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Household Consumption in Japan – Role of Income and Asset  
Developments

by Erkki Vihriälä

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I N T E R N A T I O N A L M O N E T A R Y F U N D

**IMF Working Paper**

Asia and Pacific Department

**Household Consumption in Japan – Role of Income and Asset Developments**

**Prepared by Erkki Vihriälä**

Authorized for distribution by Luc Everaert

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**Abstract**

We study Japanese household consumption at a disaggregated level focusing on the role of income and asset dynamics. Stagnation of real per capita consumption is widespread across labor market groups, age groups and regions. Consumption-to-income ratios have been mildly increasing due to the rising share of pensioners with significant assets. Evidence therefore suggests that assets have become more important in financing consumption. However, the short-term consumption dynamics remain quite sensitive to income growth but not to asset market movements.

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## I. INTRODUCTION

Household consumption in Japan has been underwhelming for a long time. The proposed explanations include weak income growth, pessimistic expectations, a deflationary mindset, risk aversion combined with uncertainty about future prospects, and population ageing. This paper taps an underused dataset, 'Family Income and Expenditure Survey' (FIES), to shed light on the evolution of household consumption in Japan in the 2000s. Particular attention is paid to the role of income and asset dynamics in determining consumption.

The permanent income hypothesis suggests that consumption is related to expectations about remaining lifetime income as well as accumulated net assets. Changes in demographics and the income and wealth distribution can therefore have important long-term and short-term effects on consumption behavior.

Firstly, it is well known that Japanese households are significant net creditors in relation to their government and Japan is an important international net creditor. At the same time, the retired share is increasing, depressing income growth. Therefore, assets could be secularly increasing in importance in financing consumption relative to current and future labor income.

In addition to the long-term effects, the structural changes can also alter the short-term reaction of consumption to various shocks. For instance, high savings can decrease consumption variability in response to transitory income shocks if assets markets are incomplete. On the other hand, ageing can increase the responsiveness of consumption to income shocks if the planning horizon of the average household shortens (Saito, 2016)<sup>1</sup>. Furthermore, high nominal savings stocks are subject to valuation changes in response to interest rate and inflation surprises, which can increase consumption variability. Finally, as the weight of creditor households increases in the economy, lower interest rates could in principle depress household consumption.

We study the co-movement of consumption, income and assets using data by region, labor market position and age group from the FIES. We find that the stagnation<sup>2</sup> in real per capita consumption is broad-based and cannot be explained by developments of particular population subgroups or regions. Notwithstanding the flat consumption volumes, consumption-to-income ratios have been increasing following weak income developments. Therefore, assets have become more important in financing expenditure, which is related to the ageing of the society. However, we find little short-term effect of asset market movements on expenditure. In contrast, consumption growth remains quite responsive to fluctuations in income. We also do not find a strong direct connection between real interest rates and growth in non-durable and services consumption. However, this absence of

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<sup>1</sup> This 'reduced Ricardianism' of the economy would also tend to increase the effectiveness of fiscal policy.

<sup>2</sup> We use 'stagnation' to refer to a flat trend.

evidence is not altogether surprising considering the low variation in the ex-ante real interest rate during the sample period when nominal rates have been against the zero lower bound.

There are existing studies that have considered consumption dynamics in an economy undergoing a change in the relative importance of income and assets. Bean (2004) pointed out in his essay the increasing significance of the wealth effects of monetary policy. Fujiwara and Teranishi (2008) used a general equilibrium model to study the dynamic response of consumption to monetary policy shocks under alternative population structures. In their model, pensioners' consumption increases in response to higher interest rates. However, contractionary monetary shocks remain contractionary in the aggregate because of negative effects on workers' consumption and investment. In an empirical study with Japanese aggregate data, Muellbauer and Murata (2009) find a positive effect from higher real interest rates on consumption. In a related paper, Aron et al. (2012) show that this result is particular to Japan and does not hold in the US or the UK. The 'difference' of Japan is explained by the high assets of Japanese households and the low intertemporal substitution (=aversion to consumption changes). Additionally, in so far as lower interest rates increase housing prices, the authors argue that this reduces consumption due to (a) higher down payment requirements and (b) underdeveloped financial markets which preclude existing owners from increasing consumption as in the US or the UK. As in Fujiwara and Teranishi, though, also Muellbauer and Murata find that in the aggregate higher interest rates reduce output. Finally, Ichiue and Nishiguchi (2015) use survey data to study the link between inflation expectations and consumption in Japan during the zero lower bound on nominal interest rates. They find that households with higher assets expect to increase consumption by more in response to lower inflation. This is consistent with lower inflation increasing the real value of nominal assets.

We contribute to the empirical literature by using disaggregated panel data from FIES on regional, labor market group and age group developments. We evaluate whether consumption developments are similar or different among population sub-groups. Secondly, the regional panel at a quarterly frequency allows to study the determinants of consumption in the 2000s when national data would not provide enough observations<sup>3</sup>. Thirdly, the disaggregated data enables to evaluate heterogeneity in the drivers of consumption by demographics and asset positions.

In the next section we introduce the conceptual framework and present the data. The third section contains our descriptive analysis. Regression results are presented in the fourth section. The fifth section concludes.

## **II. CONCEPTUAL FRAMEWORK AND DATA**

Standard economic theory suggests that in each period households make intertemporal consumption plans that depend on expectations about lifetime labor earnings and the net

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<sup>3</sup> In contrast Muellbauer and Murata use annual national account data from 1963 to 2006.

asset position at the start of the period. The key result of the permanent income hypothesis whereby households spend in each period a fraction of the net present value of their future earnings and net asset stock relies on the ability to borrow/lend freely<sup>4</sup>. However, if this assumption does not hold, disposable income can affect consumption contemporaneously.

Accordingly, in this paper, consumption is considered to be determined according to:

$$c_t = f [E_t(y^P), A_{t-1}, y_t, \Omega_t] \quad (1)$$

where  $E_t(y^P)$  refers to expectations about permanent income,  $A_{t-1}$  refers to the net asset position at the start of the period and  $y_t$  to current period disposable income.  $\Omega_t$  accounts for period-specific effects such as the real interest rate.

Following the same logic, consumption should mainly react to changes in expectations. Predictable income changes influence consumption only if credit constraints are significant for households or if rule-of-thumb behavior is prevalent. Therefore, consumption dynamics are characterized by:

$$\Delta C_t = f[\Delta E_t(y^P), \Delta_{exo} A_{t-1}, \Delta y_t, \Gamma_t] \quad (2)$$

The subscript ‘exo’ for ‘exogenous’ in reference to the change in asset positions highlights the idea that consumption plans should react only to unpredictable changes in asset valuations related to, say, stock market fluctuations. On the other hand, decisions about e.g. the size of deposit or cash holdings are a means to achieve a household’s desired consumption path in response to economic circumstances and do not reflect exogenous shocks to consumption possibilities<sup>5</sup>. Also, consumption dynamics can be affected by period-specific effects,  $\Gamma_t$ , reflecting for instance the degree of uncertainty.

The equations above follow from standard household decision theory. However, when we later estimate these relationships, we rely on data aggregated to a regional level. Regional variation in demographics and income and wealth distribution can imply differences in the importance of various factors. Therefore, in addition to estimating the aggregate relationship, we conduct subgroup estimation and/or interact the regression coefficients with demographics and asset positions<sup>6</sup>.

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<sup>4</sup> Under complete asset markets, the transfer of resources does not take the form of borrowing/lending – instead consumption smoothing relies on state-contingent payouts.

<sup>5</sup> Although, as stated previously, the real value of nominal assets is subject to interest rate and inflation surprises.

<sup>6</sup> See Muellbauer and Murata (2009) for more discussion about aggregation and the stability of coefficients on income and wealth.

## A. Data

FIES is a rotating panel survey of 8000–9000 households at a given time used for instance in the estimation of quarterly GDP and the construction of the CPI. Each individual household is followed for a period of six months and then replaced. Information on income and consumption is collected every month and information on balance sheet items once per quarter. Detailed income information (incl. disposable income) is available only, though, for households headed by a salary worker (=‘worker household’) or whose household head is unemployed/retired. Therefore, the income of certain administrator/self-employed households is not recorded. A second issue is that the survey focuses on multi-person households. This means that the survey is not necessarily a representative sample of the whole population<sup>7</sup>.

We rely mainly on data aggregated (a) at the regional and (b) broad occupation class level in our analysis<sup>8</sup>. The geographic data is divided into ten regions with information on the consumption and balance sheet items of all multi-person households and detailed income information for multi-person workers’ households<sup>9</sup>. The survey does not contain a proper measure of housing assets, which leads us to construct our own proxy as described in the Data appendix. The occupation class data that we use separates between ‘laborer’ (=blue-collar), ‘professional’ (=white-collar) and ‘pensioner’ households<sup>10</sup>. Data on income and consumption is available from 2000 to 2016 and balance sheet data from 2002 to 2016 for both the regional and labor market group data.

Our regional data is at a quarterly frequency which generates around 500 observations for regression analysis. The labor market group data does not contain enough observations for regression analysis at a quarterly frequency. On the other hand, data on a monthly level are volatile/unreliable and would need to be interpolated for balance sheet information which is collected only quarterly. Therefore, the formal analysis focuses on the regional data with the labor market group data used to provide more detail about the observed variation. In some analyses, we also employ age-groups for which consumption information exists (but not that for income).

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<sup>7</sup> However, a quick comparison of the over 65 share in the survey data and the United Nations population data does not reveal a large discrepancy. The survey measure increased from 16 percent in 2000 to 27 percent in 2015. The figures for the United Nations data were 17 percent and 26 percent

<sup>8</sup> The household-level microdata is in principle available upon application at the discretion of public officials but is subject to geographic restrictions.

<sup>9</sup> Unfortunately, the available aggregated time series do not contain a breakdown of retired households’ or all multi-person households’ income by region.

<sup>10</sup> The ‘pensioner’ category includes also households that are unoccupied for reasons other than retirement. However, the aggregate is dominated by ‘true’ pensioners which can be checked by using the shorter data sample available (from 2007) for actual pensioners. These two series basically overlap.

### III. EVOLUTION OF CONSUMPTION, INCOME AND ASSETS

Consumption is not a unitary concept; its composition reacts to changes in technology, prices and consumer tastes. Accordingly, Figure 1 reveals that whereas non-housing real consumption per capita has stayed basically flat over the sample period, durables have increased and other items decreased in *volume* terms. Durables also reacted strongly to the April 2014 VAT hike. Consumption volumes strongly mirror the development in relative prices. Technological progress has tended to decrease the prices of manufactured goods whereas more labor intensive items (in particular services) have not experienced price declines even in Japan's deflationary environment. Consequently, the purchasing power of the stagnating nominal income has increased in terms of durables but decreased in terms of non-durables and services.

The stagnation in real per capita non-housing consumption is broad-based, spanning different occupation classes, regions and age groups (Figures 2 and 3). For instance, Figure 3 shows that it is almost impossible to detect any differences in the consumption *trends* between age groups, notwithstanding the differences in consumption *levels*. This is *prima facie* evidence that aggregate consumption weakness is not explained by developments particular to a few population subgroups or regions<sup>11</sup>.

If assets are becoming more important in financing consumption, we would expect a rising trend in assets-to-income and consumption-to-income ratios. The old-age share and the retired share have been steadily rising across regions, depressing income growth (Figure 4). The increase is quite staggering with the countrywide retired share almost doubling from 12 percent to 22 percent over the sample period. However, labor participation rates have not declined correspondingly because of offsetting factors including declining unemployment, longer working careers and increased female participation. Still, in the aggregate the ratio of financial assets to income has been rising (Figures 5 and 6). Consequently, we do indeed detect a secular, although mild, increase in the aggregate consumption-to-income ratio (Figure 7 top panel). This is related to the increase in the population share of old people (with a relatively high C-I ratio) as well as a rising C-I ratio for the elderly (Figure 7 bottom panel).

Before turning to formal regression analysis, we close this section by studying whether the hypothesized bivariate relationships hold in the regional dataset (Figures 8 to 11). Firstly, financial assets relative to income are higher with an older population. Only a part of this is explained by lower income of retired people, as pensioners hold significantly higher absolute amounts of financial assets than other groups. Secondly, consumption-to-income ratios are higher as the old-age share increases, although the connection weakens significantly after netting out time and area fixed effects. Thirdly, higher financial assets are associated with higher consumption with or without controlling for fixed effects. Finally, in relation to

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<sup>11</sup> Even the little regional variation that we detect is mostly driven by the two smallest regions (Okinawa and Hokkaido) with less reliable data due to their limited sample sizes.

consumption smoothing, we find that higher ex ante liquid assets are associated with lower consumption variability.

#### IV. REGRESSION ANALYSIS

To move beyond bivariate correlations, in this section we operationalize equations (1) and (2) to study the determinants of consumption in a panel regression setup using Japanese regional data. Although we use regional data in our estimation, Figure 12 first depicts visually the co-movement of the various variables at the national level. A first thing to notice is that the range of variation is limited, i.e., there are no dramatic booms and busts during the period, even though it coincided with the global financial crisis. We again see the stagnating consumption, although it is important to note that disposable income has not performed any better. House prices were on a downward trend for a long time following the burst of the bubble back in the 1990s, but they have started to slowly recover after the financial crisis. Net liquid assets<sup>12</sup> began to increase around 2009 and the latest flattening is due to a pick-up in mortgages. Illiquid financial assets<sup>13</sup> seem to track general asset market movements during the period.

##### A. Importance of Income and Assets for Financing Consumption

To study the connection between consumption, income and asset levels, we define an empirical counterpart to equation (1) by adding leads and lags of the first differences of the explanatory variables to estimate a PDOLS model<sup>14</sup> following Mark and Sul (2003) with regions as the panel dimension:

$$\begin{aligned} \log c_{i,t} = & \beta \log y_{i,t} + \gamma_1 \log \text{NetLiqA}_{i,t-1} \\ & + \gamma_2 \log \text{IlliqA}_{i,t-1} + \gamma_3 \log \text{Housing}_{i,t-1} + \alpha_t + \varphi_i \Omega_{i,t} + \epsilon_{i,t} \end{aligned} \quad (3)$$

where  $\Omega_{i,t}$  includes two leads and lags of the first differences of income and asset variables. Common time effects  $\alpha_t$  account for short-term disturbances affecting all regions such as the 2014 VAT hike.

The consumption measure used in the levels specification is real non-housing expenditure which is the metric most closely associated with the budget constraint. Balance sheet items are separated into net liquid assets, illiquid financial assets and housing. All variables are measured in real per capita terms by deflating them with the non-housing CPI.

PDOLS estimation attempts to gauge an equilibrium connection between variables that are integrated of the same order. The budget constraint implies a strong equilibrium connection

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<sup>12</sup> Sum of deposits and cash holdings minus total debt (incl. mortgages).

<sup>13</sup> Sum of securities, individually purchased annuity policies and foreign-currency denominated assets.

<sup>14</sup> Panel Dynamic OLS.

between consumption, income and assets, although it is not to be expected that the relationship necessarily be stable, nor that the economy will find itself at the equilibrium for most of the time. The leads and lags of first differences of explanatory variables aim to account for these deviations from equilibrium.

Table 1 reveals that on average during the whole sample period, a 1 percent increase in non-property disposable income<sup>15</sup> was associated with consumption increasing by 0.5 percent. Illiquid financial assets were positively related with consumption with a point estimate for the marginal propensity to consume out of wealth of 5 percent. Also housing and consumption co-move positively, although the interpretation of the point estimate is more challenging given the construction of our housing value metric (see Data appendix for details). However, there is no statistically significant connection between net liquid assets and consumption when the whole sample period is used for estimation. Lastly, we include the old age share in the model as a test but do not detect any independent role after controlling for income and assets.

The Mark and Sul (2003) methodology assumes a common long-run relationship across regions [the vector  $(\beta, \gamma_1, \gamma_2, \gamma_3)$ ] but allows for heterogeneous dynamic reactions [the vector  $\varphi_i$ ]. However, the coefficients can be non-constant because of differences in demographics and income and wealth distribution. Therefore, we test the stability of the long-run relationship by splitting the sample temporally and by regions.

When splitting the sample into an early and late period (last two columns of Table 1), we detect that the link between income and consumption was somewhat weaker and that of assets stronger in the latter period. This would be consistent with a story where the demographic transition induces a relative increase in the weight of assets as a driver of consumption. However, the results need to be taken with a grain of salt because the two subsamples are quite short and therefore short-term shocks could affect the point estimates.

In Table 2, we split the regions equally into three categories based on the average over 65 year population share. Income is most strongly (weakly) connected to consumption for the young (middle-aged). This is consistent with the relatively young regions relying on income to finance consumption due to the paucity of assets and potential credit constraints. On the other hand, the 'middle-aged' regions could be in the process of building up assets for old age according to standard life-cycle behavior, leading to a weak relationship between income and consumption. Only for the oldest third of regions do we detect a positive relationship between net liquid assets and consumption, fitting the story of an increase in the importance of liquid savings for financing expenditure as a result of ageing.

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<sup>15</sup> We always subtract property income (rents, interest, dividends) from the aggregate disposable income because we focus on labor income. Including interest and dividends would also imply double counting because the inclusion of asset stocks is meant to capture their importance.

## B. Determinants of Short-term Consumption Movements

Moving on to explaining short-term consumption dynamics, the empirical counterpart to equation (2) is:

$$\begin{aligned} \Delta \log c_{i,t} = & \alpha_i + \beta \Delta \log y_{i,t} + \kappa \Delta E_t(y^P) + \gamma_1 \Delta_{exo} \log \text{lliq} A_{i,t-1} \\ & + \gamma_2 \Delta_{exo} \log \text{Housing}_{i,t-1} + \theta \Gamma_{i,t} + \mu_{i,t} \end{aligned} \quad (4)$$

According to our specification, consumption growth is affected by changes in disposable income, changes in expectations about future income and exogenous variation in asset holdings. The assumption is that only the value of securities and housing can change exogenously whereas changes in liquid assets (deposits, cash) are endogenous to the consumption plan of the household. Therefore, we do not include the net liquid asset term in the equation, although we later test for its empirical significance as a robustness check.  $\Gamma_{i,t}$  includes other time-specific effects that can affect consumption. Region-specific fixed effects  $\alpha_i$  are included to account for unobserved regional factors leading to differences in average growth.

The consumption measure in the dynamic equation is non-durable and services consumption, which is the relevant concept for intertemporal utility maximization, given that the utility flow from durables is spread out over a long period<sup>16</sup>. Consumption growth is measured by dividing quarterly consumption by the consumption in the same quarter in the preceding year. Standard errors are clustered at the regional level and we also allow for contemporaneous cross-region correlation (Driscoll and Kraay, 1998). Critical values are taken from the  $t(9)$  distribution given the problem of few clusters (10 regions).

Table 3 presents the results for different specifications. A clear takeaway is that disposable income growth and the relative price of the consumption basket are the most consistent predictors of short-term consumption dynamics. A 1 percent increase in disposable income is associated with a consumption rise of around 0.3 percent. We do not attempt to distinguish here between predictable/surprise or transitory/permanent changes in income because we lack household-level microdata. However, the instrumental variables results using predetermined instruments (discussed more below and in the Data appendix) generate very similar point estimates. Therefore, even predictable income changes would seem to affect consumption through, say, credit constraints or rule-of-thumb behavior.

The measure of expected future income is the Consumer Confidence Survey metric of income expectations. This measure queries income expectations six months forward, admittedly too short a period. The alternative would be to try to proxy for permanent income

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<sup>16</sup> The monetary variables are again measured in real per capita terms by deflating them with the non-durable and services CPI.

expectations by generating forecasts of future disposable income growth. This is not unproblematic though, given differences in the information sets of households and the econometrician. The Consumer Confidence Survey has the benefit that expectations are elicited directly from *households*. The expectations index is individually significant in around half of the specifications at the 5 percent level<sup>17</sup>.

The first three models differ in which metric is used to gauge the effects of asset movements that do not arise from the actions of the household. The *Baseline* model uses only the change in the value of stock holdings, which should suffer less from household decisions than a broader measure including for instance deposits. The *AllAssets* model instead includes the change in both total net liquid assets and illiquid financial assets. *Nikkei* simply replaces the balance sheet data with the Japanese stock market index.

The exact asset measure does not, however, strongly influence the results. In almost all models, lagged asset growth is not related to consumption growth. This would imply that at a yearly frequency the consumption behavior of Japanese households is not strongly affected by asset market movements. The positive but statistically insignificant housing value coefficients differ from the negative relationship between land prices and consumption found by Muellbauer and Murata (2009).

The coefficient on the real interest rate<sup>18</sup> is meant to estimate the effect on consumption arising from (a) the substitution effect and (b) the wealth effect through the real value of liquid assets and debt. The substitution effect would tend to generate a positive coefficient due to higher interest rates incentivizing delaying consumption. The wealth effect would produce a negative (positive) effect depending on whether debtors (creditors) dominate in the economy. The results do not provide strong evidence about the strength of these forces. The coefficient is not consistently significant and actually flips its sign when using only the early period for estimation. The paucity of evidence might not be that surprising given that nominal interest rates have been stuck at the lower bound and almost all of the movement in real interest rates has been due to changes in expected inflation<sup>19</sup>.

If we split the sample into an early and late half, we detect analogously to the levels estimation that the influence of disposable income on consumption seems to have weakened

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<sup>17</sup> Disposable income growth naturally also contains information about future income, which influences the additional predictive power of the expectations measure.

<sup>18</sup> The nominal interest rate is measured as the rate on the 1-year Japanese government bond. The fourth model (*HHExp*) replaces Consensus Economics as the source of inflation expectations by the Consumer Confidence Survey which elicits household expectations, although this data is only available since 2004

<sup>19</sup> It would be wrong to conclude, though, that monetary policy would not impact consumption via various economic mechanisms. For instance, disposable income growth can be influenced by traditional and unconventional monetary policy measures.

somewhat. The specification with only the more recent data is also the only one which tentatively generates a statistically significant estimate for asset growth.

We do not detect any consistent independent connection with various uncertainty indicators and consumption. Regional unemployment does not seem to influence consumption once disposable income growth is controlled for. The asset market volatility measure VXJ is also mostly insignificant, and has a counterintuitive sign when significant. Finally, the fiscal policy uncertainty indicator (see Arbatli et al. (2016)), which gauges uncertainty about fiscal policy based on domestic news coverage, has no effect either.

### **Dynamics: Robustness**

Survey based data is always noisy, which can lead to errors in point estimates with limited sample sizes. Noisy data both increases the chance of finding a connection that does not exist and the chance of not detecting a true relationship. We drop observations where the absolute value of consumption growth is over 10 percent to attempt to guard against outliers arising from mismeasurement. In addition, the model *CoreReg* drops the two smallest regions (Okinawa and Hokkaido) with the smallest sample sizes. Results remain broadly unchanged.

The specifications incorporate variables that aim to account for common factors affecting all regions. The measure of future income expectations is at a national level, as are the real interest rate, relative prices, Nikkei, VXJ, and the fiscal uncertainty index. Another option is to replace these variables by time dummies. The *Time FE* model yields similar results in terms of the impact of short-term income and asset dynamics on consumption.

Macroeconomic variables are naturally endogenous to each other with complex interactions between them. Income in the current quarter can be influenced by consumption in the same quarter. The asset stocks are predetermined because we use lagged values, although especially some measures can still be influenced by household decisions in addition to market movements. Consumption can also influence relative prices following the interplay of supply and demand. Therefore, the last two specifications are based on an instrumental variables estimation where disposable income growth, the change in assets, the real interest rate, the relative price measure and the change in regional unemployment are instrumented as described in the Data appendix. The results are broadly unchanged, although we lose quite a few observations and the statistical significance of the relative prices is weakened.

### **Heterogeneity of Consumption Response by Demographics and Assets**

Finally, we try to gauge whether the reaction of consumption growth to its determinants varies depending on demographics and asset positions. To tackle this, we modify slightly the *Baseline* model from Table 3. We interact variables of interest with the over 65 population share and different asset measures.

The results (Table 4) indicate that the connection between disposable income growth and consumption weakens as the population ages. As we measure the income of worker's households, it is unsurprising that the labor income that we primarily capture becomes less significant with ageing.

A second finding is that relatively high net liquid assets are associated with a more positive effect of higher real interest rates on consumption. This is consistent with a positive wealth effect for creditors that benefit from a higher real value of liquid assets, in line with the findings of Ichiue and Nishiguchi (2015). However, given our earlier inconclusive results, the asset rich households do not generate a strong positive effect from higher real interest rates on consumption growth in the aggregate (at least yet)<sup>20</sup>.

Finally, the results regarding assets and consumption smoothing are inconclusive. Although higher assets are associated with future income growth being less relevant for short-term consumption dynamics, this is not the case with current period disposable income growth<sup>21</sup>.

## V. CONCLUSIONS

We have studied the evolution of household consumption in Japan, highlighting potential effects of changes in income and wealth distribution and demographics. Stagnation in real per capita consumption is widespread precluding a simple explanation based on developments of a particular population subgroup. Although per capita consumption volumes are flat, we detect a secular, mild increase in consumption-to-income ratios. Assets are therefore slowly becoming more important in financing consumption relative to income. In terms of short-term reactions, though, consumption still seems more responsive to income changes than asset market movements.

Going forward, changes in demographics and income and wealth distribution can have implications on the quantitative effect of various economic shocks on consumption. For instance, large asset stocks can *limit* consumption variability in response to transitory income shocks but *strengthen* the reaction to inflation and interest rate surprises. On the other hand, ageing can shorten the planning horizon of the average household, making consumption more responsive to income changes. A higher weight of creditor households will tend to make the response of aggregate consumption to lower real interest rates less positive/more negative.

This study has relied on FIES data aggregated to regions and labor market groups to gauge the impact on consumption of structural changes in the Japanese economy. However, it is

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<sup>20</sup> A caveat should again be made about the low degree of variability in real interest rates. Still, we do not find the same result as Muellbauer and Murata (2009) in this regard.

<sup>21</sup> Naturally, the link between assets and the responsiveness of consumption to income changes depends on the nature of income shocks experienced during the period.

challenging to appropriately control for sampling variation over time using aggregated series. Many interesting research questions would also require more detailed information. These include event studies of particular policy changes, or the evaluation of birth-year cohort effects. Therefore, the availability of household-level microdata would be crucial for future research on this topic.

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## Data Appendix

### Data Sources

The Family Expenditure and Income Survey data is downloaded by using the Japanese statistics API [[www.e-stat.go.jp/api/](http://www.e-stat.go.jp/api/)] in conjunction with the R package 'estatapi' [[github.com/yutannihilation/estatapi](https://github.com/yutannihilation/estatapi)].

Interest rates, prices, unemployment rates and the Consumer Confidence Survey data are easily available from public sources. Consensus Economics provided the inflation forecasts used in the computation of the real interest rate. The fiscal policy uncertainty index was shared by the authors of the forthcoming Arbatli et al. (2016).

### Estimation of Housing Assets Held by Households

FIES does not contain detailed information about the market value of the housing assets owned by households. Houses are, still, an important part of household balance sheets. Therefore, we needed to construct our own measure. Firstly, we splice the quarterly regional real estate price index available since 2008 with the land price index on residential land available before that [[www.tochi.mlit.go.jp/](http://www.tochi.mlit.go.jp/)]<sup>1</sup>. Thereafter we deflate the nominal index with the consumption price index similarly as with other nominal variables. Finally, to estimate a *value* index of housing held by the average household in a given region and quarter, we multiply the real housing *price* index by the share of homeowners in that region-quarter pair (available in FIES) and take into account the average house size of these homeowners (also available in FIES)<sup>2</sup>.

### Instrumental Variables Estimation

In model *IV* in Table 3 the instruments Used are:

- disposable income growth: lagged level of disposable income, lagged disposable income growth and lagged expectation of future income
- stock holdings growth: Nikkei return
- ex-ante real interest rate: lagged real interest rate and lag of expected forward 1-year rates derived using the yield difference of 1- and to 2-year bonds
- unemployment change: lagged level of unemployment, lagged expectations about employment prospects (Consumer Confidence Survey), lagged level of real exchange rate,

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<sup>1</sup> The land price index is at an annual level, so we interpolate quarterly values using a polynomial smoother.

<sup>2</sup> We use a crude approximation that the house price increases to the power of 3 as the size of the house grows.

lagged values of OECD composite leading indicators for United States and China

- relative prices: lagged relative prices <sup>3</sup>

The model *IV Nikkei* is the same except that instead of instrumenting stock holdings growth by the Nikkei return, we plug in the Nikkei return directly as a proxy.

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<sup>3</sup> Our measure of relative prices is twice differentiated to ensure stationarity.

Figure 1. Real Consumption Per Capita Index (above) and Consumer Price Index (below) (2010=100)

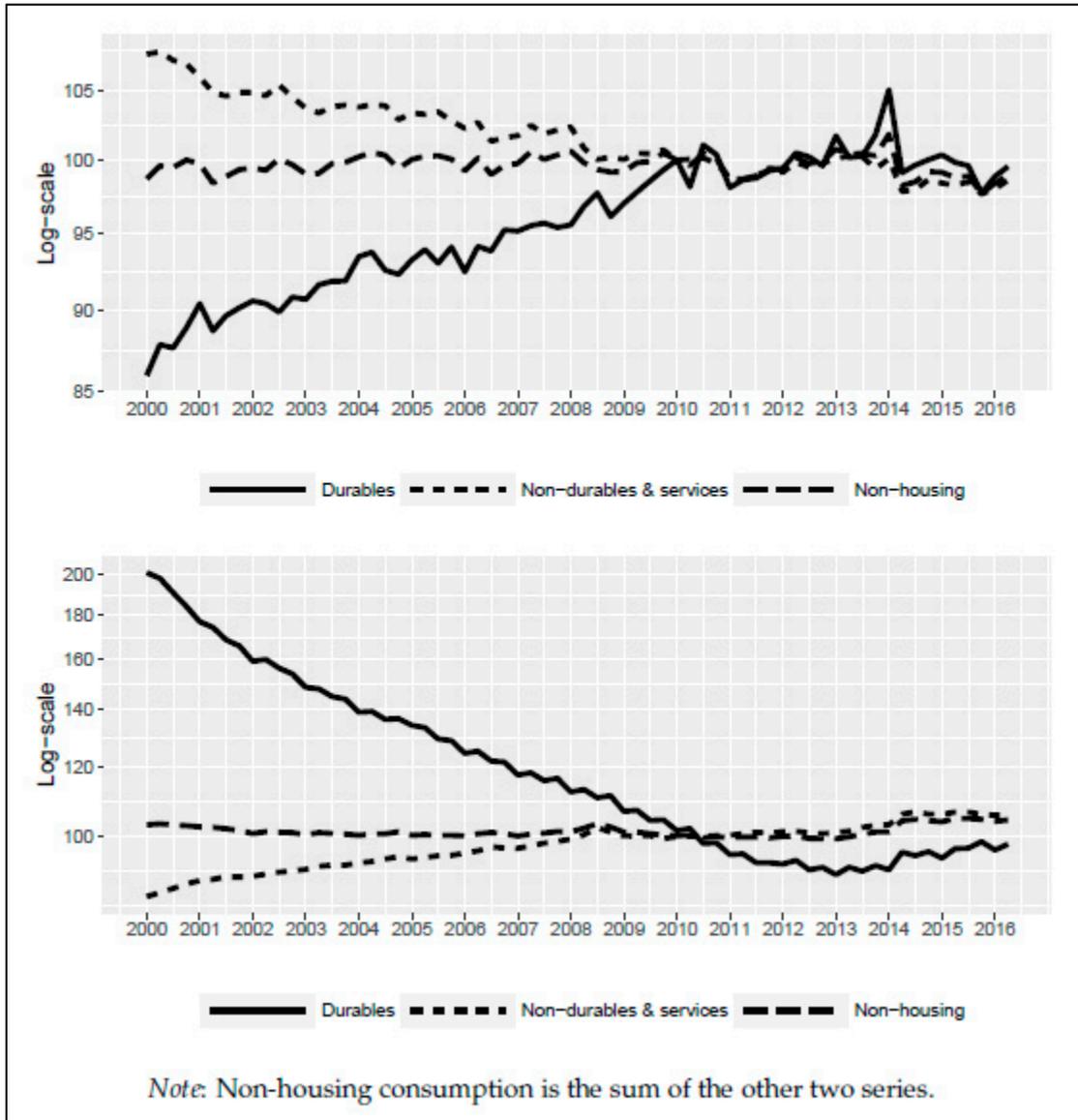
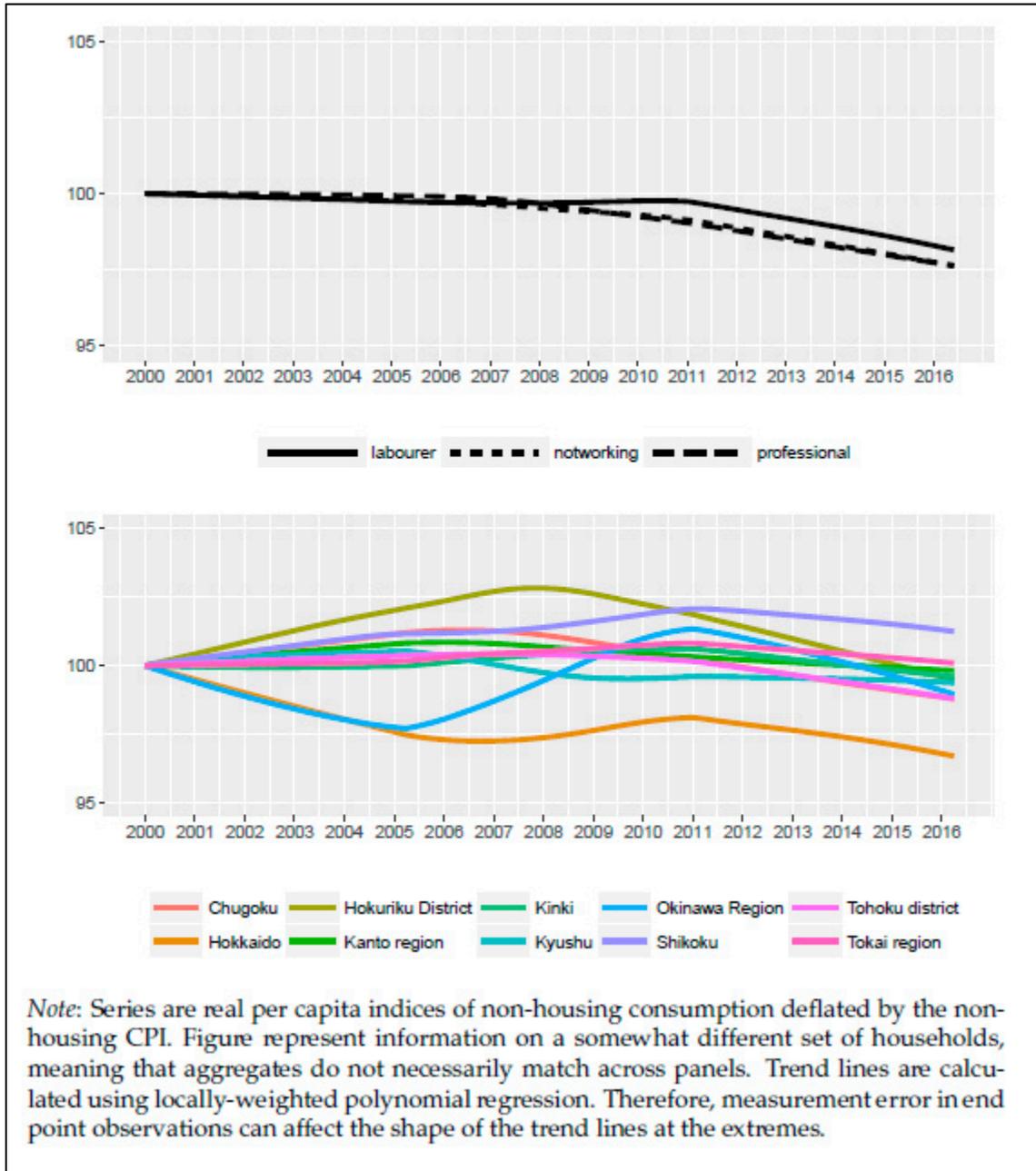
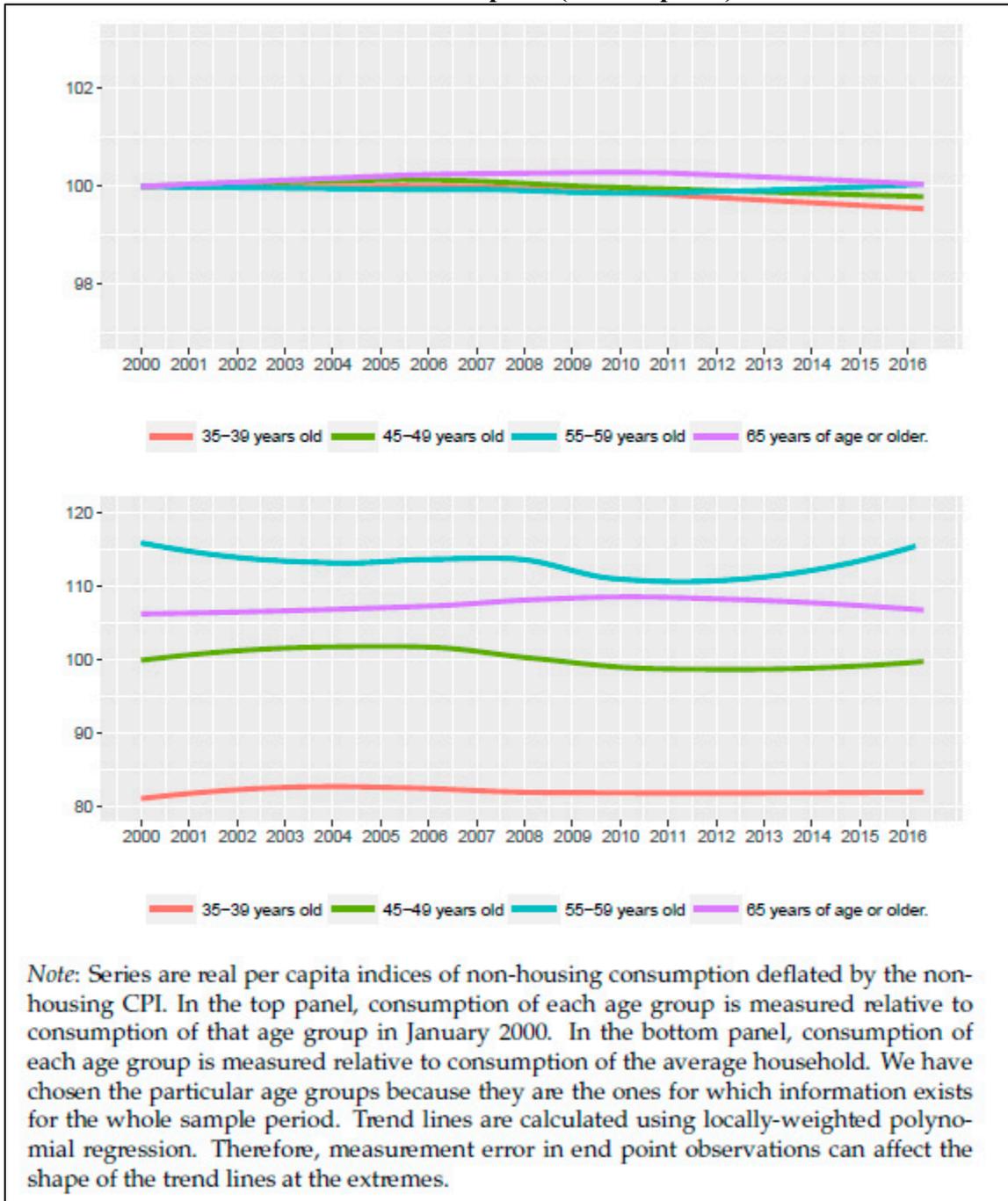


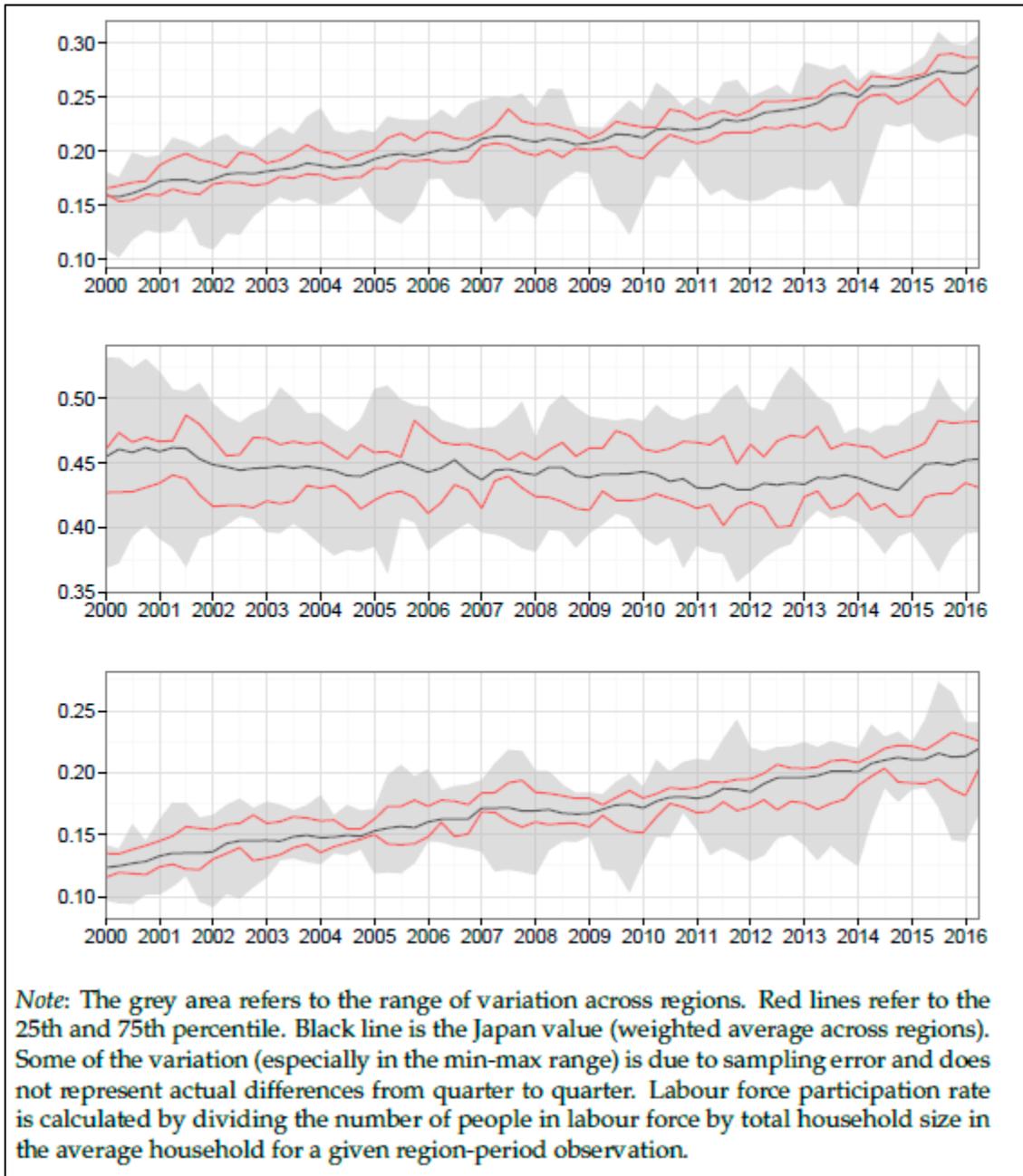
Figure 2. Trend of Consumption Volume by Occupation Class and Region (2000Jan=100)



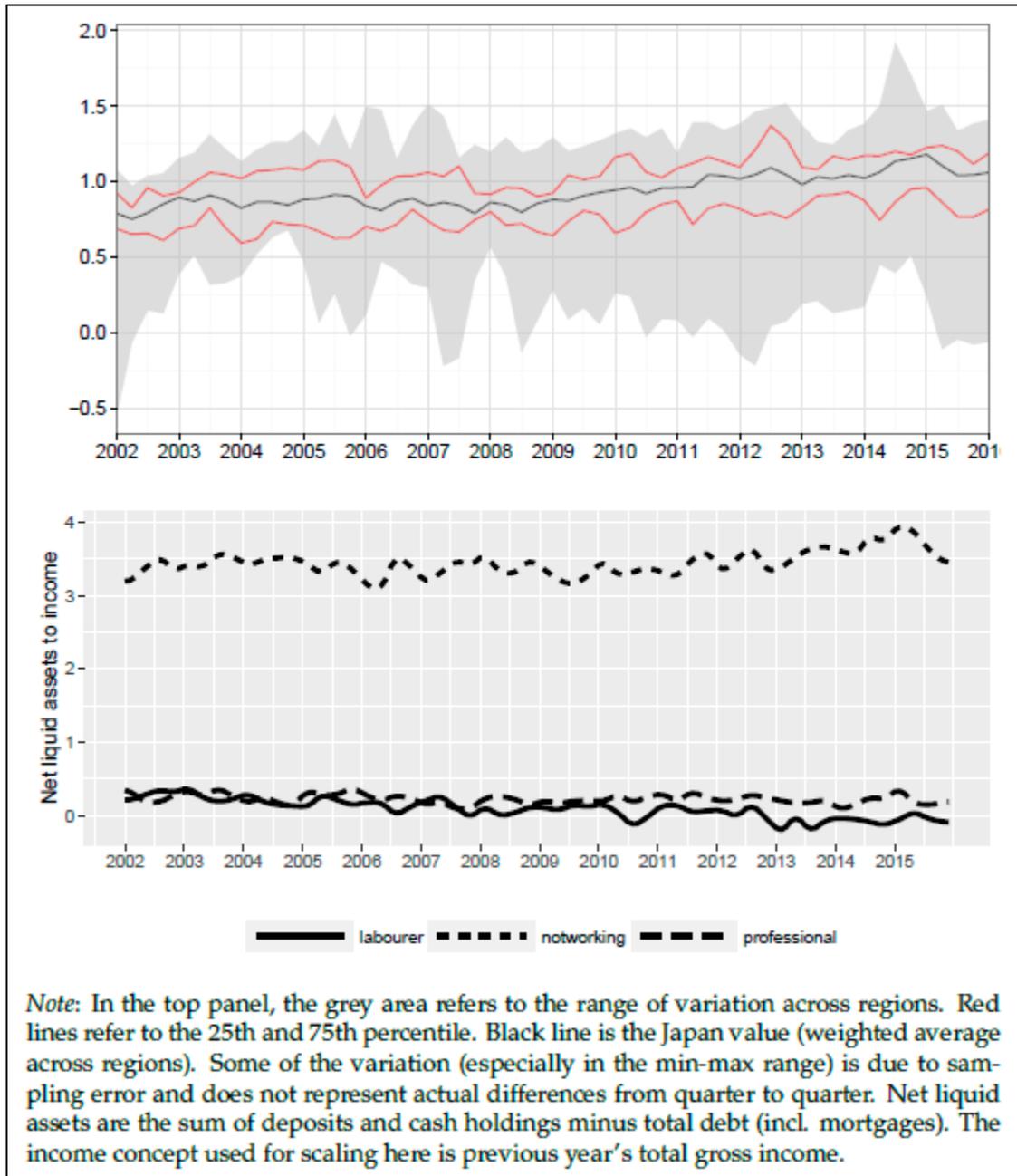
**Figure 3. Trend of Consumption Volume by Age Group (top panel) and Trend of Relative Consumption (bottom panel)**



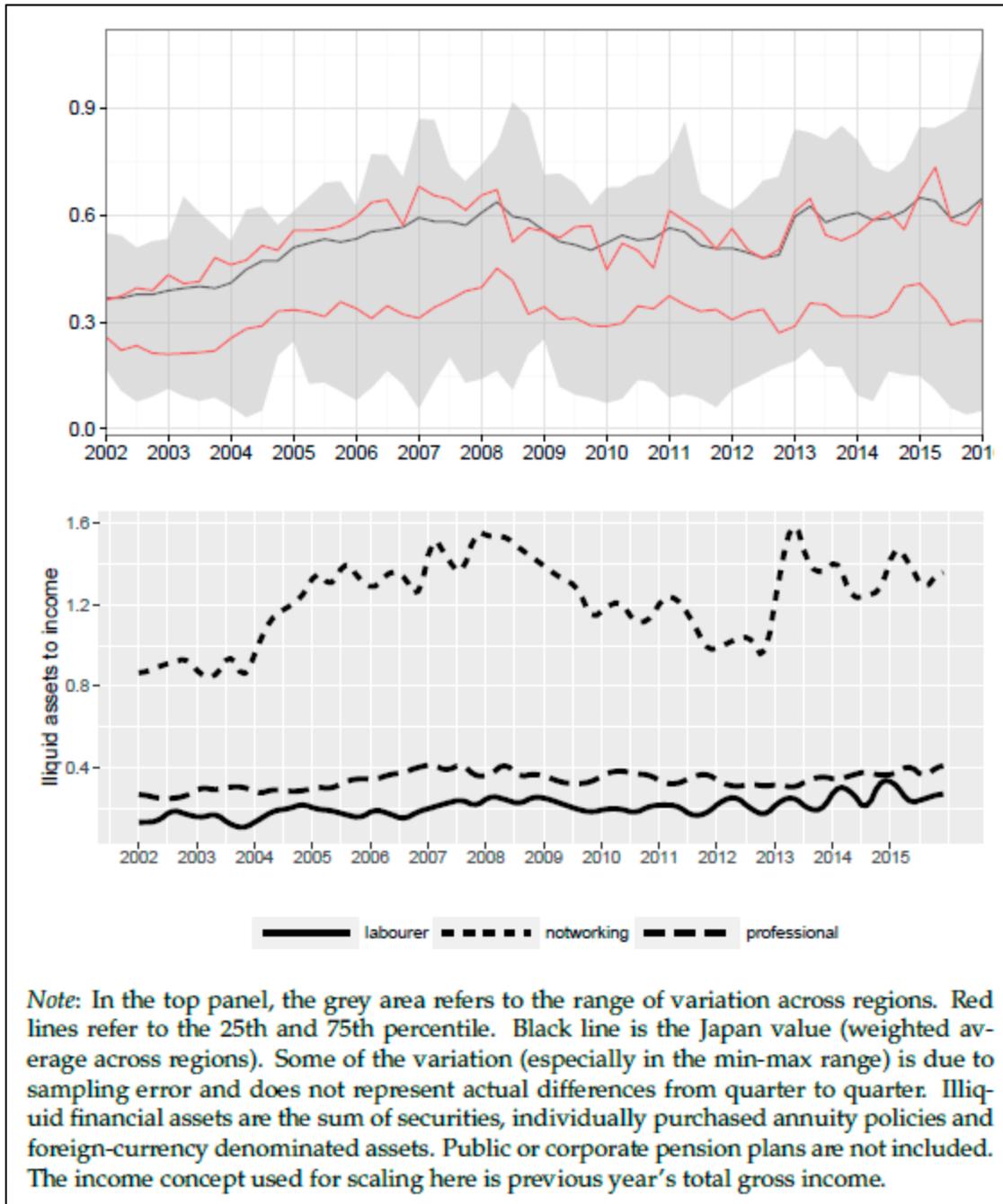
**Figure 4. Evolution of Share of Over 65 Year Olds (top), Labor Force Participation (middle) and Retired Share (bottom)**



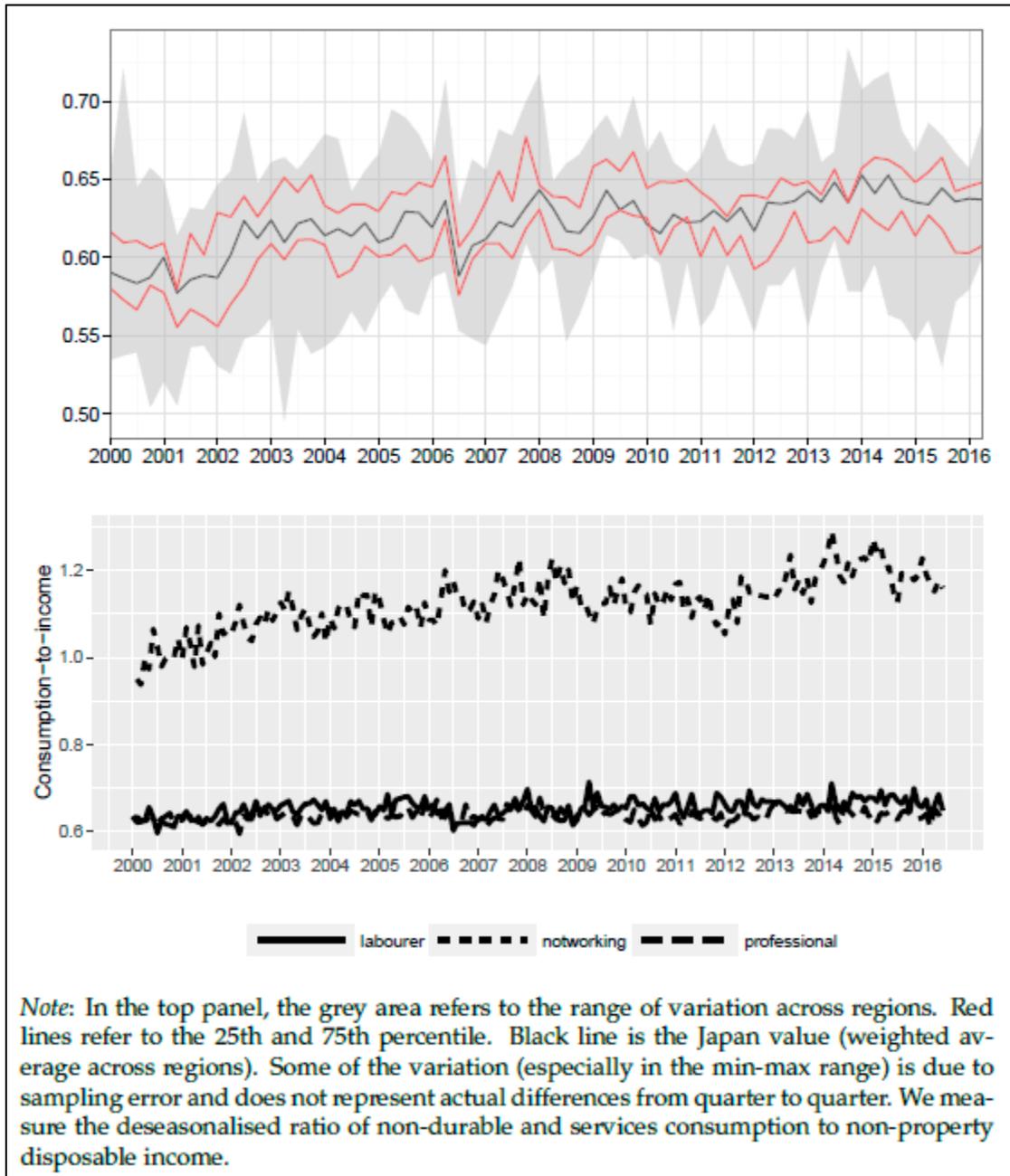
**Figure 5. Evolution of Net Liquid Assets to Income Ratios by Region (above) and Occupation Class (below)**

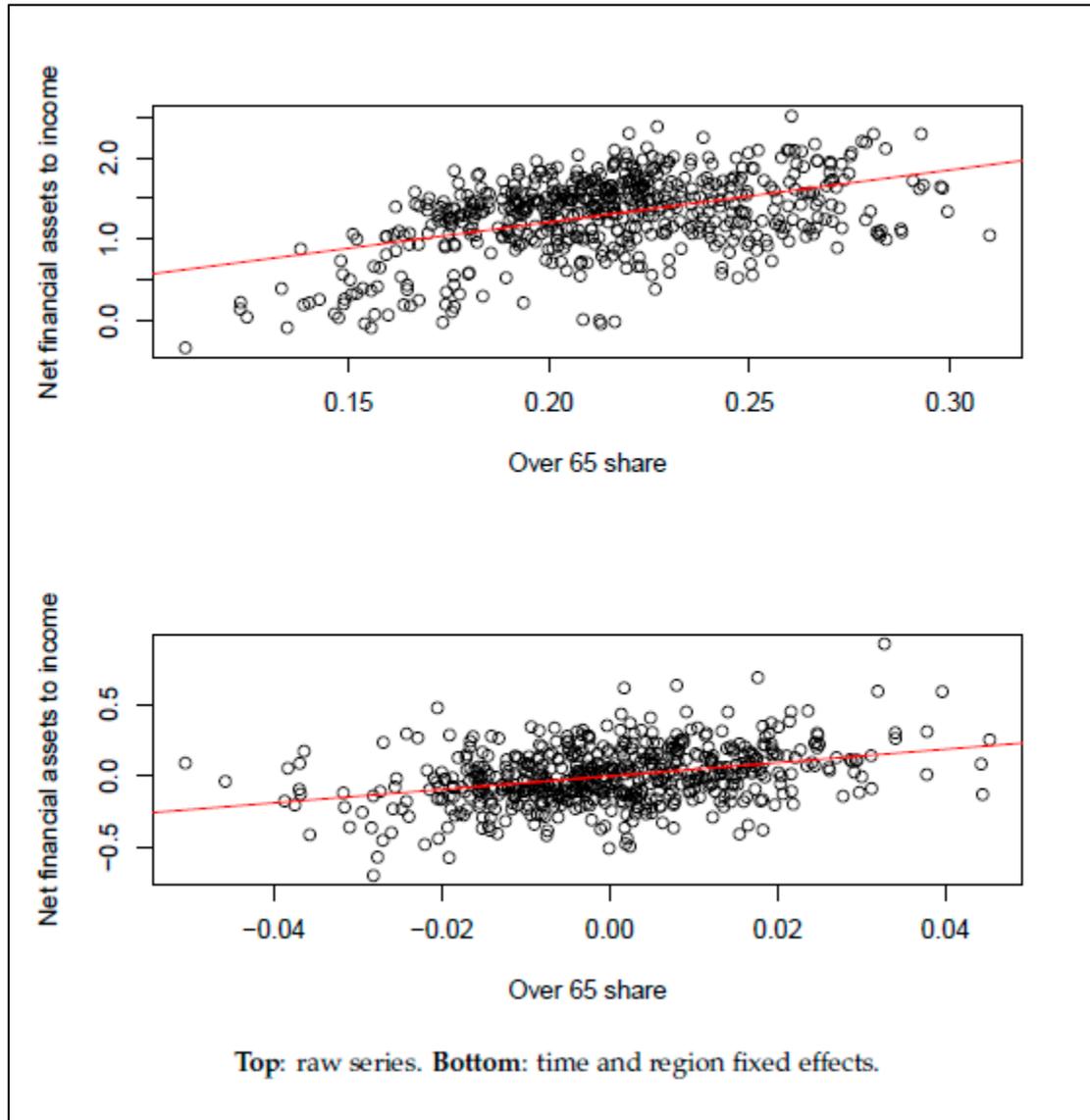


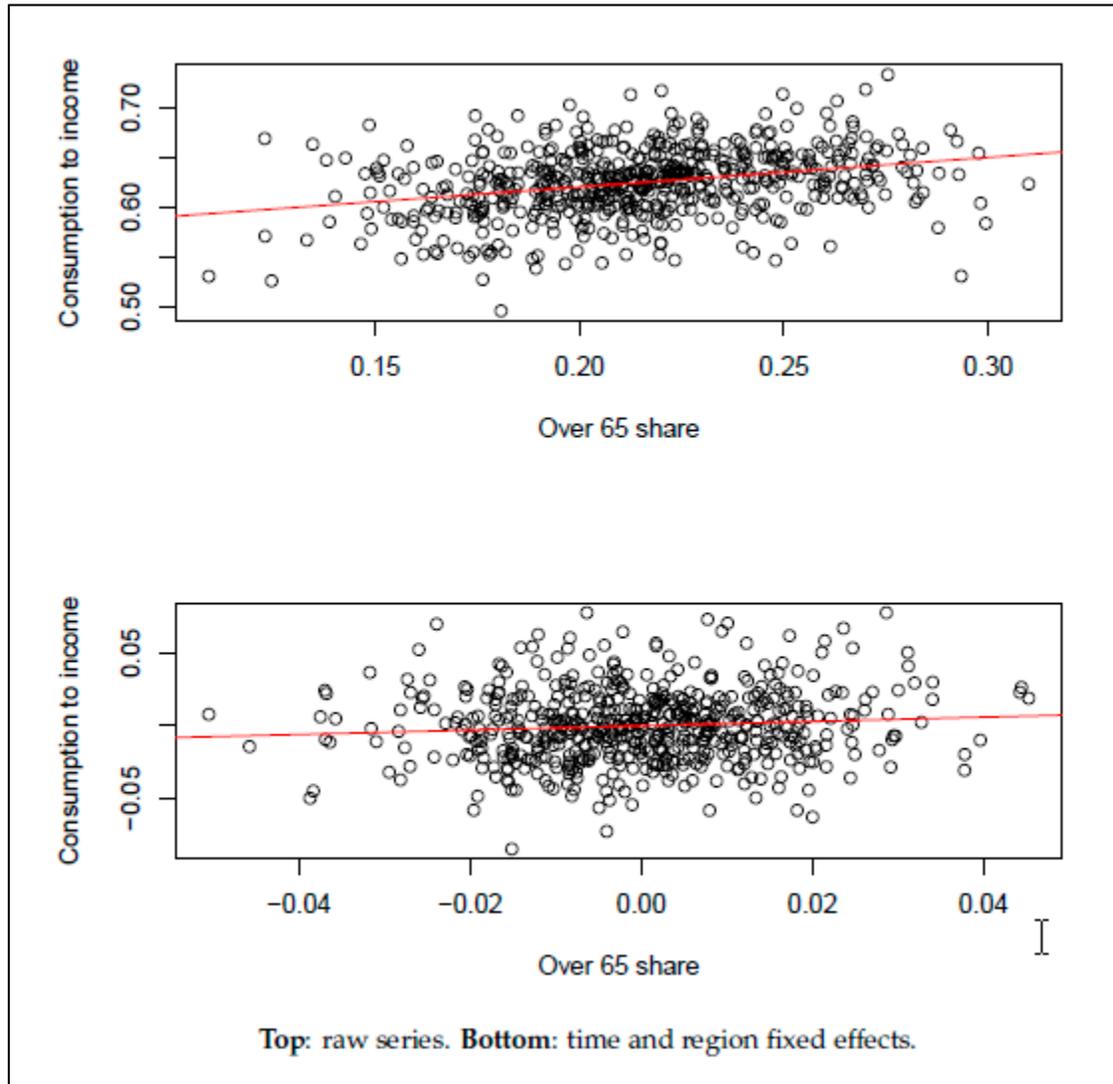
**Figure 6. Evolution of Illiquid Financial Assets to Income Ratios by Region (above) and Occupation Class (below)**



**Figure 7. Evolution of Consumption to Income Ratios by Region (above) and Occupation Class (below)**



**Figure 8. Share of Over 65 Year Olds and Assets-to-Income**

**Figure 9. Share of Over 65 Year Olds and Consumption-to-Income**

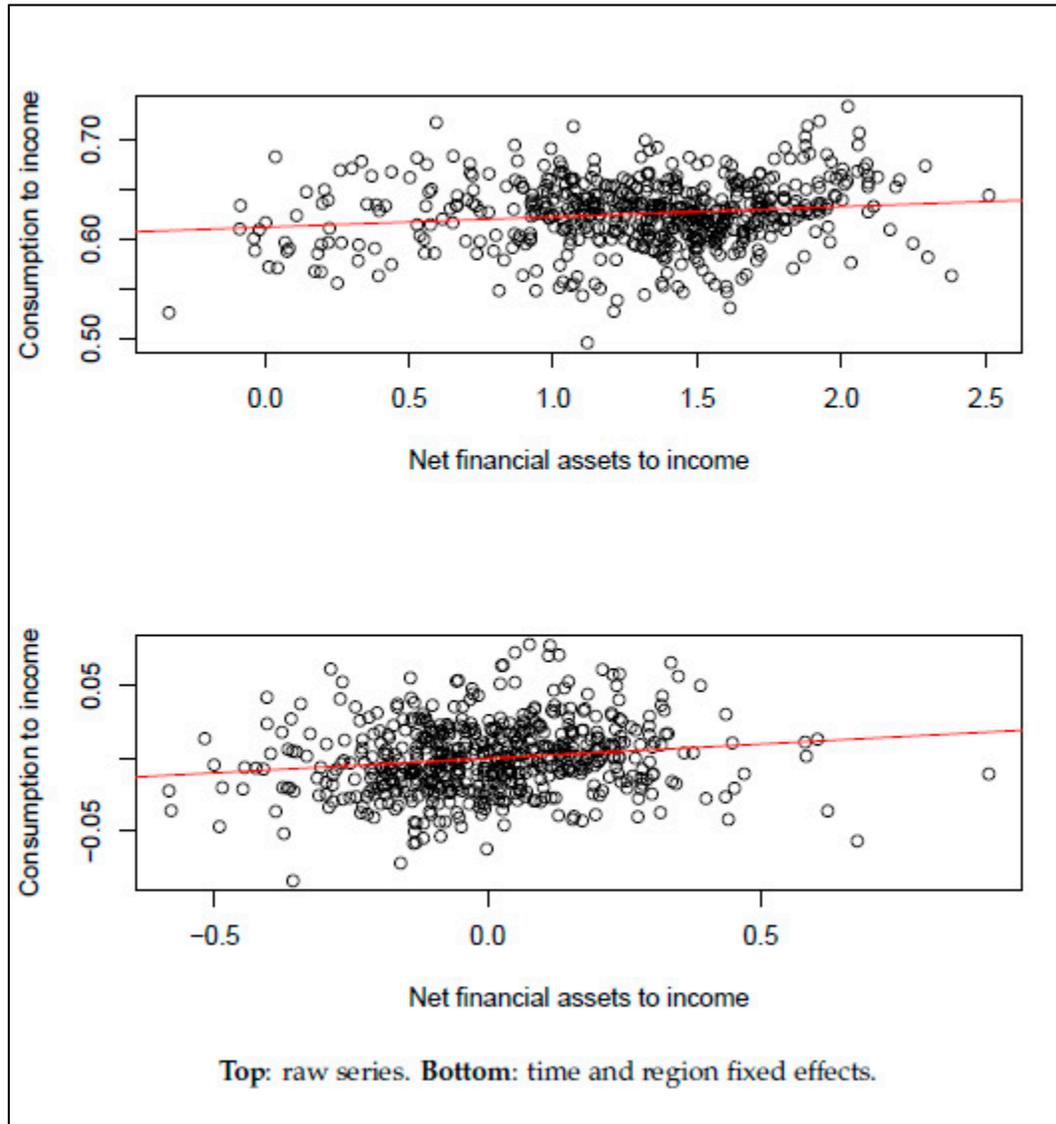
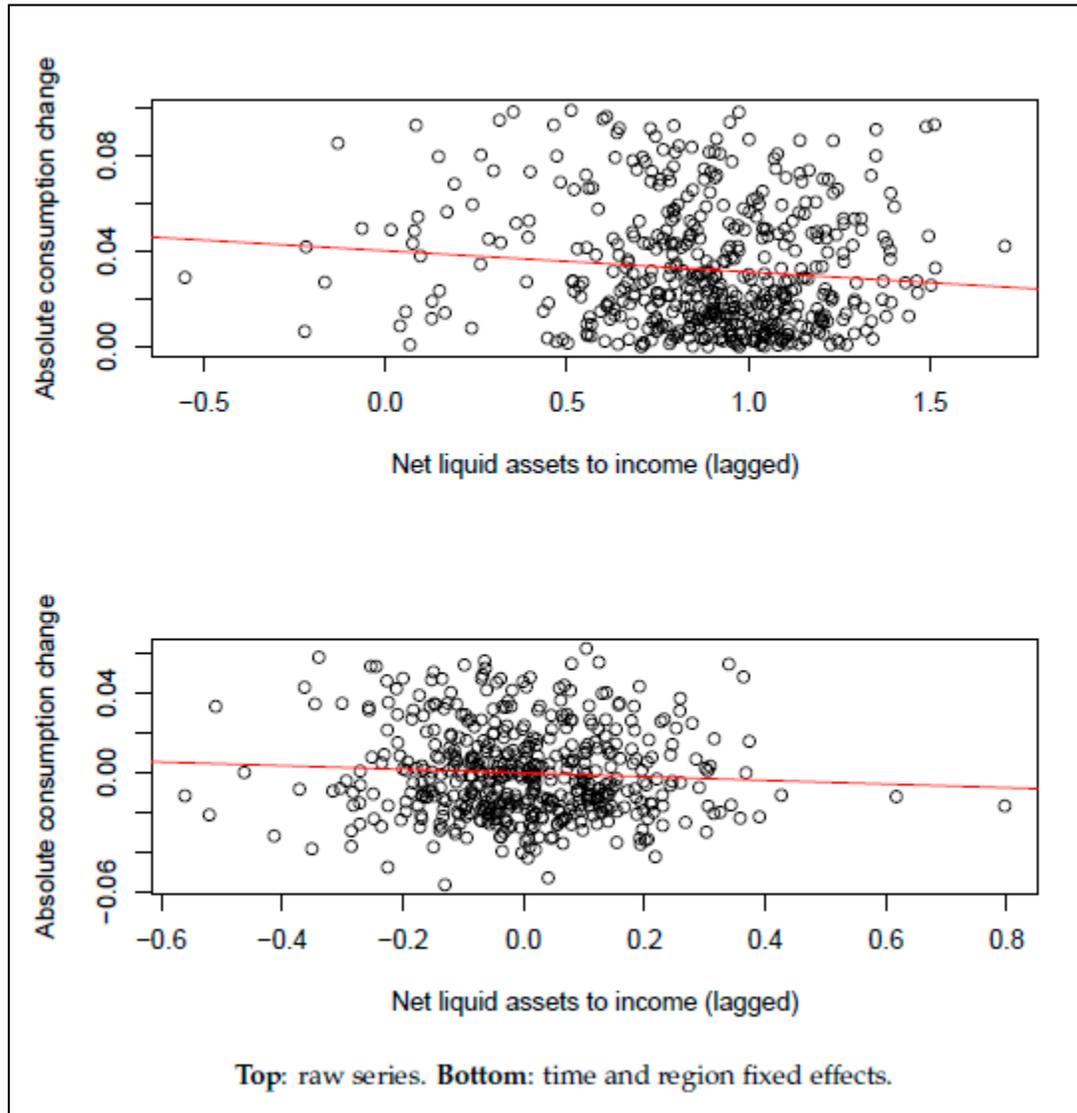
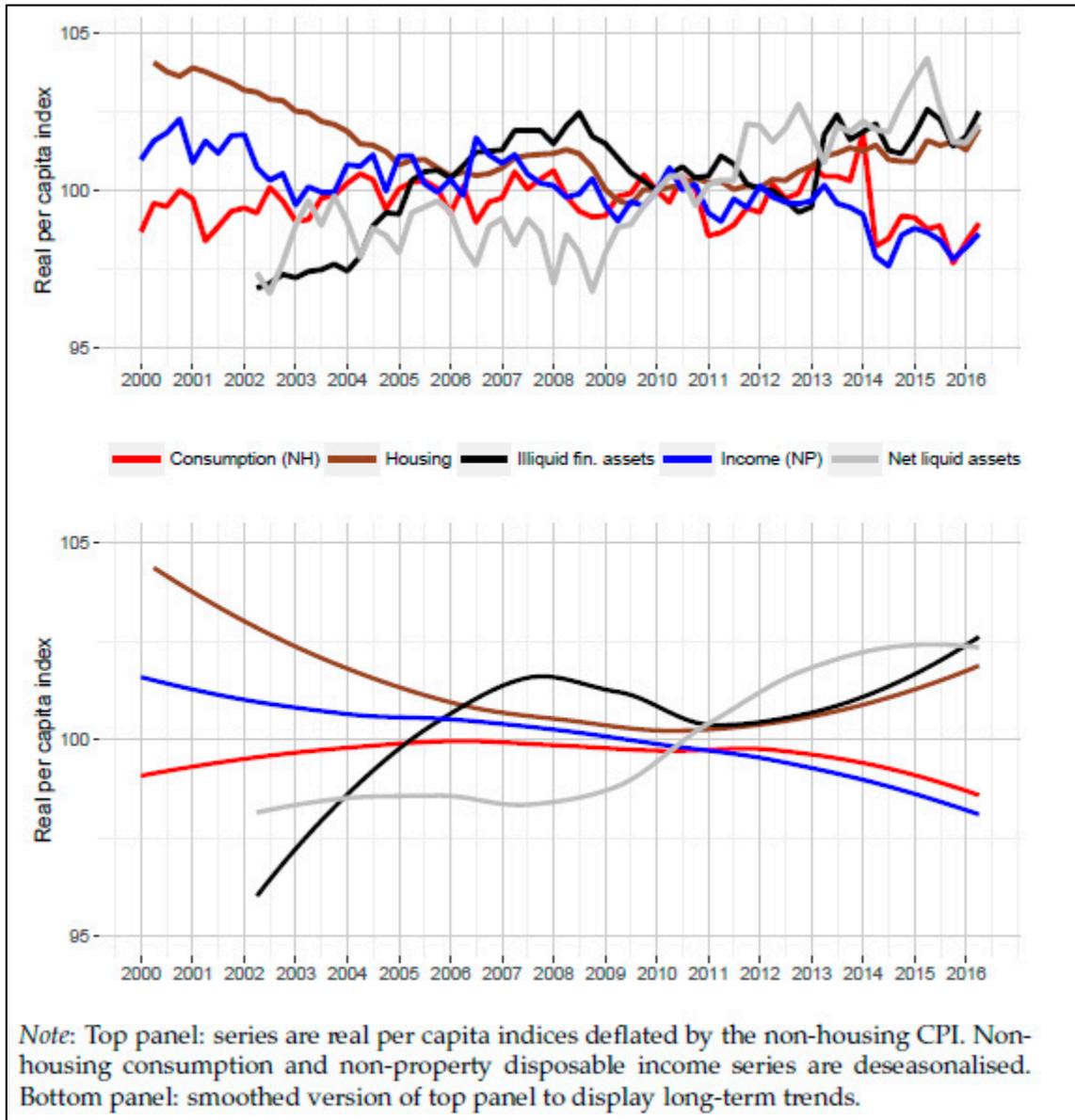
**Figure 10. Net Financial Assets and Consumption**

Figure 11. Net Liquid Assets and Consumption Smoothing



**Figure 12. Evolution of Consumption, Income and Assets at the National Level (2010Jan=100)**



**Table 1. PDOLS Estimation of Levels Relationship**

	Full sample	2002Q2-2009Q1	2009Q2-2016Q2
Income	0.50*** (0.05)	0.63*** (0.07)	0.46*** (0.05)
Net liquid assets	0.02 (0.02)	0.02* (0.01)	0.05** (0.03)
Illiquid assets	0.05*** (0.01)	0.03** (0.01)	0.05*** (0.02)
Housing	0.10*** (0.02)	0.07*** (0.02)	0.09*** (0.02)
Over 65 share	-0.08 (0.14)	0.01 (0.19)	-0.06 (0.23)
N	513	252	261

**Note:** Results from estimating the panel equation (3) with 'non-housing consumption' as dependent variable and using data on all regions except Okinawa. Okinawa excluded due to negative liquid assets in some periods, which generates an error when taking the log. Stars indicate statistical significance at the 1, 5 and 10 percent levels. Standard errors accounting for heteroskedasticity and autocorrelation in parentheses.

**Table 2. PDOLS Heterogeneity by Regional Demographics**

	Young	Middle	Old
Income	0.83*** (0.07)	0.42*** (0.06)	0.61*** (0.07)
Net liquid assets	0.03 (0.03)	-0.05* (0.03)	0.06*** (0.02)
Illiquid assets	0.02 (0.02)	0.13*** (0.02)	0.01 (0.01)
Housing	-0.03 (0.03)	0.14*** (0.01)	0.04** (0.02)
N	171	171	171

**Note:** Results from estimating the panel equation (3) with 'non-housing consumption' as dependent variable and using data on all regions except Okinawa. Okinawa excluded due to negative liquid assets in some periods, which generates an error when taking the log. The regions are divided into the three classes based on the average share of over 65 year olds over the sample period. Stars indicate statistical significance at the 1, 5 and 10 percent levels. Standard errors accounting for heteroskedasticity and autocorrelation in parentheses.

**Table 3. Determinants of Consumption Dynamics – Aggregate Results**

	Baseline	AllAssets	Nikkei	HHExp	CoreReg	Time FE	2003Q2:2009Q3	2009Q4:2016Q1	IV	IV Nikkei
Income growth	0.29*** (0.02)	0.27*** (0.02)	0.29*** (0.02)	0.26*** (0.02)	0.27*** (0.02)	0.30*** (0.02)	0.28*** (0.03)	0.21*** (0.03)	0.29*** (0.08)	0.28*** (0.08)
Income exp. change	0.04** (0.01)	0.04** (0.02)	0.04 (0.04)	0.06*** (0.01)	0.03 (0.02)		0.08** (0.03)	0.04 (0.04)	0.05 (0.03)	0.06 (0.04)
Stock holdings growth	0.00 (0.00)			0.00 (0.01)	0.00 (0.00)	0.01 (0.00)	-0.00 (0.00)	0.02** (0.01)	-0.01 (0.03)	
Net liquid assets growth		0.00 (0.02)								
Illiquid fin. assets growth		0.01 (0.01)								
Nikkei return			-0.00 (0.02)							-0.00 (0.02)
Housing value change	0.04 (0.02)	0.04 (0.03)	0.04 (0.02)	0.02 (0.02)	0.06* (0.03)	0.02 (0.02)	0.04 (0.04)	0.04 (0.02)	0.01 (0.03)	0.01 (0.03)
Real rate (ex ante)	0.21 (0.13)	0.28** (0.12)	0.20 (0.27)		0.17 (0.21)		-1.39** (0.55)	0.54** (0.19)	0.84* (0.40)	0.82* (0.44)
RealRateHHExp (ex ante)				0.68** (0.25)						
ReICPI	-0.58*** (0.08)	-0.59*** (0.08)	-0.58*** (0.10)	-0.72*** (0.14)	-0.56*** (0.10)		-0.50*** (0.06)	-0.66*** (0.16)	-0.45* (0.24)	-0.45* (0.24)
Fiscal Uncertainty change	-0.01 (0.00)	-0.01 (0.01)	-0.01 (0.00)	-0.01 (0.01)	-0.01 (0.01)		0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
VXJ change	0.01 (0.01)	0.01* (0.01)	0.01 (0.01)	0.01** (0.01)	0.01 (0.01)		0.00 (0.01)	0.01** (0.01)	0.01 (0.01)	0.02 (0.01)
Unemployment change	-0.02 (0.34)	0.06 (0.39)	-0.06 (0.53)	0.14 (0.34)	-0.11 (0.47)	-0.01 (0.72)	-0.90 (0.55)	0.51 (0.77)	0.28 (0.58)	0.20 (0.64)
R <sup>2</sup>	0.31	0.32	0.31	0.28	0.34	0.24	0.44	0.26	0.26	0.28
Adj. R <sup>2</sup>	0.29	0.30	0.29	0.27	0.32	0.21	0.40	0.23	0.25	0.26
Num. obs.	475	462	475	399	411	475	236	239	309	309

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Each column is a different specification with 'non-durable and services consumption growth' as the dependent variable. All specifications include region fixed effects and demographic controls (not reported).

**Table 4. Determinants of Consumption Dynamics – Interactions with Demographics and Assets**

	Over 65 share	Net financial assets	Net liquid financial assets	Illiquid financial assets
Age:DispInc	-3.62*** (0.87)			
Age:IncExp	0.15 (1.02)			
Age:Housing	0.26 (1.00)			
Age:Stock	0.11 (0.14)			
Age:RealRate(ExAnte)	6.51 (13.80)			
NetFin:DispInc		0.12 (0.11)		
NetFin:IncExp		-0.26*** (0.07)		
NetFin:RealRate(ExAnte)		1.73** (0.67)		
NetFin:VXJ		-0.01 (0.02)		
NetLiqFin:DispInc			0.16* (0.08)	
NetLiqFin:IncExp			-0.32*** (0.07)	
NetLiqFin:RealRate(ExAnte)			2.05*** (0.30)	
NetLiqFin:VXJ			-0.03* (0.01)	
IlliqFin:DispInc				-0.04 (0.11)
IlliqFin:IncExp				-0.06 (0.06)
IlliqFin:RealRate(ExAnte)				0.78 (0.91)
IlliqFin:VXJ				0.01 (0.01)
R <sup>2</sup>	0.33	0.33	0.34	0.31
Adj. R <sup>2</sup>	0.31	0.31	0.32	0.29
Num. obs.	475	417	417	417

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Each column is a different specification building on the *Baseline* model from Table 3. Only interaction coefficients are reported.