juselius and Drehmann (2015) find that debt service burdens negatively affect credit and expenditure growth, and can signal the likelihood of a future recession and financial crisis.[1]

Another strand of literature delves into heterogeneous household debt burdens and their effects on consumption. Baker (2018) finds that highly indebted households are more sensitive to income changes because of borrowing and liquidity constraints. Kovacs et al (2017) use household-level data and show that highly leveraged households made larger cuts in their consumption following the crisis compared to average households, and this particularly the case for young households.[2] The debt vulnerabilities generally vary with the type of debt instruments held by households. Flodén et al (2017) for example find that highly indebted households with floating rate mortgages are more likely to cut their consumption growth by more in response to increases in interest rates than households with little debt or fixed rate mortgages. From another perspective, Kaplan et al (2018) develop the heterogeneous agent new Keynesian (HANK) models where households save in liquid and illiquid assets, suggesting that the household consumption is driven by more wealth effect than traditional intertemporal substitution effect. In such an environment, it is emphasised that the monetary policy effectiveness depends on fiscal response to the monetary expansion because of failure of Ricardian equivalence (see also Mian et al (2013), Kaplan et al (2014), La Cava et al (2016), Auclert (2017)).

This paper assesses the impact of Japanese household debt burdens on consumer behaviour using a panel dataset based on the Preference Parameters Survey (PPS). The paper is the first to find significant heterogeneity between marginal propensities to consume (MPCs) and debt burdens for Japanese households. One unique feature of this Japanese household survey, compared to previous surveys, is its compilation of responses to forward-looking questions. These data allow us to explore economic motives of Japanese savers.

We find empirical evidence that household MPCs are significantly higher for highly-indebted households than households with no debt. In the previous literature,

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1 Before the GFC, earlier works have found that household debts have significant roles in economic activity (eg Mishkin (1978), King (1994) and Olney (1999)). Debelle (2004) argues that households become more sensitive to changes in income and interest rates when facing high levels of debt.

2 See also Aron et al (2012), Dynan (2012) and Mian et al (2013) for households' consumption behaviours around the GFC, which appear to significantly differ depending on their debt burden.

precautionary savings due to liquidity and credit constraints have been highlighted (eg Mian et al (2013), Baker (2018)). The PPS dataset confirms the importance of the precautionary saving motive for Japanese households. In addition to funding consumption plans in the latter stages of life, Japanese savings behaviour reflects households' desire to self-insure against the unlikely event of a future unemployment spell and mortality risk.

The rest of the paper is organised as follows. Section 2 explains the econometric methodology to assess the relationship between household consumption patterns and the debt. Section 3 describe the main features of Japan's household-level data from the PPS. Section 4 presents estimation results from the panel-data estimation, and Section 5 provides concluding remarks.

2. The econometric methodology

The marginal propensity to consume (MPC) can be decomposed into income elasticity and average propensity to consume (APC); namely,

$$\frac{\Delta C}{\Delta Y} = \frac{\Delta C/C}{\Delta Y/Y} \times \frac{C}{Y},$$

where *C* is consumption and *Y* is income; the left-hand side of the equation is the MPC, and the first and second terms on the right-hand side are the income elasticity and APC, respectively. In the following analysis, the income elasticity is estimated with a panel regression model, and the APC is calculated as the sample average within a respective group of households. This approach enables us to assess whether differences in the MPC across groups is attributable to the income elasticity or the APC.[3] The analysis focuses on the heterogeneity of the consumption pattern across households with different levels of debt burden.

To estimate the income elasticity and its link to debt burdens, we consider the following panel regression model:

$$\Delta \ln(c_{it}) = \alpha_i + \beta_1 \Delta \ln(y_{it}) + \beta_2 \Delta \ln(y_{it}) \times DR_{it} + \gamma X_{it} + \varepsilon_{it},$$

where $\Delta \ln(c_{it})$ is the annual change in expenditure of household i in the year t, $\Delta \ln(y_{it})$ is the annual change in income, DR_{it} is a variable of debt ratio, X_{it} is a vector of household characteristics, and α_i is the household fixed effect.[4] The coefficient β_1 measures the income elasticity for a household without any debt. The coefficient β_2 measures an effect of holding debt on the income elasticity. For a household with a certain amount of debt with the debt ratio $\overline{DR}$, the income elasticity is $\beta_1 + \beta_2 \overline{DR}$.

The analysis takes account of the possible asymmetry in the consumption patterns between positive and negative income changes. As a baseline model, the following regression is estimated:

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[3] The paper's analysis follows the approach of Bank of Japan (2016, p35) for estimating the MPCs from the household data.

[4] In the PPS dataset, expenditures exclude mortgage interest payments, taxes, insurance premiums and expensive consumer goods (eg houses and cars).

$$\Delta \ln(c_{it}) = \alpha_i + \beta_1 \Delta \ln(y_{it})^+ + \beta_2 \Delta \ln(y_{it})^+ \times DR_{it} + \beta_3 \Delta \ln(y_{it})^- + \beta_4 \Delta \ln(y_{it})^- \times DR_{it} + \gamma X_{it} + \varepsilon_{it}, \quad (1)$$

where

$$\Delta \ln(y_{it})^+ = \begin{cases} \Delta \ln(y_{it}) & (\text{if } \Delta \ln(y_{it}) > 0) \\ 0 & (\text{otherwise}), \end{cases}$$

$$\Delta \ln(y_{it})^- = \begin{cases} \Delta \ln(y_{it}) & (\text{if } \Delta \ln(y_{it}) < 0) \\ 0 & (\text{otherwise}). \end{cases}$$

This specification implies that the income elasticity is $\beta_1 + \beta_2 DR_{it}$ for households facing a positive income change in the current year and $\beta_3 + \beta_4 DR_{it}$ for those facing a negative income change. The coefficients β_2 and β_4 measure the effects of household debt on the income elasticity in the cases of positive and negative income changes, respectively.

Further, the analysis addresses the saving motives as one possible factor to account for the relationship between debt and consumption. To empirically test its relevance, the following regression is estimated:

$$\Delta \ln(c_{it}) = \alpha_i + \Delta \ln(y_{it})^+ \times (\beta_1 + \beta_2 Z_{it}) + \Delta \ln(y_{it})^+ \times DR_{it} \times (\beta_3 + \beta_4 Z_{it}) + \Delta \ln(y_{it})^- \times (\beta_5 + \beta_6 Z_{it}) + \Delta \ln(y_{it})^- \times DR_{it} \times (\beta_7 + \beta_8 Z_{it}) + \gamma X_{it} + \varepsilon_{it}, \quad (2)$$

where Z_{it} is a dummy variable indicating a saving motive for household i in the year t. The coefficients β_2 and β_6 reflect the baseline effect of the saving motive on the income elasticity, and β_4 and β_8 measure an additional effect of holding debt on the income elasticity. For example, when a household with a debt ratio $\overline{DR}$ faces a positive income change, the income elasticity is represented by $\beta_1 + \beta_2 Z_{it} + \overline{DR} \times (\beta_3 + \beta_4 Z_{it})$. If the household does not have a saving motive (ie $Z_{it} = 0$), the income elasticity is $\beta_1 + \beta_3 \overline{DR}$. If it has a saving motive (ie $Z_{it} = 1$), the income elasticity becomes $\beta_1 + \beta_2 + (\beta_3 + \beta_4)\overline{DR}$. A statistical test on the coefficient β_4 can address whether the heterogeneity of the income elasticity across different level of indebtedness arises from the household's saving motive.

3. Data

3.1. Household survey

The analysis exploits the Japanese household survey from the Preferences Parameters Study (PPS) conducted by the Institute of Social and Economic Research at Osaka University. This PPS dataset includes information on households' characteristics (eg age, employment status, residence region), income, expenditure, balance sheet, and future expectations.[5] The survey was conducted annually from 2003 to 2013. The

[5] Kubota and Fukushige (2016) use this survey data to test rational expectations hypothesis. Ito et al (2017) exploit the same data to investigate determinants of household portfolio selection. The detail of the survey can be found in http://www.iser.osaka-u.ac.jp/survey_data/eng_panelsummary.html.

sample of households were randomly selected from the Basic Residents Registration System to provide a representative sample of Japanese households.[6] The dataset is an unbalanced panel. Households that did not reply to the survey in a given year were dropped from the survey in subsequent years. New households were added in 2004, 2006, and 2009. The dataset includes an average of 4,000 samples for each year.[7]

One advantage of this survey for the current analysis is that the dataset includes answer to questions about each households' expectations about the future. In particular, households' responses to questions about expected future employment and old age situations. These responses allow us to assess the importance of the precautionary saving motives and the role of debt for household consumption behaviour.

3.2. Selected variables and summary statistics

Details about the variables selected for the analysis are described in this section. Missing questionnaires in 2003 and 2004 restrict the useable survey data to be from 2005 to 2013 for the panel regression analysis.[8] Table 1 reports descriptive statistics of the variables described in the following.

(1) Annual change in expenditure

The dependent variable in the regression is the annual change in expenditures. The survey asks about the annual change in a household's total expenditure and offers categorical choices for responses: starting from "decrease by more than 9%", "decrease by 5%-7%", "decrease by 3%-5%", to "increase by 7%-9%" and "increase by more than 9%." For the estimation, the mid-point of each category range is assigned a numeric variable, following Kubota and Fukushige (2016). The first and last open-ended categories are replaced with -11% and 11%, respectively.[9] Over the sample, the average annual expenditure growth is 1.35%. The cross-sectional averages over time exhibit a similar trend to that of national consumption growth.

(2) Annual change in income

The main explanatory variable in the regression is the annual change in income. The questionnaire offers the same categorical choices for this variable as for the annual change in expenditures. The same numeric assignment is applied to the income change. Over the sample, the average annual income growth is −0.87%, and cross-sectional averages over time are similar to the trend in national earnings growth.

(3) Debt ratios: debt over assets (D/A), over financial assets (D/FA), over income (D/I)

The key explanatory variable in the regression is the cross-term of the annual income change with the debt ratio (*DR*). In the regression analysis, three debt

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6 The Basic Residents Registration System is the registry that contains various information for each citizen such as address, date of birth and gender.

7 Note that the panel regression model includes year-fixed effects.

8 In addition, self-employed households are excluded from the sample because assets and debts owned by their firms may be included in their answers.

9 The results are robust to various values for these open-ended categories.

ratios are examined: the ratio of debt over assets (*D/A*), over financial assets (*D/FA*), and over income (*D/I*). In the survey, the debt (*D*) is defined as total housing loans, car loans, and any other instalment payments on which the household has to pay interest charges.[10] The assets (*A*) are the appraised value of all housing, property, and financial assets (*FA*) such as savings, stocks, and insurance owned by the household. The income (*I*) is annual earnings before taxes plus bonuses of the entire household.[11] The sample averages of *D/A*, *D/FA*, and *D/I* are 0.31, 2.04, and 1.51, respectively.[12] Note that 46 percent of the sample households report having no debt.

The model regresses the annual change in income onto the change in expenditure to measure the elasticity of consumption. One of caveats in this analysis is that we cannot identify whether income changes are permanent or temporary. The samples in the time series dimension are not adequate, and the dataset is unbalanced as households are invited to answer the survey only for, on average, four consecutive years.[13]

In addition to the baseline specification, a robustness check examines unexpected changes in income and expenditure, using the answers to the questions about the expected changes in the next-year income and expenditure. This specification can assess a household's reaction to an unexpected income change and its relation to the household's debt burden. The responses for the expected income and expenditure changes are the same categorical choices as for the realized annual changes in income and expenditure. The same numeric assignment is applied for the expected changes.

Two important questions associated with precautionary saving motives address concerns about future unemployment spells (CON_UEMP) and old age (CON_OLD):

(4) Concerns about unemployment (CON_UEMP)

Q. What is the possibility that you or your spouse will be unemployed within the next two years? Choose one of the following: 1. Strong possibility, 2. Some possibility, 3. Little possibility, 4. Don't know.

(5) Concerns about old age (CON_OLD)

Q. I have anxieties about my 'life after I am 65 years old.' Answer on a scale from 1 to 5, where "1" means it is particularly true and "5" means that it doesn't hold true at all.

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10 There is no information about households' credit condition and debt contracts such as collateral, housing price, and fixed/floating rates.

11 The questionnaires for these balance sheet information are categorical choices. For example, the categories for the total asset holding are starting from "less than 1 million (m) Japanese Yen", "1 to 2m", "2 to 4m", "4 to 6m", to "18 to 20m" and "over 20m." For the estimation, the mid-point of each category range is assigned as a numeric variable. The last open-end category is replaced with 21m Japanese Yen. Even if this value for the last category is changed, the results remain almost the same.

12 For each of these DR variables, the upper 1% samples are discarded as extremes.

13 It would be beneficial to address Friedman's permanent income hypothesis (Friedman (1957)), if the sources of change for each household's income can be identified. This is left as a future work.

In the estimation, these categorical choices are converted to dummy variables that take a value of one or zero. Specifically, the value for CON_UEMP is one if the answer to the question is "1", and zero otherwise. The value for CON_OLD is one if the answer is either "1" or "2", and zero otherwise. As shown in Table 1, these concerns are notably common in Japanese households; 22% and 54% of the samples have concerns about unemployment and old age, respectively.[14]

The control variables are the following household characteristics that may possibly affect the annual change in expenditure:

(6) Change in household size

The survey asks about the number of household members. A change in household composition from the previous year is calculated as the control variable. When the number of household members increases (decreases), it is expected to increase (decrease) the annual consumption expenditure (eg Kubota and Fukushige (2016)).

(7) Job change

The survey includes a question about job categories of the household members, such as farming, construction, and financial operations. A dummy variable is created that takes a value of one if the job categories have changed from previous year, and zero otherwise. Changing a job may affect the expenditure beyond the income change.

(8) Residence change

The information about households' residential area is used as a control variable. The survey identifies the household's residential area by four city size categories: cabinet-designated city (a city with population greater than 500,000), population over 100,000, population less than 100,000, and town or village. A dummy variable is created that takes a value of one (minus one) if the household moves to a larger (smaller) city in the current year, and zero otherwise.

4. Empirical results

4.1. Baseline results

Table 2 shows estimation results for baseline regression model (1), with each specification examining a different debt ratio: debt over assets (*D/A*), over financial assets (*D/FA*), and over income (*D/I*). The income elasticity of consumption measured by the coefficient of the annual income change is around 0.24 to 0.28, with little difference between the positive and negative income changes.

The coefficient of the cross-term of the annual change in income with the debt ratio (*DR*) is not significant for the positive income change, but it is significantly positive for the negative income change. This result implies that when the households face a decline in income, those with a higher level of debt tend to save more than

[14] Ito et al (2017) use similar variables to assess the precautionary saving motive to analyse households' portfolio selection. See also Miura and Higashi (2017).

those with no debt or a lower level of debt. This relation holds for all specifications with different debt ratios reported in Table 2.

To compute the MPC for different groups of households by the debt ratio (debt over assets), the APC is calculated for households with $DR = 0$ ("Low" debt ratio) and $DR > H$ ("High"). The latter group is defined as households holding debts with a debt ratio exceeding the threshold H. Specifically, $H = 0.36$ is used here, which corresponds to the upper quartile of the distribution of DR across the entire sample. Graph 1 illustrates the estimate of APCs, which are about 0.75 and 0.84 for the groups of $DR = 0$ and $DR > H$, respectively. It shows the slightly higher APC for the highly-indebted households, although little difference exists between the cases of facing positive and negative income changes.

Graph 1 also shows the resulting MPCs for the two groups of household in the cases of positive and negative income changes. The estimate indicates that the MPC is considerably higher for households with debt when they face a negative income change. The MPC for no-debt households is around 0.20, as is the MPC for highly-indebted households when they gain income, while it increases to 0.28 when the highly-indebted households face the negative income change. Note that the degree of income elasticity, APC and MPC obtained here are consistent with the estimate by the Bank of Japan (2016).

What underlies the households' consumption behaviour? The next regression analysis examines the precautionary saving hypothesis.

4.2. Precautionary saving motive

Theoretically, precautionary saving motives are modelled as arising when constant relative risk aversion utility and certain liquidity constraints are assumed, as shown by Deaton (1991) and Carroll and Samwick (1997).[15] A consumer who faces uncertainty on income shocks holds a positive amount of wealth to have a buffer stock of savings. A wide range of studies provide empirical support for consumers' precautionary saving behaviour (eg Dynan (1993), Horioka and Watanabe (1997), Carroll and Samwick (1998), Lusardi (1998), Engen and Gruber (2001), Cagetti (2003), Hochguertel (2003), Fisher and Montalto (2010)). A close look at precautionary motives not only yields a better understanding of individual consumers' behaviour, but also provides macroeconomic and policy implications (Zeldes (1989)). For example, Caballero (1990) argues that consumers' precautionary saving motives explain several facts about aggregated consumption, such as its excessive smoothness and excessive sensitivity to anticipated income changes. The current paper sheds light on the importance of the debt burden to consider different MPC across households and their precautionary saving when they face a decline in income.

Table 3 reports estimation results for panel regression model (2), with the dummy variable for concerns about (a) unemployment and (b) old age. In this regression, the debt ratio over asset is used for the cross-term of the annual change in income. The results show that the coefficient of the cross-term with the dummy variable for concerns is significantly positive only for the case of a negative income change, while coefficients of other cross-terms are not significant. This outcome

[15] Keynes (1936) points out a number of saving motives, such as precautionary and bequest motives. Zeldes (1990), Cabellero (1990) and other studies develop theoretical foundations of the precautionary saving motive. In their setup, the impact of the precautionary saving motive increases with higher income uncertainty.

supports the precautionary saving hypothesis, as the concern about unemployment risk increases the income elasticity through the cross-term of the annual change in income with the debt ratio.

Graph 2 presents the estimated income elasticity, APC and MPC for households with precautionary saving motives. The "High" group of debt ratio is the households with *DR*>*H* and with concerns about unemployment risk (CON_UEMP=1). The resulting MPC is higher for highly-indebted households than no-debt households for the case of a negative income change. In addition, the MPC is lower for highly-indebted households for the case of a positive income change. This result implies that the highly-indebted households tend to save more when they have concerns about income risk due to future unemployment and uncertainty about resources in old age.

The literature has emphasised the possibility of a precautionary saving motive that arises from liquidity and credit constraints linked to debt burdens (eg Mian et al (2013), Baker (2018)). Highly-indebted households are more likely to be bound by liquidity and credit constraints. In such circumstances, households have an incentive to save more as incomes increase than those households with low debt levels, thereby relaxing the constraints. In other words, highly-indebted households would have lower MPCs than those with low debt levels. When they face a decline in income, they cut their spending to have enough buffer from the constraint, which makes their MPC higher. The Japanese dataset confirms this household behaviour and reveals that the concerns about the latter stages of life and unemployment risks are key determinants of the precautionary saving motive.[16]

Table 4 reports estimation results of the panel regression model (1) for different age cohorts. Significant consumption differences among the cohorts are found. For a decline in income, consumption choices by cohorts of (b) ages 36-50 and (c) ages 51-65 are sensitive to debt levels (the coefficient on the cross-term of the income change and debt is significantly positive). For an increase in income, the cohort of (b) ages 36-50 is also significant. These relationships are not found for the cohorts of (a) ages 20-34 and (d) ages 65-80.

The results indicate that debt burdens significantly influences consumption behaviour of pre-retirement middle-aged households, but not of younger households. These differences are consistent with housing debt playing an important role in consumption behaviour. In the earlier stages of life, few Japanese households own their housing. Their major component of debt is credit card loans. For middle-aged households (from the late 30s to the early 60s), Japanese households typically buy houses and take on a high level of debt. This debt overhang appears to make their saving behaviour more sensitive to income changes. In particular, highly-indebted middle-aged households up to their 40s tend to save much more when income increases. This is consistent with evidence that Japanese households are likely to pre-pay mortgage debt (Kobayashi (2012)). After the standard retirement age of 65, most households have paid down their mortgage debt; along with a relatively lower level of debt and pensions being a major source of income, consumption behaviour appears less sensitive to debt.

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[16] From the PPS dataset, there is little evidence that Japanese households with high levels of debt tend to face liquidity constraints of the type associated with the so-called 'hand-to-mouth' consumers. The Japanese dataset shows that the highly-indebted households typically have a large amount of wealth (see eg, Kaplan et al (2014) for a discussion of 'hand-to-mouth' consumers, and Kovacs et al (2017) for liquidity constraints in younger households observed in their UK household dataset).

Using another Japanese household survey conducted in 1994, Horioka and Watanabe (1997) show the existence of saving motives due to retirement and illness. They also show that Japanese households tend to save for debt service related to housing debt. Murata (2003) provides empirical evidence that Japanese households tend to have precautionary savings if they have concerns about the uncertainty of public pension benefits, particularly when they cannot receive money transfers from their parents. The current result adds the new evidence to this area of studies on Japanese households' saving behaviours.

4.3. Robustness

To check the robustness of the estimation results, the panel regression model is estimated with different sets of variables. First, Table 5(1) shows the regression results with the expected change in the next-year income additionally included as a control variable. The coefficients of the expected income change are significantly positive (negative) for positive (negative) expected change, which implies households' consumption smoothing behaviour. The coefficient for the cross-term of the current income change with the debt ratio is significantly positive for the case of facing a negative income change. This finding is still valid for the specification with the annual changes in expenditure and income replaced by unexpected changes, as shown in Table 5(2).

Table 6(1) reports another regression with a level of debt for the cross-term, instead of the debt ratio, which shows the same significance for the cross-term of the highly-indebted households. Table 6(2) examines the annual change in income relative to national income change to control for the influence of the national business cycle. Further, the number of household members and their ages, their job classifications, the geographic locations of their residences and sizes of the city in which they live are treated as additional control variables. The results confirm the robustness of the reported findings.

5. Concluding remarks

This paper assesses the impact of Japanese household debt burdens on consumer demand using the household data for Japan. The analysis reveals that MPCs are higher for households with higher levels of debt, especially for negative income shocks. The estimation results indicate that precautionary saving motives play an important role in making highly-indebted households more sensitive to income decline due to concerns about future unemployment risks and about having adequate savings for the latter stages of life.

The results have some policy implications. A policy that decreases future uncertainty about income during spells of unemployment and about adequate income during old age would be beneficial for highly-indebted households. For example, Engen and Gruber (2001) demonstrate the benefit of unemployment insurance for consumption behaviour. With increasing life expectancy, life after retirement becomes one of the more serious concerns. Mortality risk implies that well funded pension and health insurance systems can influence households' consumption patterns. Guiso et al (1992) point out that uncertainty about health is an important factor for precautionary saving.

Murata (2003) finds that Japanese households tend to have precautionary saving motives due to uncertainty about the public pension scheme, which implies that a more sustainable pension restructuring could be key when addressing the challenges posed by a progressively aging society. Japanese elderly households heavily depend on public pension as a dominant source of income after retirement. The pension restructuring has been repeatedly discussed including an increase in the normal pension age (eg Fukawa (2006)), while timing of the reform is typically unknown. This policy uncertainty can increase uncertainty on the main source of income after retirement, which can affect the households' precautionary saving behaviour. Kitao (2018) points out an adverse effect of delaying the reform in Japan using a general equilibrium life-cycle model. Assessing changes in households' saving behaviour responding to the pension reform with an age-cohort analysis would be an important future work.

One caveat in the PPS dataset is that there is no information about the debt service burden which each household faces. However, if the wealth effect is more dominant than the intertemporal substitution effect in response to monetary policy as eg Kaplan et al (2018) show, the household debt heterogeneity on MPCs found in this paper suggests the importance of the household balance sheet information in considering the monetary policy effectiveness. A quantitative assessment of both intertemporal-substitution and wealth effects with the debt heterogeneity in the household sector remains as a relevant future work.

The PPS dataset includes the survey not only of households in Japan but also households in the United States, China, and India. Although the latter datasets are relatively smaller and more limited than the Japanese one, comparing the role of household debt and its effect on consumption expenditures across the countries could shed further light on the issues raised in this paper. Several Asian countries have faced rising debt (eg BIS (2009) and ADB (2017)). However, for China and India, assessment of the role of debt with large-scale household panel data is limited. Chamon et al (2013) use Chinese data and point out an increasing saving rate in China's urban households; they show that rising income uncertainty leads to a significant increase in households' saving.[17] With a careful examination of data quality, the Preferences Parameters Study has the potential to provide new insights for those Asian countries. Such investigation is left as a future work.

[17] Rungcharoenkitkul (2011) focuses on household balance sheets and estimate wealth effects on consumption in Thailand.

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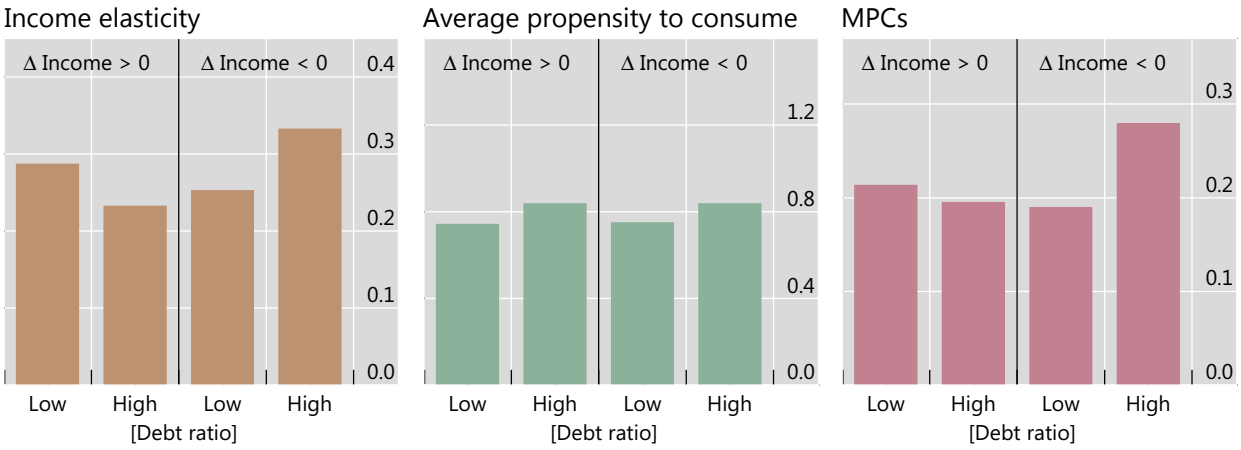
Marginal propensities to consume (MPCs) by income change and debt ratio

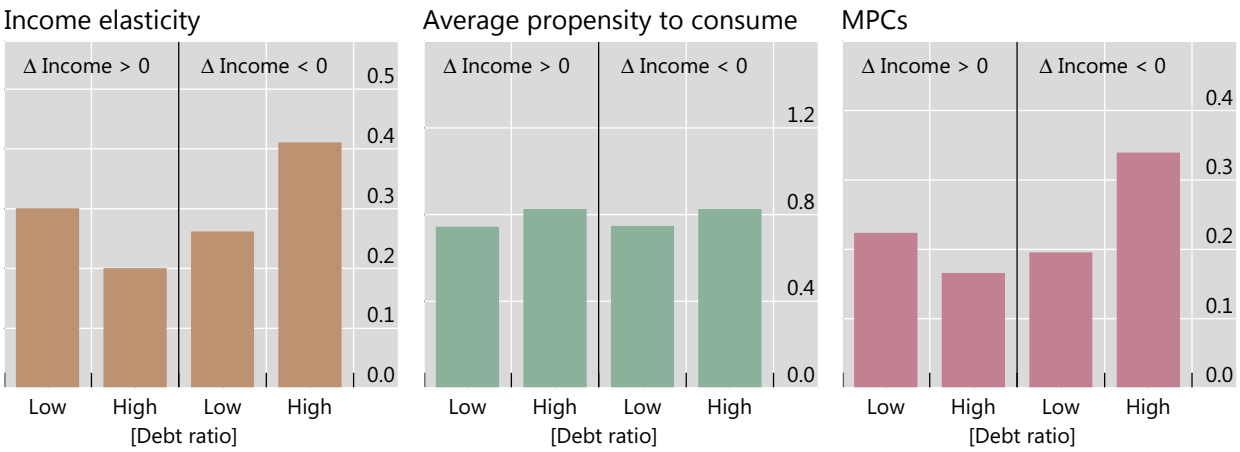
Graph 1



Debt over assets is used for the debt ratio (DR): "Low" group of debt ratio is households with DR=0, and "High" is DR>0.36 (the upper quartile of DR).

MPCs for households with precautionary saving motive

Graph 2



Debt over assets is used for the debt ratio (DR): "Low" group of debt ratio consists of households with DR=0, and "High" with DR>0.36 (the upper quartile of DR) and with concerns about unemployment (CON_UEMP=1).

Summary statistics Table 1

	Mean	Stdev.
Annual change in expenditure (%)	1.35	4.61
Annual change in income (%)	-0.87	4.03
Debt ratio over assets (*D/A*)	0.31	0.58
Debt ratio over financial assets (*D/FA*)	2.04	5.19
Debt ratio over income (*D/I*)	1.51	6.13
Debt (million Japanese Yen)	5.45	10.27
Unexpected change in current-year expenditure (%)	-0.29	5.99
Unexpected change in current-year income (%)	0.13	5.47
Expected change in next-year income (%)	-0.80	3.71
Annual change in income relative to national income increase (%)	-0.06	4.18
Concerns about unemployment (dummy)	0.22	0.42
Concerns about old age (dummy)	0.54	0.50
Change in household size	-0.05	0.67
Job change	0.06	0.24
Residence change	-0.02	0.18
The number of samples	25,803	
The number of households	6,246	

Baseline regression result Table 2

Dependent variable: Annual change in expenditure

	(a) DR= D/A	(b) DR= D/FA	(c) DR= D/I
Annual change in income			
(+) dummy	0.288 (0.021) ***	0.259 (0.021) ***	0.270 (0.019) ***
(−) dummy	0.253 (0.016) ***	0.260 (0.016) ***	0.245 (0.015) ***
Annual change in income × Debt ratio (DR, %)			
(+) dummy	-0.038 (0.028)	0.006 (0.004)	0.008 (0.061)
(−) dummy	0.056 (0.025) **	0.008 (0.004) **	0.016 (0.005) ***
Control variables			
Change in household size	0.139 (0.044) ***	0.145 (0.045) ***	
Job change	-0.181 (0.128)	-0.160 (0.133)	-0.222 (0.122) *
Residence change	-0.004 (0.160)	0.001 (0.164)	-0.082 (0.150)
Observations	22,485	21,018	24,378
Households	5,837	5,620	6,100

The regression model (1) is estimated using ordinary least squares (OLS) with household and year-fixed effects. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Regression result for precautionary saving motives Table 3

Dependent variable: Annual change in expenditure		
	(a) DC= CON_UEMP	(b) DC= CON_OLD
Annual change in income		
(+) dummy	0.301 (0.024) ***	0.301 (0.029) ***
(−) dummy	0.262 (0.019) ***	0.260 (0.025) ***
(+) dummy × DC	-0.046 (0.043)	-0.031 (0.039)
(−) dummy × DC	-0.011 (0.031)	-0.010 (0.031)
Annual change in income × Debt over assets (%)		
(+) dummy	-0.039 (0.031)	-0.031 (0.039)
(−) dummy	0.016 (0.030)	-0.021 (0.046)
(+) dummy × DC	0.001 (0.058)	0.027 (0.052)
(−) dummy × DC	0.096 (0.048) **	0.091 (0.053) *
Control variables		
Change in household size	0.125 (0.045) ***	0.153 (0.045) ***
Job change	-0.142 (0.130)	-0.217 (0.133)
Residence change	0.031 (0.166)	-0.058 (0.163)
Observations	21,956	21,332
Households	5,796	5,442

DC indicates the dummy variable for concerns about (a) unemployment (CON_UEMP) and (b) old age (CON_OLD). The regression model (2) is estimated using OLS with household and year-fixed effects. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Regression result for the different age cohorts Table 4

Dependent variable: Annual change in expenditure

	(a) Age: 20-35	(b) 36-50	(c) 51-65	(d) 66-80
Annual change in income				
(+) dummy	0.284 (0.051) ***	0.352 (0.036) ***	0.212 (0.036) ***	0.336 (0.048) ***
(−) dummy	0.192 (0.061) ***	0.206 (0.035) ***	0.276 (0.023) ***	0.220 (0.037) ***
Annual change in income × Debt over assets (%)				
(+) dummy	0.058 (0.073)	-0.113 (0.039) ***	0.070 (0.063)	-0.212 (0.295)
(−) dummy	0.048 (0.081)	0.071 (0.038) *	0.110 (0.050) **	0.089 (0.129)
Control variables				
Change in household size	-0.152 (0.091) *	0.111 (0.100)	0.241 (0.077) ***	0.158 (0.089) *
Job change	-0.239 (0.544)	0.123 (0.396)	-0.407 (0.245) *	-0.119 (0.170)
Residence change	0.335 (0.436)	-0.295 (0.246)	0.235 (0.310)	-0.240 (0.333)
Observations	2,494	7,278	8,459	4,253
Households	976	2,201	2,607	1,219

The regression model (1) is estimated using ordinary least squares (OLS) with household and year-fixed effects. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Regression result for robustness check with expectations variables Table 5

Dependent variable: Annual change in expenditure

	(1) Realized expenditure	(2) Unexpected expenditure
Annual change in income		(Unexpected change)
(+) dummy	0.269 (0.022) ***	0.218 (0.019) ***
(−) dummy	0.272 (0.017) ***	0.234 (0.020) ***
Annual change in income × Debt over assets (%)		(Unexpected change)
(+) dummy	-0.038 (0.028)	0.007 (0.026)
(−) dummy	0.056 (0.025) **	0.127 (0.029) ***
Control variables		
Expected change in next-year income		
(+) dummy	0.056 (0.022) **	
(−) dummy	-0.045 (0.016) ***	
Change in household size	0.136 (0.044) ***	0.275 (0.063) ***
Job change	-0.203 (0.128)	-0.301 (0.177) *
Residence change	-0.002 (0.161)	-0.061 (0.229)
Observations	22,485	21,732
Households	5,837	5,685

The regression model (1) is estimated using OLS with household and year-fixed effects. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Regression result for robustness check with other variables Table 6

Dependent variable: Annual change in expenditure		
	(1)	(2)
Annual change in income		(Relative to national income increase)
(+) dummy	0.273 (0.022) ***	0.286 (0.019) ***
(−) dummy	0.246 (0.016) ***	0.252 (0.018) ***
Annual change in income × Debt	(Level of debt)	(Debt over assets, %)
(+) dummy	0.014 (0.040)	-0.036 (0.023)
(−) dummy	0.055 (0.034) *	0.058 (0.029) **
Control variables		
Change in household size	0.121 (0.041) ***	0.139 (0.044) ***
Job change	-0.252 (0.123) **	-0.180 (0.128)
Residence change	-0.099 (0.152)	-0.004 (0.160)
Observations	22,485	21,018
Households	5,837	5,620

The regression model (1) is estimated using OLS with household and year-fixed effects. Robust standard errors are in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

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