The Time Trend and Life-cycle Profiles of Consumption*

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Abstract

This paper analyzes the time trend of household consumption in Japan between 1981 and 2020, using microdata from the Family Income and Expenditure Survey (FIES). We examine how the trends in the levels, shares, and growth of consumption vary across categories of consumption, items and age groups, and assess changes in consumption inequality over time. Our analysis shows that consumption inequality mildly increased, driven primarily by the trend of service consumption. Additionally, we estimate the life-cycle profiles of consumption and find that the age component of total consumption follows a standard hump-shaped pattern, but varies significantly across goods and service categories and item groups. Finally, using the estimated age profiles of different consumption items, we project how aggregate consumption and its composition may evolve as Japan's population ages in the coming decades.

Keywords: Consumption, Life-cycle Profiles, Inequality, Non-durable goods, Durable goods, Service, Demographic Aging.

JEL Classification: D12, D30, E21

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1 Introduction

Understanding inequality is important in the discussion of economic policy in areas such as income taxation, social security, and various subsidies and transfers. Much focus has been paid to the evolution of income and wealth inequality, but relatively less to expenditures and consumption, which are ultimately more relevant to economic well-being and the quality of life experienced by households.

How have the consumption level and inequality evolved over time? How different is the consumption of the young vs the old, and how does consumption inequality vary with age? What is the implications of ongoing demographic aging for the future path of the aggregate consumption and the composition of the consumption items?

We take Japan, a country that is experiencing the most rapid demographic aging among developed countries, in this paper and answer these questions. We use the microdata of the Family Income and Expenditure Survey (FIES) to examine the time trend of consumption in aggregates, by age groups, by broad categories of durable and non-durable goods and services, and by more detailed item groups. We then follow the method of Aguiar and Hurst (2013) and estimate a model to extract age components of the consumption data and do so for disaggregated components of consumption. We also examine how the inequality of consumption evolves over the life-cycle across various goods and services, which together account for the overall inequality across households.

The average consumption of households rose from the early 1980s to the early 1990s and declined thereafter. This inverted v-shaped pattern is driven by the same pattern of movement in durable goods and services during the same period. The average consumption of non-durable goods mildly declined in the 1980s and 1990s and stayed flat thereafter. There is also much heterogeneity in the time trend across different types of goods and services. Some items such as medical care, transportation and communications, fuel, light and water almost continuously rose during the sample period, while other items such as food, furniture, and clothes and footwear kept declining.

The decline in the average consumption is also due to the change in the household size and the shift of the age distribution. The decline in average consumption after the 1990s is less pronounced when household expenditures are adjusted by an equivalence scale. Consumption levels are the highest among the middle-aged households and the lowest among the elderly and demographic aging and a higher share of the elderly leads a decline in average household consumption.

The estimated life-cycle profile of total consumption is hump-shaped, as typically found in empirical studies. The shape, however, varies by consumption categories (durable and non-durable goods vs services) and by more detailed items. Average consumption of non-durable goods sharply rises until around age 40 and then mildly increases thereafter, while spending of durable goods and services increase only slightly at younger ages and decline sharply after age 50. Some consumption items such as medical care and fuel, lights and water keep increasing throughout the life-cycle, but other items such as clothes and footwear declines throughout. Food consumption exhibits a hump-shape, but while food at home declines only gradually and slightly, food away from home falls sharply after around age 40.

Inequality of consumption, measured in terms of the variance of residuals from the estimation, increases in age, consistent with the findings of Aguiar and Hurst (2013). However, the age profile of inequality varies by consumption categories and item groups. Inequality of food and fuel, lights and water remains low and increases only slightly over the life-cycle.

We simulate simple projections of the aggregate consumption over the next few decades, based on the demographic projections and the age components of consumption estimated from the FIES data. The total population will decline rapidly for decades in Japan due to a persistent decline in fertility rates and a rise in the number of deaths of baby-boomers born in the late 1940s. We show that the aggregate consumption declines even faster as the average per-capita consumption falls, as a result of changes in the age distribution and the composition of consumption items. The shares of durable goods and services are expected to decline during the coming decades while that of non-durable goods rises, as the shares of items such as food at home and fuel, light and water are relatively higher among middle-aged and old households than the young households.

2 Related Literature

Standard single-good life-cycle models of optimizing households typically generate a hump-shaped consumption profile, and this is in line with life-cycle consumption profiles estimated using microdata.[1] Recent works that analyze microdata carefully also reveal that the life-cycle profiles of consumption vary by the types of expenditures, such as durable vs non-durable consumption (Ferńandez-Villaverde and Krueger, 2011) and work-related items vs others (Aguiar and Hurst, 2013), by the family size and household composition (Ferńandez-Villaverde and Krueger, 2007), and by the health shocks and wealth levels (Blundell et al., 2020) and so on.

It is also well known that inequality of consumption does not stay constant over the life-cycle as documented Storesletten et al. (2004), for example. Krueger and Perri (2006) find that consumption inequality increases with age but in a lesser degree than income inequality. Aguiar and Hurst (2013) show the heterogeneity in the life-cycle consumption inequality across different commodities. Hubmer (2023) finds that high income households spend relatively more on labor-intensive commodities than low income households, leading to a shift in the aggregate labor share as income inequality changes. Straub (2019) uses the PSID data to estimate the elasticity of consumption to permanent income, which stands at 0.7, and shows that a model with non-homothetic preferences that imply higher saving rate of richer households predicts the empirical pattern well.

A number of papers also examine the time trend of consumption inequality using various sources of microdata. See, for example, Aguiar and Bils (2015), Heathcote et al. (2010), and Krueger and Perri (2006). The time path of inequality varies for various

[1] See, for example, Deaton and Paxson (1994), Attanasio and Browning (1995), Attanasio et al. (1999), Gourinchas and Parker (2002), Ferńandez-Villaverde and Krueger (2007), Hansen and İmrohoroğlu (2008))

reasons, but most studies find that inequality either remained mostly unchanged or increased over the last few decades.[2] Attanasio and Pistaferri (2014) provides a comprehensive survey of consumption data and various issues associated with the analysis of consumption inequality using expenditure data.

There is also a large literature that investigates the consumption dynamics along the business cycle. Attanasio et al. (2022) use the CEX data for the spending on cars during the Great Recession, as an example of large durable goods that generate heterogeneous responses across households of different ages, and estimate a rich life-cycle model with endogenous durable goods purchase in both intensive and extensive margins. Berger and Vavra (2015) use the PSID microdata and find muted responses in durable goods purchases during recessions and estimate a general equilibrium model of incomplete markets to assess effects of stimulus policies.[3]

Turning our attention to Japan, Ohtake and Saito (1998) is an early study that uses the National Survey on Family Income and Expenditure (NSFIE) to evaluate the trend of consumption inequality since the 1980s. They show that aging of the babyboom cohort drives a rise in inequality in the 1980s as the cohort approaches the 40s, the ages when expenditure level is high and inequality starts to increase. Lise et al. (2014) use the NSFIE and the Family Income and Expenditure Survey (FIES) to evaluate the trend of consumption inequality, together with those of wage and income, finding that the inequality of consumption mirrored that of income between the 1981 and 2008. They also show that in the life-cycle dimension, consumption inequality does not increase as much with age as income does.

Cashin and Unayama (2021) analyze the response to a rise in consumption taxes using the FIES expenditure data before and after the 1997 VAT rate increase. Hausman et al. (2019) study effects of low interest rate policy under "Abenomics" by focusing on consumption differences between homeowners and renters. Higa (2019) uses the FIES data to estimate the trend of consumption inequality and sensitivity to the treatment of measurement errors of the survey. Kubota (2020) studies effects of income shocks on consumption using the Japanese Panel Survey of Consumers (JPSC) data.

[2]Differences in the outcome of the analysis of consumption inequality arise from reasons such as the use of different microdata sources, alternative definitions of consumption (measuring expenditures or quantities of consumption, or subtracting saving from income), items to include in the definition (nondurable and durable goods and service), and methods of correcting measurement errors. See Meyer and Sullivan (2022) for alternative methods to account for measurement errors in consumption data.

[3]See also Kaplan et al. (2020) who build a life-cycle model to study housing boom and bust during the Great Depression and emphasize the roles of wealth in accounting for the consumption elasticity, as also emphasized by Mian et al. (2013).

3 Data: Family Income and Expenditure Survey (FIES)

3.1 Overview

This paper uses microdata of the Family Income and Expenditure Survey (FIES) collected by the Statistics Bureau of the Ministry of Internal Affairs and Communications. The FIES is monthly data, and the survey has been conducted since 1981. In this paper, we use the data between 1981 and 2020. The household survey is one of the reliable statistical data that form the basis of Japanese economic statistics and is also used to estimate aggregate private consumption in the SNA statistics and to compile the consumer price index.[4]

The FIES covers two-or-more person households, and single-person households have also been included since January 2002. Members of two-or-more households do not necessarily include a married couple, and the samples include households headed by single-mothers and single-fathers, as well as singles living with their parent(s).

The FIES compiles monthly data on household expenditures as well as labor and other income data. Since January 2002, data on savings and debt have also been collected. The FIES requires each household to fill out a household account book (*kakeibo*), which is a feature that makes the data more accurate than other survey data on consumption which rely on memory recalling. The survey also collects detailed item-by-item expenditure data.

The household survey is panel data, with up to six months of responses for each household. Because it is a rotating panel, approximately one-sixth of the sample will be replaced each month. However, some households may drop out of the data within six months, resulting in unbalanced panel data. Each household reports basic attributes about the household, such as family structure and housing information, during the first survey month. Annual income for the previous year is also answered only once. Households report total annual income and there is no information about the composition of the annual income .[5]

[4]Other officially collected microdata sources of household consumption include the National Survey of Family Income and Expenditure (NSFIE), Comprehensive Survey of Living Conditions (CSLC), and Annual Report on the Survey of Household Economy (ARSHE). See Unayama (2015) (in Japanese) for more details about these surveys and comprehensive comparison across them. Unayama (2015) shows that the total consumption level of the FIES is in line with those of the NSFIE and CSLC, but lower than that of ARSHE. Stephens and Unayama (2012) point out the possibility that the samples of the FIES underreport the expenditures due to the "survey fatigue" from the multiple reporting requirements during the six-month survey period and Unayama (2015) argues that the FIES samples underreport expenditures of high-cost items compared to the ARSHE samples and this is likely due to the different survey methods (a household account book of the FIES vs the pre-code method of the ARSHE).

[5]In addition to the annual income, each household reports its monthly income. For monthly income, they report labor income and more details about other sources of income such as property income, rental income, private transfers such as remittances, and public transfers such as social security benefits.

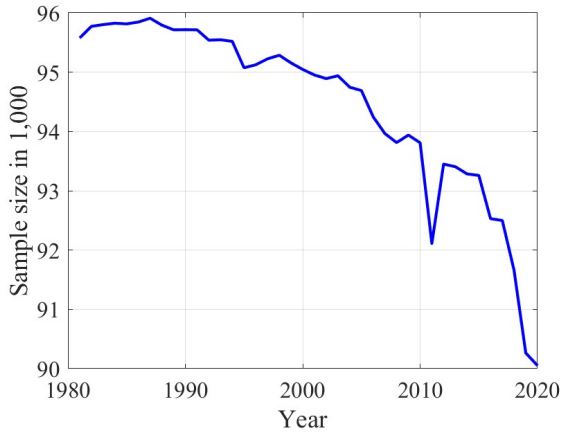
3.2 Sample Selection and Household Characteristics

We use monthly consumption data of 7,000-8,000 households with two or more members collected each month between 1981 and 2020. Figure 1 shows basic description of the data over the sample period.

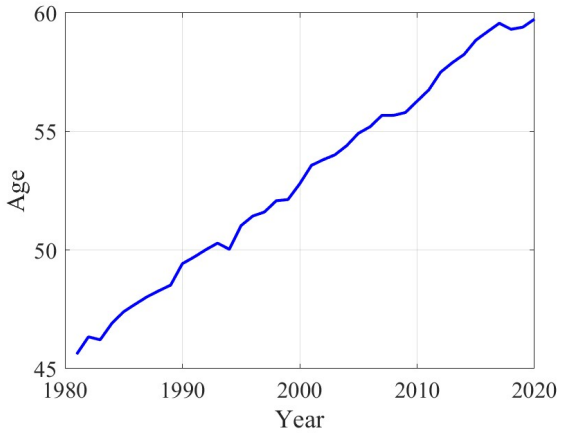
As shown in Figure 1a, the sample size in each year is in the range of 90,000-96,000. Figure 1b shows the average age of household heads in our sample each year, which increased from around 45 in 1981 to nearly 60 in 2020. The average size of households declined monotonically from above 3.8 in 1981 to below 3.0 by 2020, as shown in Figure 1c. This decline is largely driven by a fall in the number of children aged 16 and below in households, as shown in Figure 1d.

As shown in Figure 1e, the share of married households in our sample is around 90% and has declined since the 1980s.[6] The share of households aged 25-59 in which both a husband and a wife work has increased from around 45% to above 55%, as shown in Figure 1f.

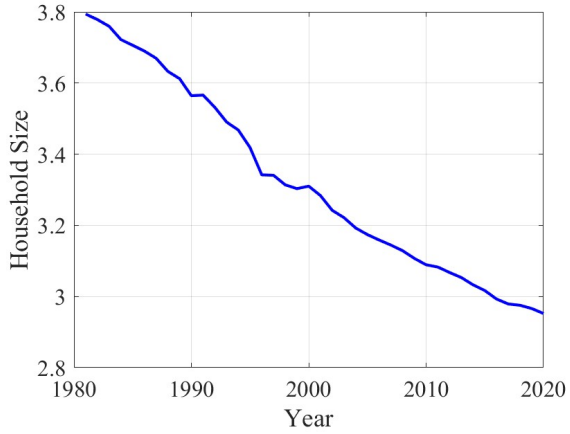
[6]Figures 1e and 1f start in 1987, since a variable that indicates the relationship of household members is available only after 1987.



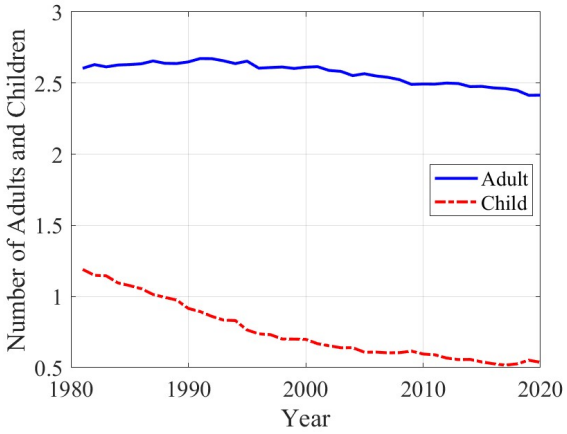
(a) Sample Size (in 1,000)



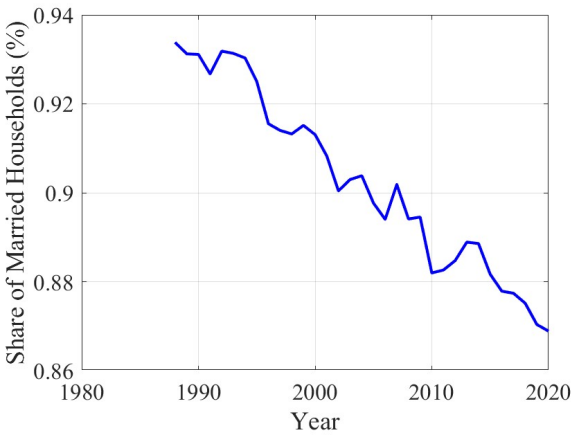
(b) Age of Household Heads



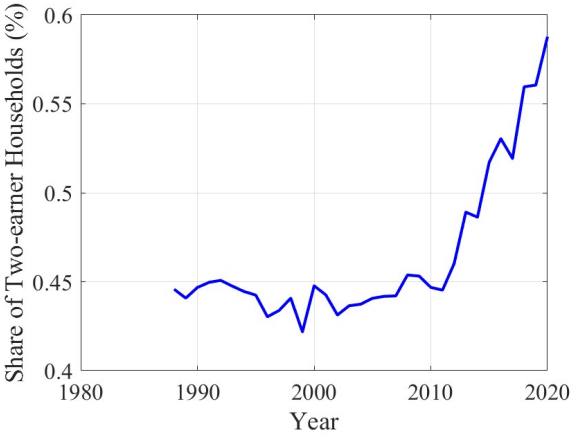
(c) Size of Households



(d) Number of Adults and Children



(e) Share of Married Households



(f) Share of Two-earner Households

Figure 1: Sample Description

Figure 2 shows the average sample size by the age of household head, averaged over 1981-2020 period. Our sample consists of households with two or more members, and there are fewer households aged 20s and early 30s. The sample size decreases above age 70.

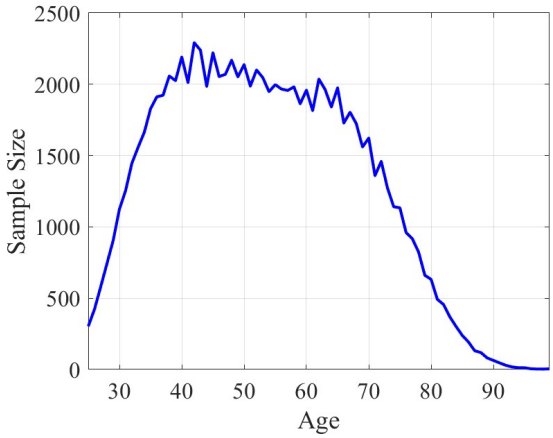


Figure 2: Sample Size by Age (Averaged over 1981-2020)

3.3 Consumption Data and Classifications

Our main analysis is based on the monthly consumption expenditure data of the FIES.[7] The FIES classifies consumption expenditures into four categories of goods and services. Goods are classified into non-durable goods, full-durable goods and semi-durable goods.[8] Non-durable goods are the goods whose expected life is less than one year and full-durable and semi-durable goods are expected to last for one year or longer. Full-durable goods are "relatively expensive" and semi-durable goods are not as expensive.

In our analysis, we combine full- and semi-durable goods into one group as durable goods, and classify all consumption expenditures into three categories: (1) durable goods, (2) non-durable goods, and (3) services. Table 1 shows items included in each category. For more details of the classification, see Appendix A.

All variables are deflated by the 2020-based monthly consumer price index, using the Core CPI, comprehensive index excluding fresh food. Note that there are two items, pocket money without detailed description of the usage and remittances which are not classified to one of the four categories. We exclude these items from the analysis since it is not clear what items are purchased, or if they were in fact spent to purchase goods or services.

[7]Note that we focus on consumption expenditure data of a given month and this is not necessarily the month in which the goods or services are consumed.

[8]In the FIES classification, this "full-durable" category is simply called "durable," but we add "full" to distinguish it from our own classification of durable goods, which include both "full-durable" and semi-durable goods according to the FIES definition.

Table 1: Consumption Categories

Category and Items
Durable Goods
Full-Durable goods
· Household durable goods, furnishing and decorations, bedding
· Medical supplies and appliances
· Purchase of vehicles and bicycle
· Recreation durable goods
Semi-Durable Goods
· Tools for repair and maintenance
· Domestic utensils
· Clothing and footwear items
· Maintenance of vehicles
· Recreational goods
· Personal care goods, personal effects
Non-Durable Goods
· General food items
· Fuel, Light and Water Charges
· Domestic non-durable goods
· Medicines, health fortification
· School textbooks, books
· Tobacco, other miscellaneous
Services
· Eating out, school lunch
· Rents, repairs and maintenance
· Domestic services
· Services related to clothing
· Medical services
· Public transportation, communication
· School fees, tutorial fees, recreational services
· Personal care services, social expenses
Uncategorized
· Pocket money (with no details), remittance

3.4 Adult Equivalence Scale

The average household size has changed significantly between 1981 and 2020. Therefore, we compute both the simple household expenditure data and equivalized data to account for the different family size of each household. We use the OECD Equivalent Scale to calculate equivalent consumption and income statistics. The OECD Equivalent Scale adjusts for the number of family members with the first adult as 1, the second and

subsequent adults as 0.7, and children under 16 as 0.5. For example, a family with a married couple and one child each in junior high school and elementary school would be 1 + 0.7 + 0.5 + 0.5 for 2.7 and household consumption data is divided by 2.7 to obtain the equivalent income. The same calculation is used for income data.

Ferńandez-Villaverde and Krueger (2007) point out that the pattern of consumption expenditures over the life cycle varies by the scale used for equivalence adjustment. For example, the OECD-modified equivalent scale uses an adjustment of 0.5 and 0.3 for the second and subsequent adults and children under 16, rather than 0.7 and 0.5, respectively. Another frequent adjustment method is to take the square root of the number of family members. Deaton and Paxson (1994) calculate adult equivalence by leaving the number of adults aged 17 and older unchanged and adding 0.5 for those aged 16 and younger. See Kaplan (2012) for more discussions about the impact of various equivalence scales.

4 Time Trends of Consumption

In this section, we examine the time trends of consumption between 1981 and 2020. We will first study the overall consumption trend and by major consumption categories, followed by more detailed analysis by item groups and household age groups. Finally, we discuss the trends of consumption inequality across households and also the trends of household income and income inequality.

4.1 Consumption Time Series

Figure 3 shows the trend of the average monthly consumption per households. It increases from less than 290,000 yen in 1981 to around 330,000 in the early 1990s, and declines thereafter. With the onset of the COVID-19 crisis, there is a visible decline in total consumption in 2020.

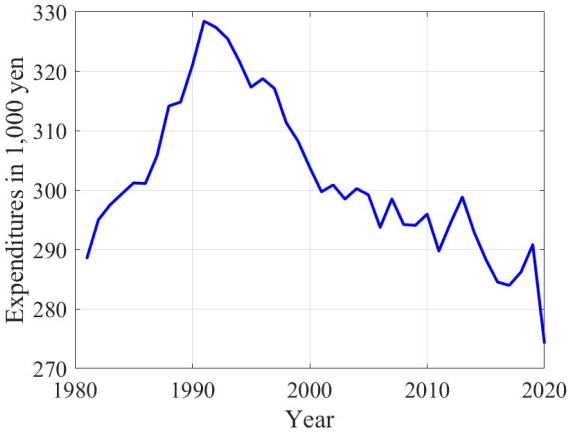
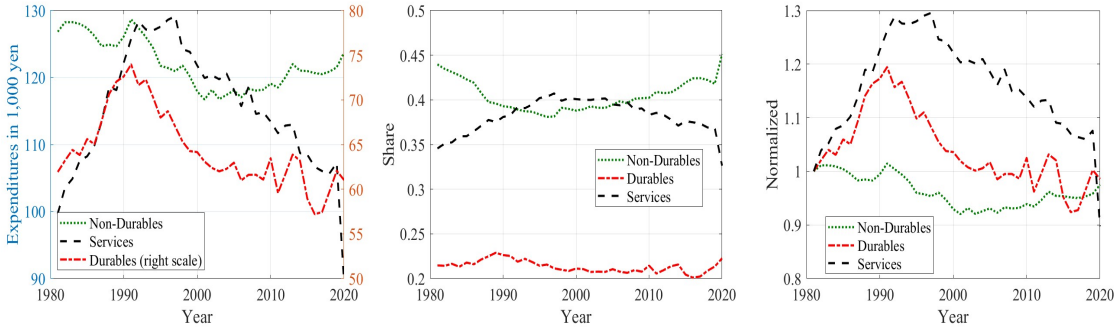


Figure 3: Total Consumption (Household)

The composition of the household consumption has changed during the last four decades. Figure 4 shows the trends of consumption by broad categories of non-durable goods, durable goods and services. The level of non-durable goods expenditures shows a mild decline but it has stayed within a narrow range around 120,000 yen, as shown in Figure 4a. Durable good expenditures (right scale) rose by about 10,000 yen in the 1980s, but declined since then and stayed at around 60,000 yen. The service expenditures increased most dramatically in the 1980s. As a result of the changes in the composition, the share of service rose from below 35% to above 40% at the peak and gradually declined thereafter, as shown in Figure 4b. Service consumption falls sharply in 2020 due to the COVID-19 crisis. The share of non-durable goods declined initially but rose thereafter.



(a) Levels (b) Shares (c) Growth (1981=1)

Figure 4: Consumption by Categories (Household)

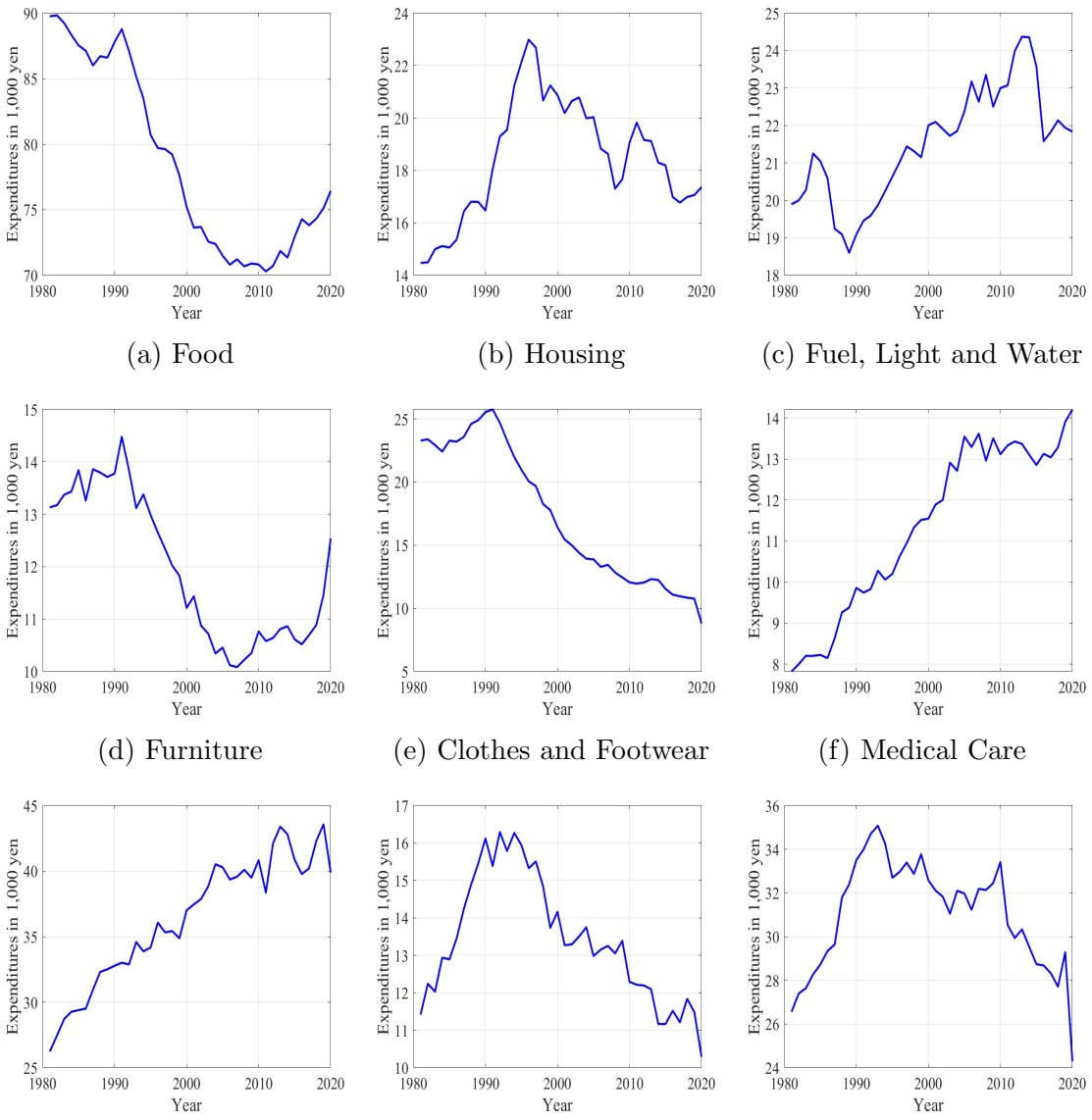
4.2 Trends by Item Groups

In this section, we present the trends of consumption by more detailed item groups, using the categorization of the FIES. Expenditure items are divided into ten groups, (1) food (at home and eating out), (2) housing, (3) fuel, light and water charges, (4) furniture and household utensils, (5) clothing and footwear, (6) medical care, (7) transportation and communication, (8) education, (9) culture and recreation, (10) others.

Some groups include items that belong to multiple broad categories of service, durable and non-durable goods. For example, the food includes grocery items which are classified as non-durable goods, as well as meals outside the home, which belong to the service category. See Appendix A for more details about the categorization.

Figure 5 shows the trend of household consumption by the item groups. Food, furniture, and clothes and footwear declined since the early 1990s. The food expenditures decreased by the largest amount and a large part of this is explained by the decline in the family size. In Appendix B, we show that the path of equivalized consumption items and the decline in food expenditures is more muted with the adjustment.

Expenditures on fuel, light and water, medical care, and transportation and communications continued to increase throughout the sample period.



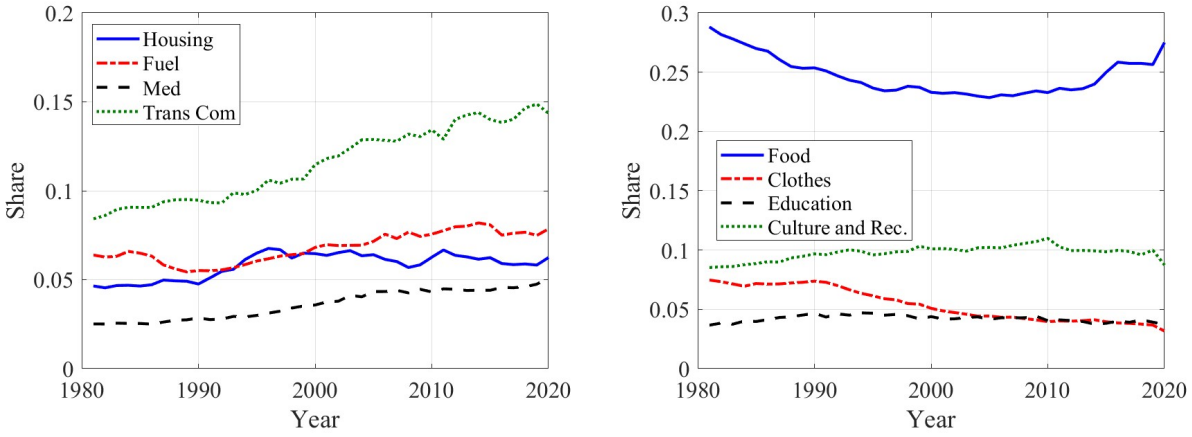
(a) Food (b) Housing (c) Fuel, Light and Water

(d) Furniture (e) Clothes and Footwear (f) Medical Care

(g) Transp. and Communication (h) Education (i) Culture and Recreation

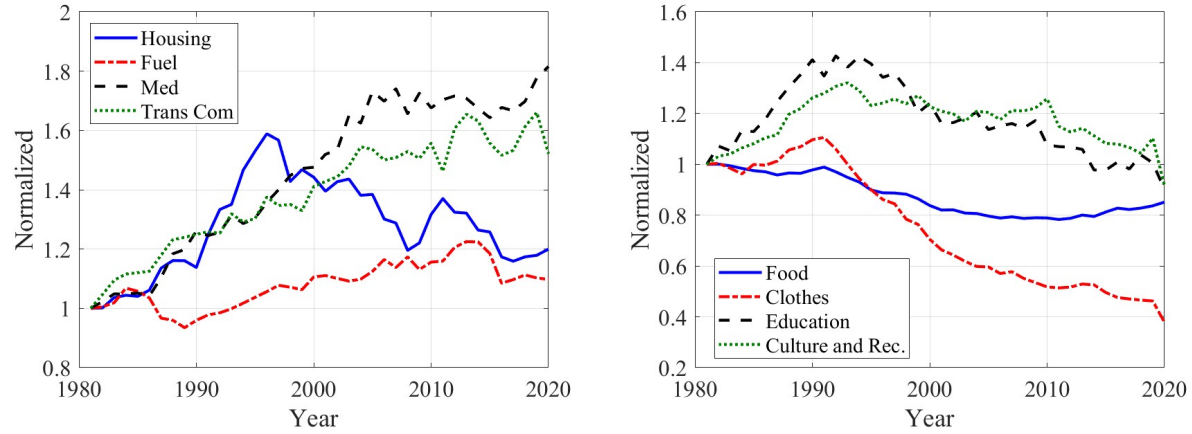
Figure 5: Consumption by Item Groups (Household)

Figure 6 shows the trends of the shares of consumption items out of total consumption. Food has the largest share of about one quarter. Items such as transportation and communication, fuel, light and water, and medical care show a steady increase in their shares. Figure 7 shows the growth in the consumption level relative to the level of each item in the initial year of 1981.



(a) Group (1) (b) Group (2)

Figure 6: Consumption Shares by Item Groups (Household)



(a) Group (1) (b) Group (2)

Figure 7: Consumption Growth by Item Groups (Household, 1981=1)

4.3 Equivalized Consumption

Figure 8 shows the path of the equivalized total consumption, where the household consumption is adjusted by the OECD equivalence scale. There is no sharp decline in consumption after 1990, as was seen in Figure 3, implying that a part of the decline is associated with a decline in the household size. In Appendix B, we show the path of consumption equivalized by different methods other than the OECD equivalence scale.

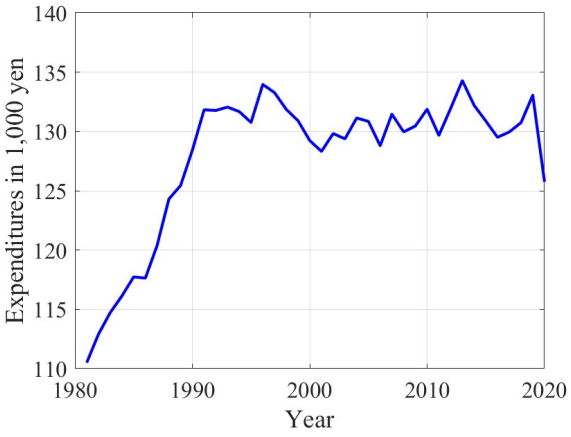


Figure 8: Total Consumption (Equivalized)

Figure 9 shows the paths of equivalized consumption by broad categories. Similarly to the trajectory of total consumption, the decline during the last three decades since 1990 is milder compared to the paths household consumption. Non-durable goods consumption increases monotonically, which indicates that much of the decline in the household consumption was due to the change in the family size. Service consumption declines since the mid-1990s.

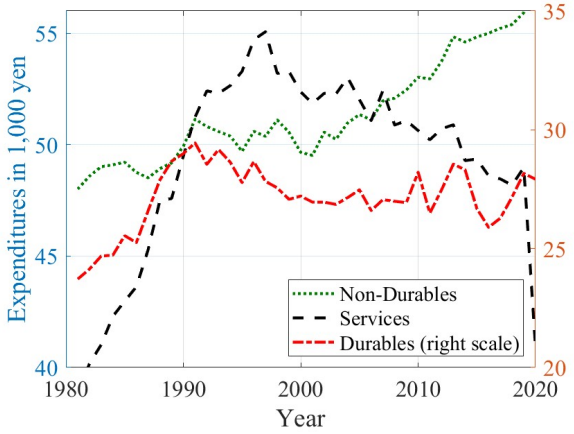


Figure 9: Consumption by Categories (Equivalized)

4.4 Trends by Age Groups

In this section, we examine the consumption trends by age groups. We divide households into three age groups by the age of the household head: 25-44, 45-64 and 65 and above. Figure 10 shows the path of average total consumption for the three age groups. The middle-aged households spend the most and old households aged 65 and above spend the least. The consumption levels rose in the 1980s and the early 1990s for all age groups,

and declined thereafter for the young and middle-aged households but remained flat for the old age group.

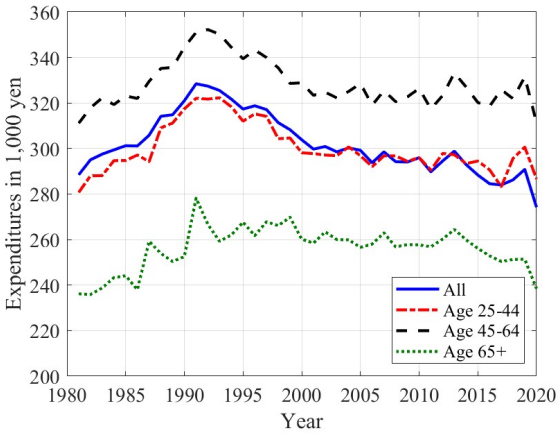
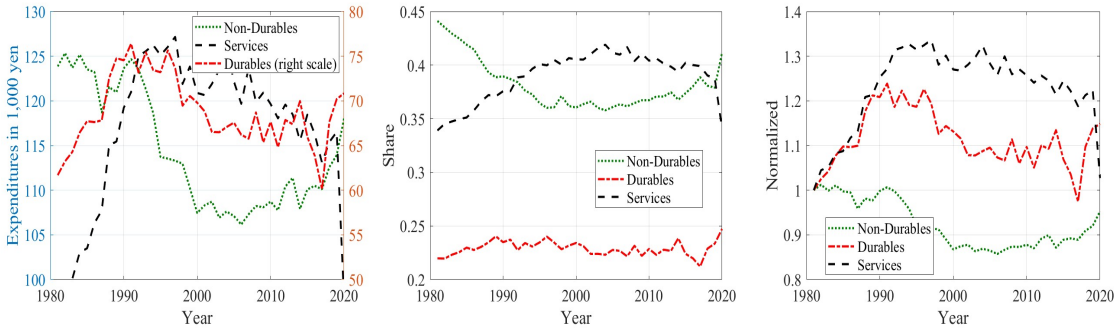


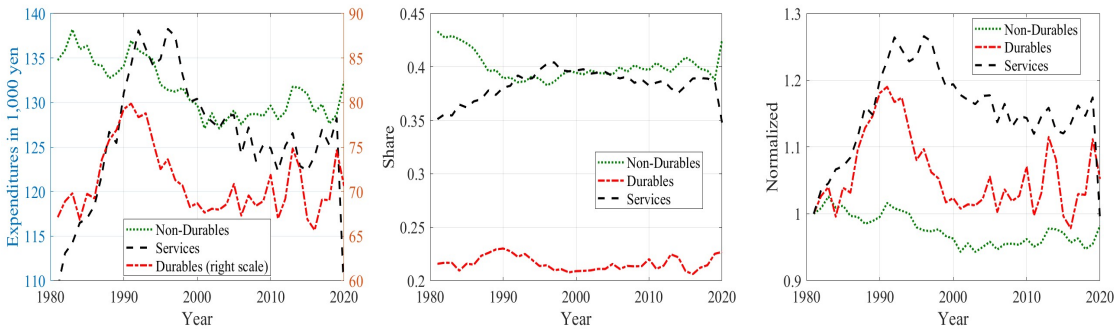
Figure 10: Total Consumption by Age Groups (Household)

Figures 11, 12 and 13 show the consumption trend by the three broad categories for each age group. The share of durable goods remained stable for all groups. The share of service for young and middle-age households. For old households the share of service declined after the 1990s and the share of non-durable goods increased.



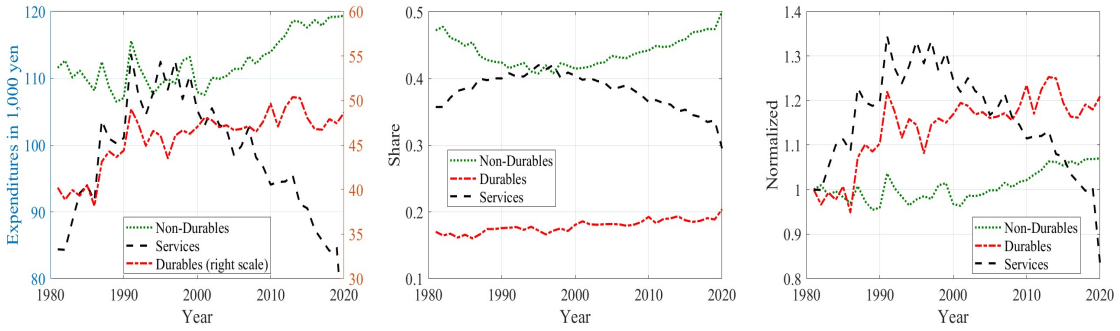
(a) Levels (b) Shares (c) Growth (1981=1)

Figure 11: Consumption by Age Group (1) 25-44 (Households)



(a) Levels (b) Shares (c) Growth (1981=1)

Figure 12: Consumption by Age Group (2) 45-64 (Households)



(a) Levels (b) Shares (c) Growth (1981=1)

Figure 13: Consumption by Age Group (3) 65 and above (Households)

Age Effects on Average Consumption: During the sample period, the demographic structure changed significantly and the share of the old rose while the share of the young decreased, as shown in Figure 14.

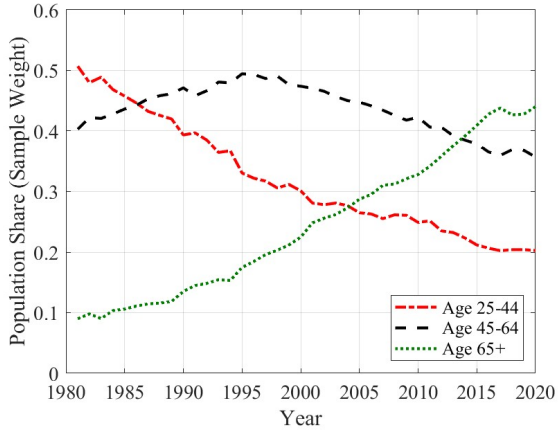


Figure 14: Distribution of Age Groups (Sample Weight)

Since the pattern of consumption differs across age groups, the demographic transition would affect the time trend of average consumption and its composition. Figure 15 compares the path of average consumption in the baseline and under a hypothetical scenario in which the distribution of age groups is exogenously fixed to the distribution of the initial year, 1981. The total consumption would be higher if the age distribution remained unchanged and the divergence from the baseline widens from the 2000s, when the shares of not only the young but also middle-aged households who consume the most start to decline.

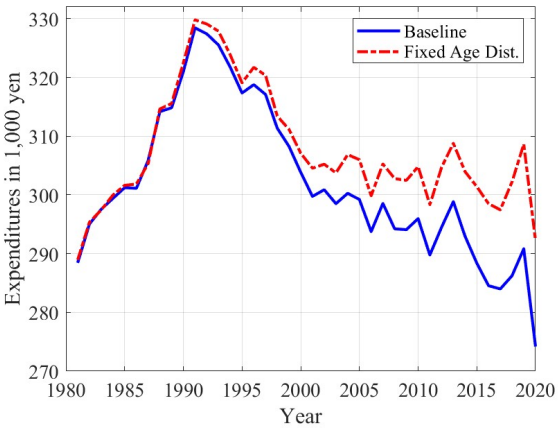
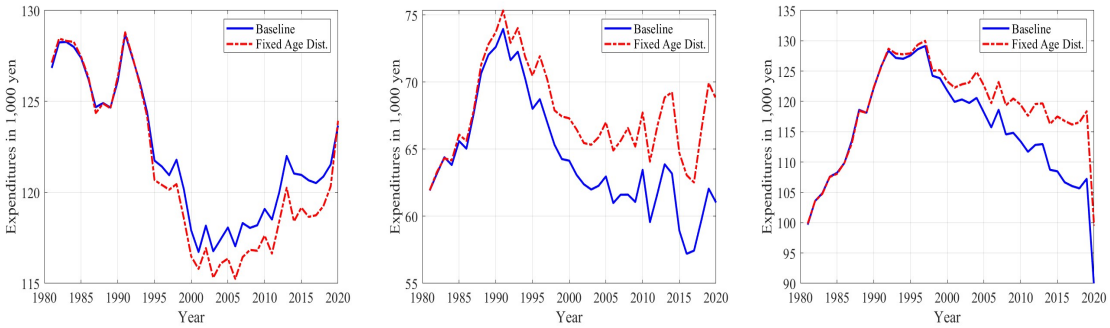


Figure 15: Total Consumption (Fixed Age Distribution)

The difference between the baseline and the hypothetical scenario also varies by the consumption categories as shown in Figure 16. Since the old households spend relatively more on non-durable goods, total durable consumption would be lower under the hypothetical scenario as shown in Figure 16a.



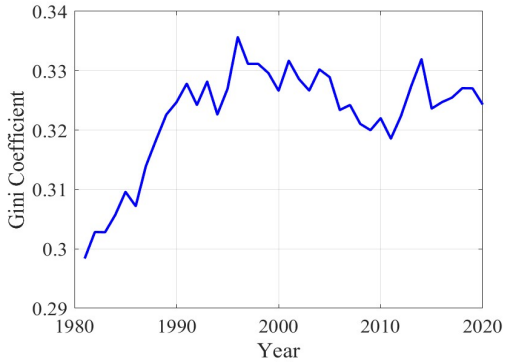
(a) Non-Durable (b) Durable (c) Service

Figure 16: Consumption by Categories (Fixed Age Distribution)

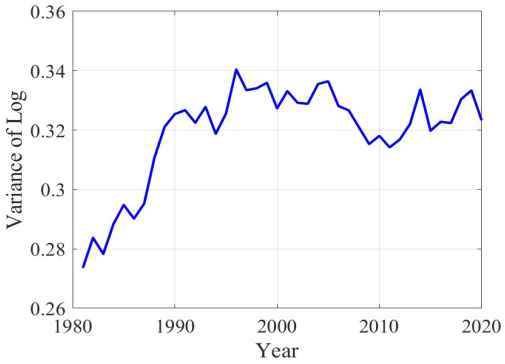
4.5 Trends of Inequality

Figure 17 shows the trends of four indicators of inequality in consumption; Gini coefficient, variance of log, and ratios of consumption at the 90th and 50th percentiles, and the 50th and 10th percentiles. Both the Gini coefficient and variance of log increased from the early 1980s to the late 1990s and stabilized thereafter. A rise in these indices occurred when both the ratio of consumption at the 90th percentile to median and the ratio of median to the 10th percentile increased in the 1980s.[9]

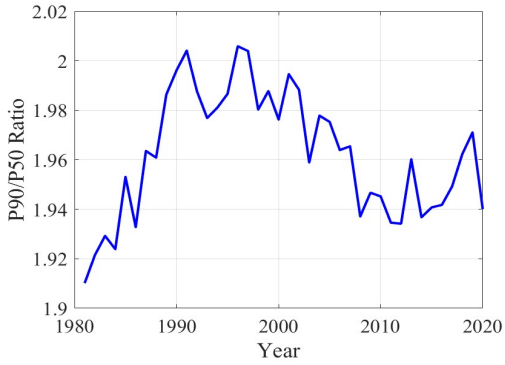
[9]In Appendix B, we compute inequality statistics after controlling for month effects by regressing the consumption data on monthly dummies and removing the effects. Profiles are similar to those in Figure 17.



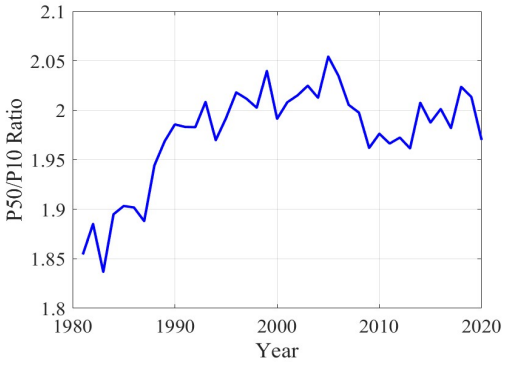
(a) Gini Coefficient



(b) Variance of Log



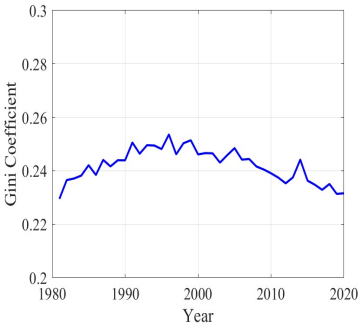
(c) P90/P50 Ratio



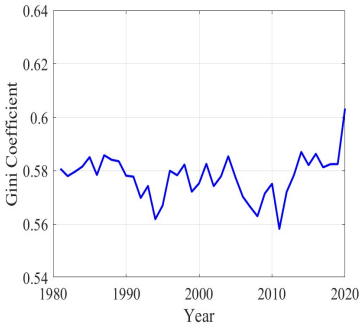
(d) P50/P10 Ratio

Figure 17: Consumption Inequality: Total Consumption (Households)

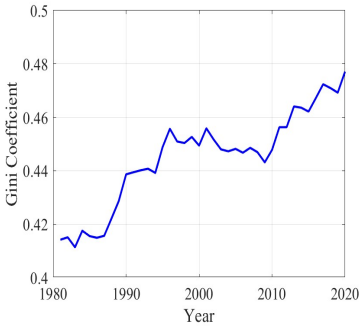
Figures 18, 19 and 20 show the path of the four inequality statistics for the consumption of the three categories. Inequality increased by most in service consumption and Figure 20c shows that the ratio of consumption at the 90th and median rose sharply from below 3 in 1981 to almost 4 in the late 2010s.



(a) Non-Durable

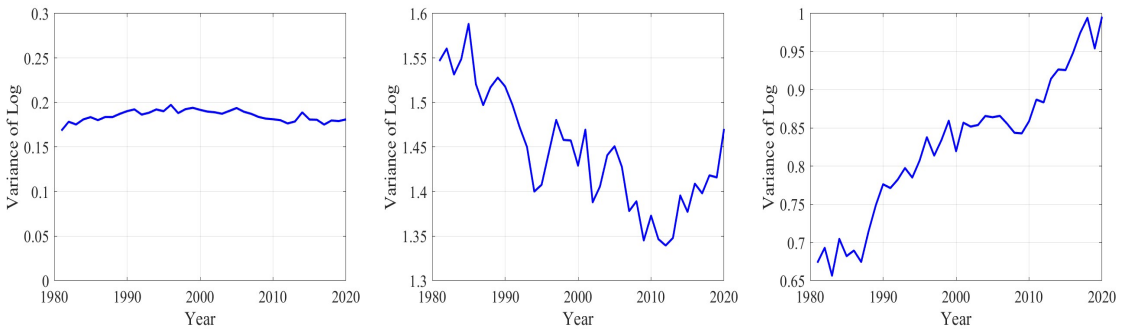


(b) Durable



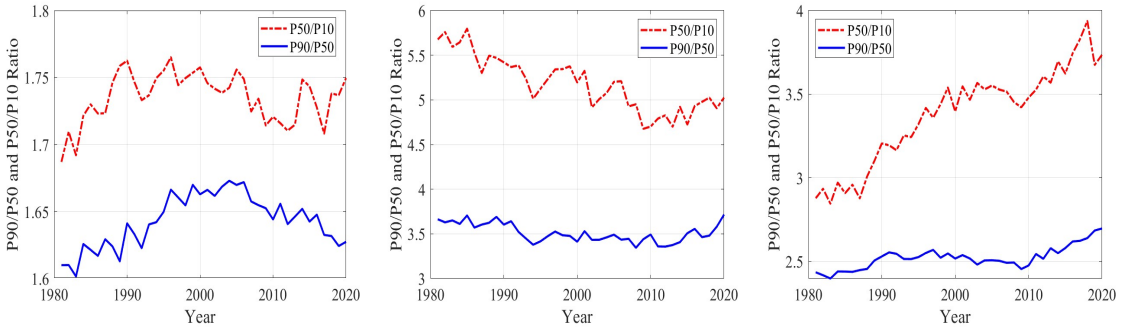
(c) Services

Figure 18: Gini Coefficients by Consumption Category (Households)



(a) Non-Durable (b) Durable (c) Services

Figure 19: Variance of Log by Consumption Category (Households)



(a) Non-Durable (b) Durable (c) Services

Figure 20: P90/P50 and P50/P10 Ratios by Consumption Category (Households)

4.6 Income Trend

The FIES contains two types of income data. The first is annual gross income of households, and it asked once a year for the entire household. The second is monthly income, which consists of labor income, gross income before taxation, and disposable income. Labor income is the sum of wages and salaries, as well as income from piecework. Gross income before taxation includes labor income, asset income and private transfers. Disposable income includes gross income before taxation plus social security, net of the payment of taxes and social insurance premiums.

Although the annual income data is available for most households, it does not provide information about the sources of income and breakdowns. The monthly income data contains more details, but suffers from the limitation in coverage since it is available for households with employed heads only and no data is available for households headed by self-employed individuals and those not in labor force. Moreover, households are followed for six months only and the data does not provide earnings of an entire year and the bonus payment is only partially included if any. Given the limitations, we focus on and report ony the trend and inequality of annual income below.

Figures 21 and 22 show the time trends of average annual income and Gini coefficients. Household income rose until the early 1990s and declined thereafter, a trend that is also confirmed in other studies such as Kitao and Yamada (2019).

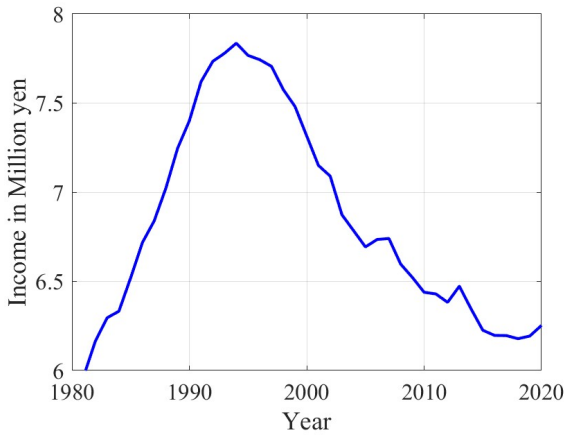


Figure 21: Annual Income (Households)

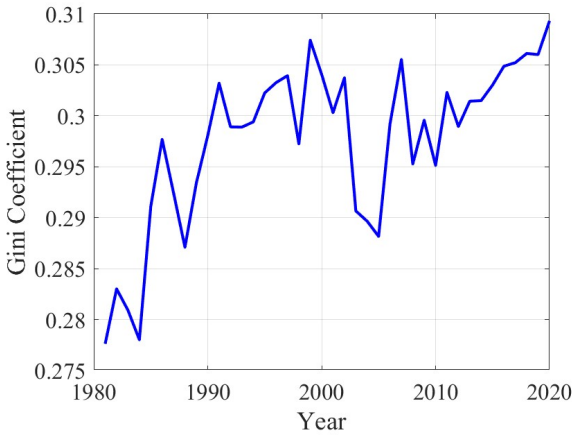


Figure 22: Income Inequality: Gini Coefficient (Households)

5 Estimation of Age Profiles

We use the FIES data to estimate the life-cycle consumption profile of households, following the methods of Aguiar and Hurst (2013). We use the sample of households headed by individuals aged between 25 and 80 and the data between 1981 and 2020. The following regression is estimated.

$$\ln C_{it}^{k} = \beta_0 + \beta_{\text{age}} D_{it}^{\text{age}} + \beta_c D_{it}^{\text{cohort}} + \beta_t D^{\text{year}} + \beta_m D^{month} + \beta_{\text{fam}} \mathbf{X}_{it} + \epsilon_{it} \qquad (1)$$

where C_{it}^k is expenditure of household i in period t on consumption item k, D_{it}^{age} is a vector of age dummies (for ages 25-80), D_{it}^{cohort} is a vector including fourteen five-year birth cohort dummies, D^{year} is a vector of year dummies from 1981 to 2020 and D^{month} is the vector of month dummies. $\mathbf{X}_{it}$ is a vector of family structure dummies that include a gender dummy, a marital status dummy, the number of adult dummies (2-5), and dummies for the number of children by ages: 0-2, 3-5, 6-13, 14-17, 18-21.[10]

To deal with the multicollinearity problem of including age, year and cohort effects in the estimation, we follow Deaton (1997) and Aguiar and Hurst (2013) and impose the following two restrictions on coefficients on the year dummies: $\sum_{t=1981}^{2020} \beta_t = 0$ and $\sum_{t=1981}^{2020} t\beta_t = 0$.[11]

Total Consumption and by Categories: Figure 23 shows the life-cycle profile of total consumption per household. The figure is based on the age effects of consumption extracted from the estimation; the values of coefficients on age dummies in equation (1).[12]

The profile exhibits a standard hump-shape over the life-cycle, as normally assumed in the literature. The consumption increases by about 20%, from below 150,000 yen at age 25 to the peak of 175,000 yen in the mid-40s. Thereafter, the consumption decreases monotonically to reach about 130,000 yen by age 80.

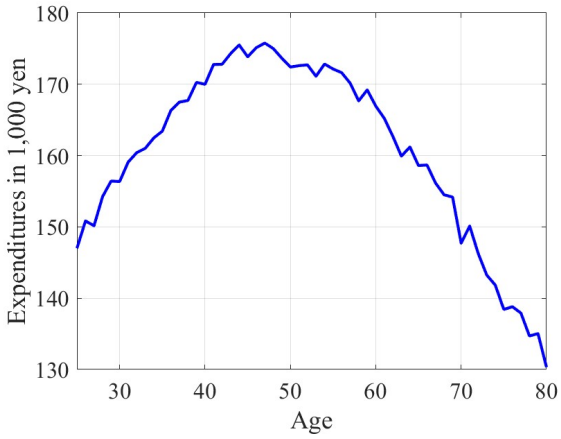


Figure 23: Life-Cycle Profile of Total Consumption

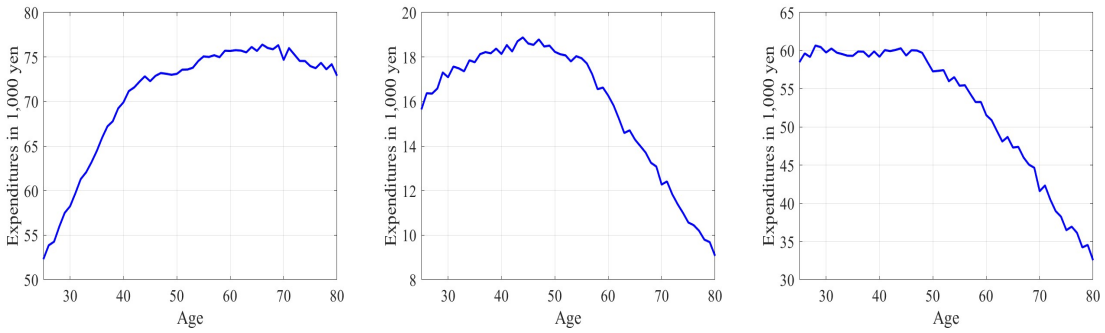
[10] See, for example, Gourinchas and Parker (2002), for alternative specifications to estimate consumption profiles. Ferńandez-Villaverde and Krueger (2007) estimate consumption over the life cycle using semi-nonparametric methods.

[11] As alternatives, we also estimate models of cohort effects only (without year effects) and year effects only (without cohort effects) and estimated age profiles are similar across alternative specifications. For the detailed discussion on the control for cohort effects or for time effects, see Heathcote et al. (2005).

[12] The age profile can also be interpreted as the life-cycle consumption profile of a male head in a household with two or more members.

For the details of the estimation results including the estimated values of the coefficients and standard errors, please see the data appendix.

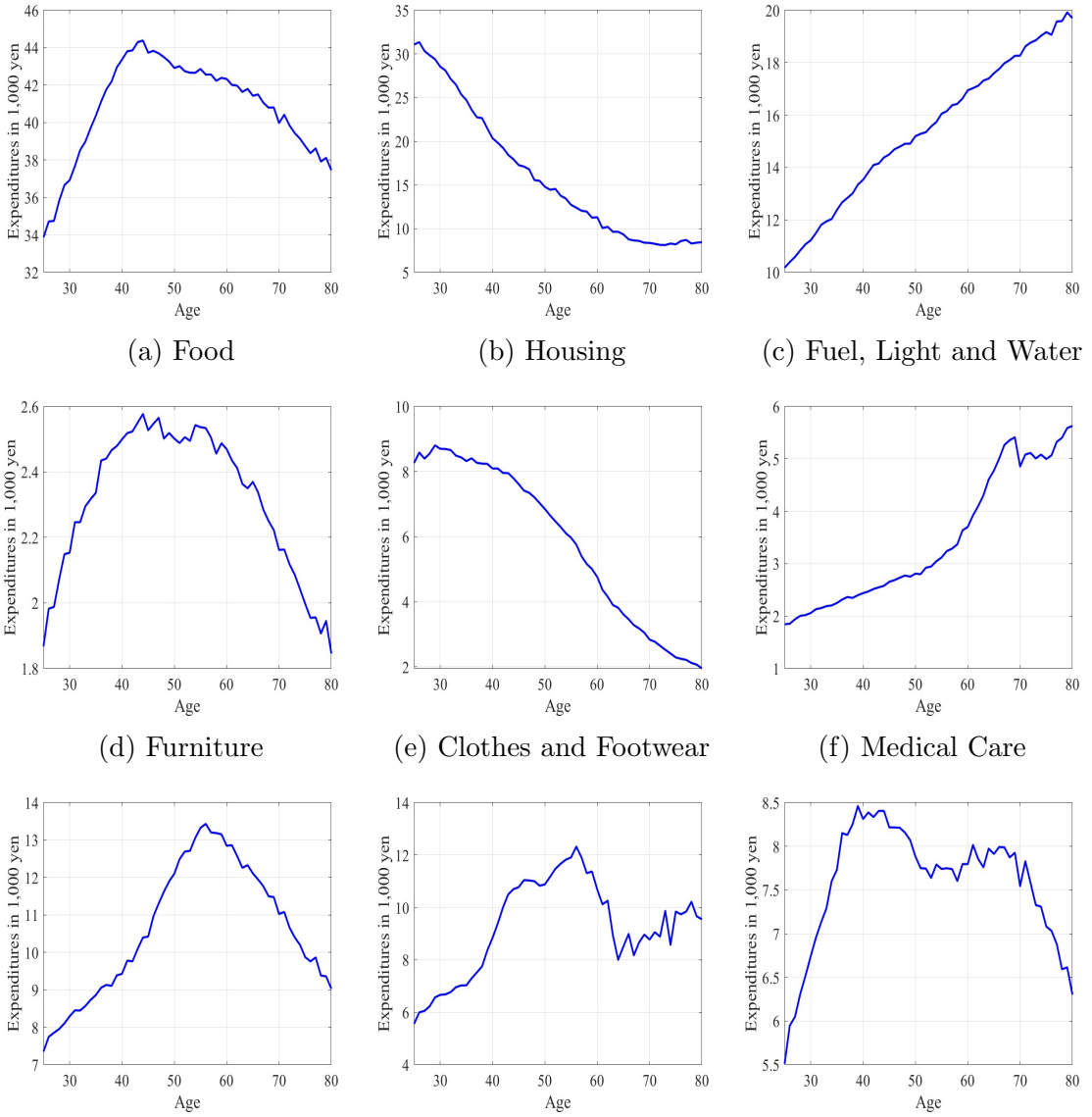
The composition, however, of the total consumption and profiles by consumption categories show different pictures, as shown in Figure 24. Non-durable consumption increases rapidly from age 25 to 40 and more mildly thereafter, essentially staying flat after the mid-50s. Durable expenditures follow a mildly hump-shaped profile, though the profile is much less symmetric than the total consumption profile as it declines more sharply by about 50%, from above 18,000 yen in the 40s to 9,000 yen in the late 70s. Service consumption stay flat until around age 50, and decreases sharply thereafter.



(a) Non-Durable (b) Durable (c) Services

Figure 24: Life-Cycle Profiles of Consumption by Categories

Figure 25 shows the age-profile of consumption by item groups. The shapes vary across items and only a few items such as food, furniture and transportation and communications, exhibit a hump-shape. Some items such as housing and clothes and footwear continues to decline over the life-cycle, and other items such as fuel, light and water and medical care continue to rise.



(a) Food (b) Housing (c) Fuel, Light and Water

(d) Furniture (e) Clothes and Footwear (f) Medical Care

(g) Transp. and Communication (h) Education (i) Culture and Recreation

Figure 25: Life-cycle Profiles of Consumption by Item Groups

The food category has the largest share and exhibits a hump shape, but the profiles vary by more detailed decomposition of food items. As shown in Figure 26, the profile of food at home is flat after their mid-40s until around age 70, while expenditures of eating out monotonically and more sharply decline after age 40.

Figure 26: Life-cycle Profiles of Food at Home and Eating Out

To facilitate the comparison of consumption growth across categories and item groups, Figures 27 and 28 show the levels of each consumption item relative to the level at age 25.

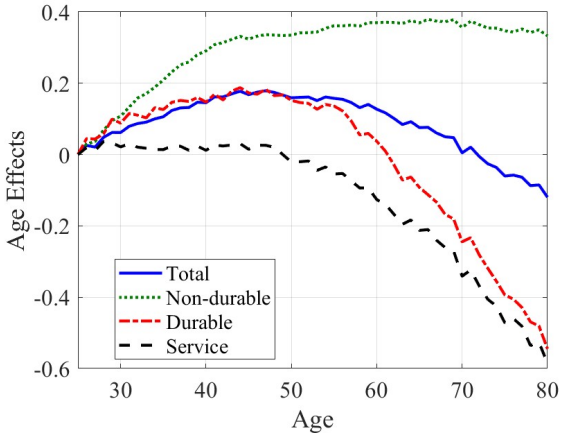
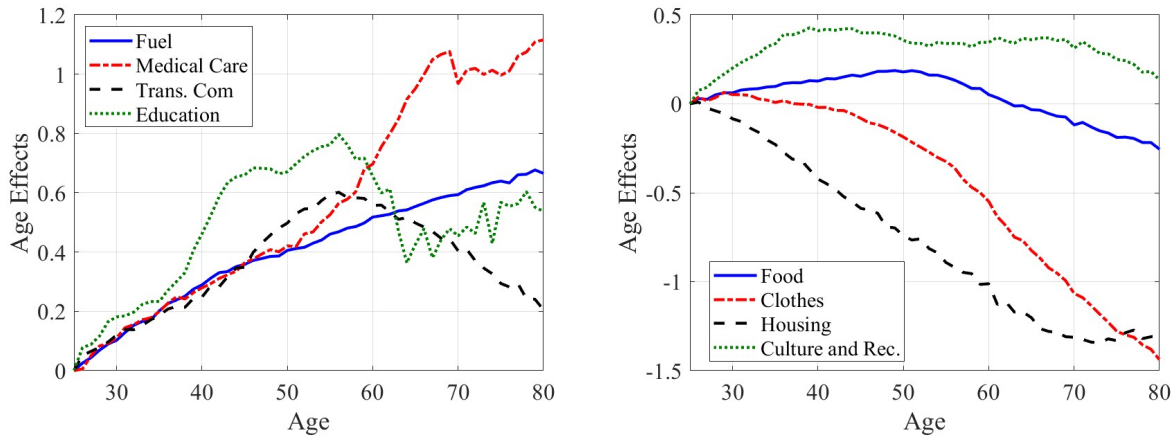


Figure 27: Age Effects of Consumption by Categories



(a) Group (1) (b) Group (2)

Figure 28: Age Effects of Consumption by Item Groups

Residual Variance: To assess the age profile of the dispersion of consumption across households, Figure 29 shows the variance of residuals from the regression at each age. The variance declines slightly from the late 20s to the early 30s and increases sharply from around 0.22 to 0.34 at age 60 and stays above 0.3 thereafter.

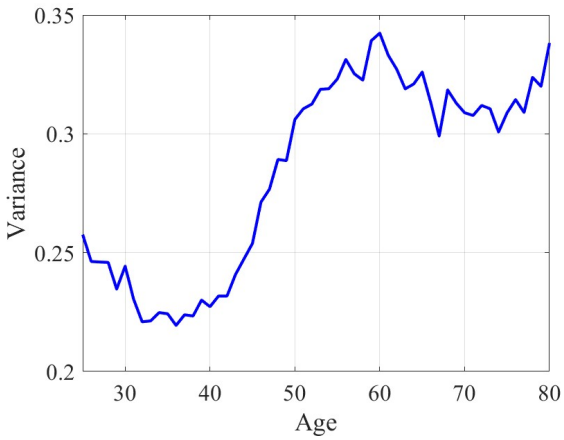


Figure 29: Variance of Residuals: Consumption

Figure 30 shows the variance of residuals by broad consumption categories. Although the levels are different across categories, the pattern over the life-cycle is similar across the three, showing paths of variances that are initially flat or declining until around age 40 and increase thereafter.

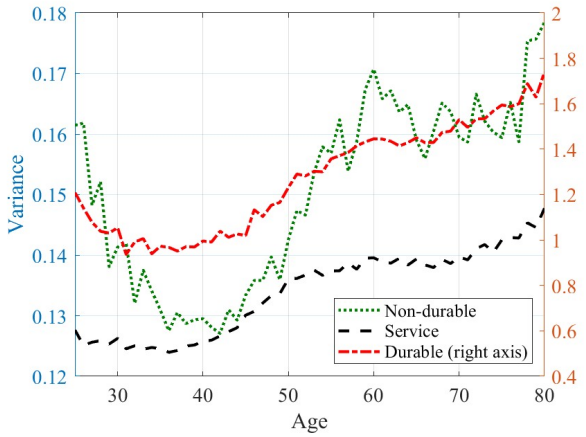
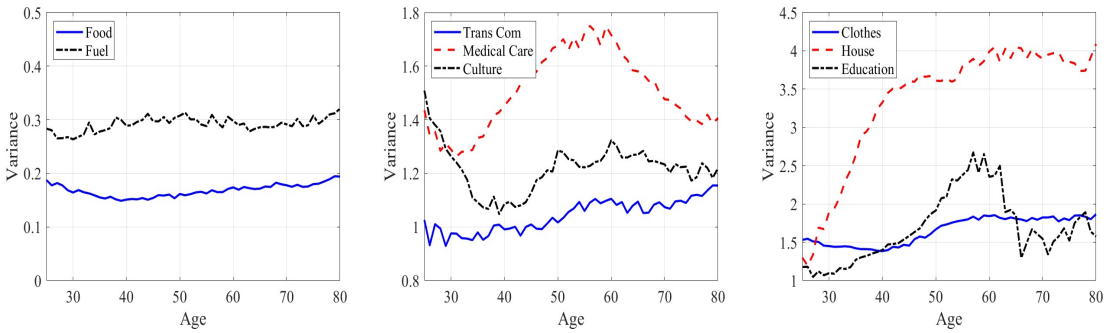


Figure 30: Variance of Residuals: Consumption by Categories

The profiles, however, vary significantly by item groups, as shown in Figure 31. Variance of food and fuel, light and water items stays at a very low level of about 0.3 and below 0.2, respectively, not showing any significant increase in the later part of the life-cycle. Other items have much higher variance and exhibit different timings and magnitude of changes over the life-cycle.



(a) Group (1) (b) Group (2) (c) Group (3)

Figure 31: Variance of Residuals: Consumption by Item Groups

Income: To evaluate the age profile of income, we use the same specification as in equation (1) replacing consumption with annual income as a dependent variable and estimate the model. Figure 32 shows the profile of regression coefficients on ages. Income rises in age and the variance peaks at around age 50. Income falls thereafter and sharply after age 60, when individuals start to leave the labor force. Figure 33 shows the profile of variance of the regression residuals. Income becomes more dispersed in age, peaks at around age 60.

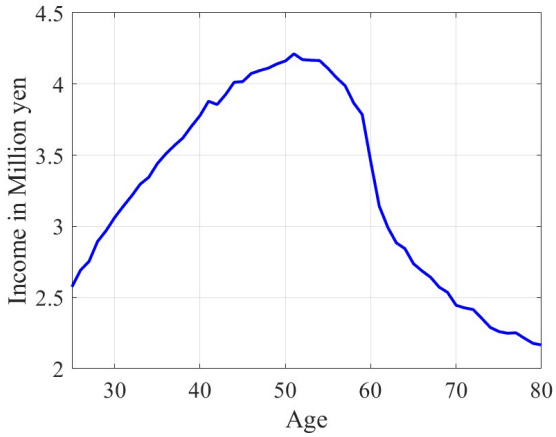


Figure 32: Life-Cycle Profile of Annual Income

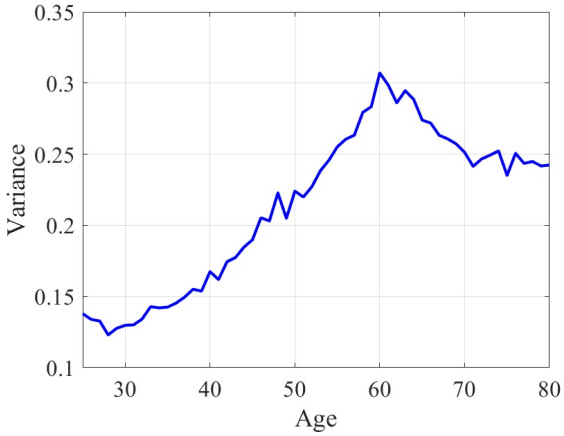


Figure 33: Variance of Residuals: Annual Income

6 Demographic Aging and Simple Projections

Using the age profiles estimated above, we compute a projected path of consumption during the next few decades, assuming that age-specific consumption expenditures of different items follow the life-cycle path estimated in the previous section. This is a simple partial equilibrium exercise under a strong assumption, which shows directions in which the demographic dynamics could influence for the trajectory of the aggregate consumption, as well as its composition over the coming decades.

We estimate a smooth age polynomials of each consumption item using the life-cycle profiles estimated in section 5 and use them to compute the path of aggregate consumption based on the population projections of the National Institute of Population and Social Security Research (IPSS).[13] We focus on the consumption of adults at and

[13]Since we do not have reliable estimates for expenditures beyond age 80 and it is difficult to extrap-

above age 25.

Figure 34 shows the percentage change in the population aged 25 and above and the total consumption, relative to the levels in 2020. The two paths do not exactly overlap since consumption expenditures vary by age and the age distribution shifts over time. The faster decline in total consumption implies that the average per capita consumption declines over time due to demographic aging.

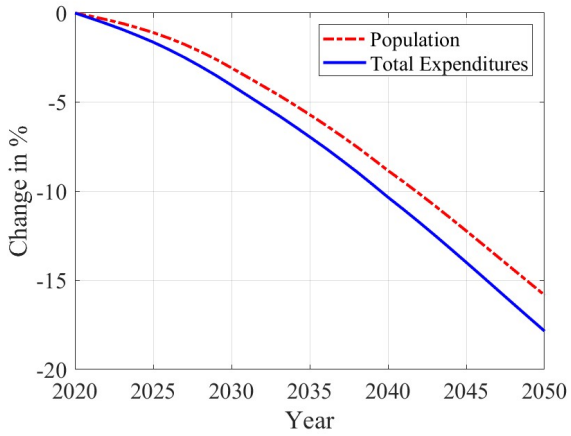
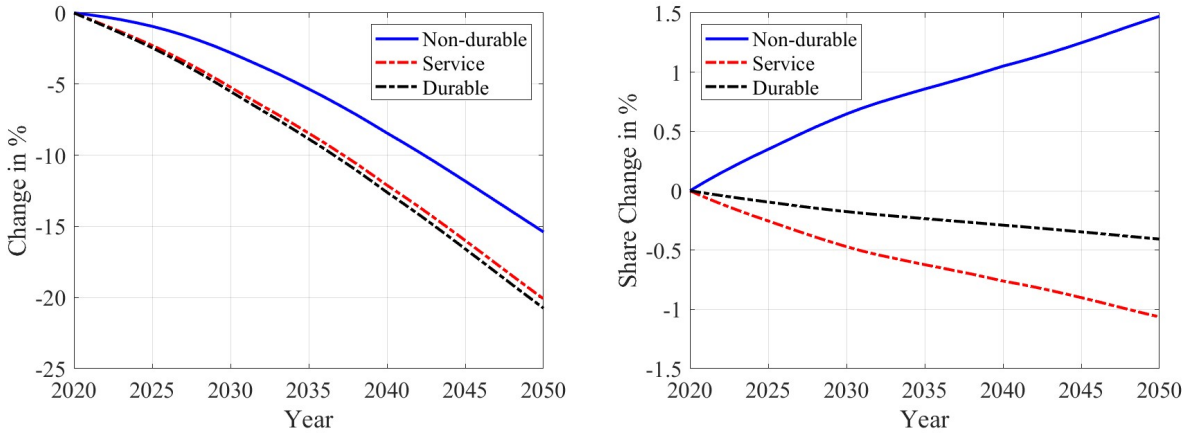


Figure 34: Population (aged 25-105) and Consumption Projections

Figure 35 shows the change in the levels and shares of non-durable, durable and service consumption. Although consumption of all three categories falls during the next three decades, the speed of decline differs across them. This is because, as we saw in Figure 24, the non-durable consumption continues to rise in age and the profile does not exhibit a hump-shape as in the profiles of durable goods and service. Since old households, whose population share keeps rising, spend relatively more on non-durable goods, especially on items such as food at home and fuel, light and water, than on service and durable goods, the consumption of non-durable goods declines more slowly. As a result, the share of non-durable goods out of total consumption keeps growing, as shown in Figure 35b.

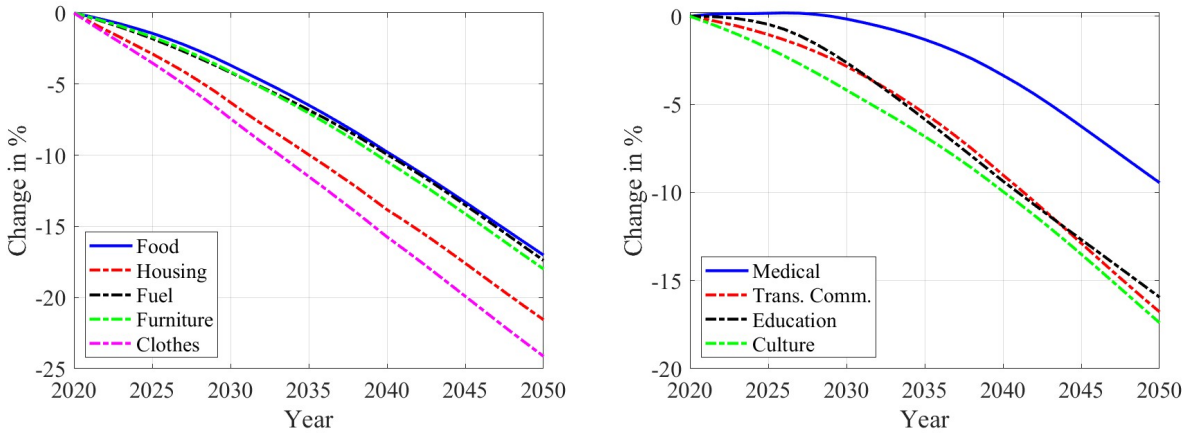
olate the profile to higher ages, we assume that the age-specific expenditures will remain the same after age 80.



(a) Change in Levels (%) (b) Change in Shares (%)

Figure 35: Consumption Projections by Categories

Figure 36 shows the consumption paths by item groups, expressed in terms of percentage changes relative to the levels in 2020. Consumption of medical care, food and fuel decline more slowly than other items, since the elderly spends relatively more on these items.



(a) Group (1) (b) Group (2)

Figure 36: Consumption Projections by Items

7 Conclusion

We used the Family Income and Expenditure Survey (FIES) data between 1981 and 2020 and investigated the trend of household consumption and inequality. Average consumption of households rose through the early 1990s and declined thereafter. This pattern is driven by the movement of durable goods and service consumption, while non-durable consumption remained more stable during the period. Consumption inequality

increased in the 1980s and early 1990s and stayed flat since then. The increase in inequality is driven primarily by the trend of service consumption.

We also investigated the age profile of consumption following the estimation method of Aguiar and Hurst (2013). Average total consumption exhibits a standard hump-shape over the life-cycle, although the shape varies by the categories of consumption. Non-durable goods consumption rises rapidly until around age 40 and stays in a narrow range thereafter. Durable goods and service consumption declines sharply after age 50. Consumption of items such as medical care and fuel, light and water keeps increasing throughout the life-cycle but other items such as food and transportation and communications follow a hump shape and items such as clothes and footwear decline monotonically. Consumption inequality increases through the early 60s and stays at a high level thereafter. The inequality pattern also varies by the consumption categories and items.

The demographic structure changed dramatically during the last few decades in Japan and will continue to do so over the coming decades. Our analysis reveals major differences in consumption behavior across households of different ages and points to the importance of including life-cycle dimensions in accounting for the consumption trends, especially in economies that experience a large shift in the demographic structure.

A More Details on Data Construction

Consumption expenditures are classified into four categories: (1) nondurable expenditure, (2) service expenditure, (3) semidurable expenditure, and (4) durable expenditure. The breakdown of each category with the survey's classification numbers is as follows.

1. Food (c_{FD}): "food (1)" − "meal outside the home (1.12)" + "tobacco (10.1.4)"
2. Nondurables (c_{ND}): Food (c_{FD}) + "fuel, light and water charges (3)" + "domestic nondurable goods (4.5)" + "medicines (6.1)" + "health fortification (6.2)" + "school textbooks and reference books for study (8.2)" + "books and other reading materials (9.3)" + "other miscellaneous (10.1.5)"
3. Services (c_{SV})[14] : "meal outside the home (1.12)" + "rents for dwelling and land (2.1)" + "service charges for repairs and maintenance (2.2.2)" + "domestic services (4.6)" + "services related to clothing (5.8)" + "medical services (6.4)" + "public transportation (7.1)" + "communication (7.3)" + "education (8)" − "school textbooks and reference books for study (8.2)" + "recreational services (9.4)" + "personal care services (10.1.1)" + "social expenses (10.3)"
4. Semidurables (c_{SD}): "tools and materials for repairs and maintenance (2.2.1)" + "domestic utensils (4.4)" + "clothing and footwear (5)" − "services related to clothing (5.8)" + "maintenance of vehicles (7.2.3)" + "recreational good (9.2)" + "personal care goods (10.1.2)" + "personal effects (10.1.3)"
5. Durables (c_{D}): "household durable goods (4.1)" + "interior furnishing and decorations (4.2)" + "bedding (4.3)" + "medical supplies and appliances (6.3)" + "purchase of vehicles (7.2.1)" + "purchase of bicycle (7.2.2)" + "recreation durable goods (9.1)"
6. Total expenditure (c_T): Sum of 2-5.

Detailed Items: In addition to the consumption of broad consumption categories above, we analyze data of the following item groups. Note that the items from the four categories of expenditures are discretely added to the more subdivided item groups.

1. Food
    - Non-durable: general food items (cereals, fish and shellfish, meat, dairy products and eggs, vegetables and seaweeds, fruits, oils, fats and seasonings, cakes and candies, cooked food, beverages, alcoholic beverages)
    - Service: meals outside the home (eating out, school lunch)

[14]Note that Aguiar and Hurst (2013) do not include health expenditures and education from service category.

2. Housing[15]
    - Service: rents for dwelling and land, service charges for repairs and maintenance
    - Semi-durable: tools and materials for repairs and maintenance
3. Fuel, light & water charges
    - Non-durables: electricity, gas, other fuel and light, water and sewerage charges
4. Furniture & household utensils
    - Durable: household durable goods, interior furnishing and decorations, bedding
    - Semi-durable: domestic utensils
    - Non-durable: domestic non-durable goods
    - Service: domestic services
5. Clothing & footwear
    - Semi-durable: Japanese clothing, clothing, shirts and sweaters, underwear, cloth and thread, other clothing, footwear
    - Service: services related to clothing (washing charges, charges for clothing rent, etc)
6. Medical care
    - Non-durable: medicines, health fortification
    - Durable: medical supplies and appliances
    - Service: medical services (medical treatment, dental treatment, delivery fees, other hospital charges, fees for medical checkups, etc.)
7. Transportation & communication
    - Services: public transportation, communication (postage, telephone charges, mobile phone charges, forwarding charges, mobile phones, other communication equipments)
    - Durable: purchases of vehicles and bicycle
    - Semi-durable: maintenance of vehicles (gasoline, automotive parts, articles related to private transportation, rent for park, charges for rental car and car sharing, auto insurance premium, etc.)

[15]The FIES does not include imputed rents for homeowners. The System of National Accounts (SNA) includes imputed rents in both expenditures and income. See Unayama and Yoneta (2018) for more details about the discrepancy between the SNA and the FIES.

8. Education
    - Service: school fees (elementary school fees, junior high school fees, high school fees, college fees, pre-primary education fees, special training school fees), tutorial fees (children and elementary school tutorial fees, junior high school tutorial fees, high school tutorial and prep school fees)
    - Non-durable: school textbooks and reference books for study
9. Culture & recreation
    - Durable: recreation durable goods (TV sets, video recorders and players, personal computers, cameras and video cameras, musical instruments, desks and chairs for students and office workers, etc)
    - Semi-durable: recreational goods (stationary, sporting goods, toys, games, etc.)
    - Non-durable: books and other reading materials (newspapers, magazines, books, etc.)
    - Service: recreational services (accommodation services, package tours, lesson fees, charges for NHK and cable TV license, admission fees for movies, plays and sports, gym charges, membership dues, internet charges, etc.)
10. Other consumption expenditures
    - Service: personal care services, social expenses
    - Semi-durable: personal care goods, personal effects,
    - Non-durable: tobacco, other miscellaneous

B More Details on the Consumption Trend

Equivalized Consumption: Figure A.1 shows the path of consumption equivalized by three alternative methods. The OECD scale assigns the value of 1.0 to the first adult, 0.7 and 0.5 to each of additional adults and children, respectively. The OECD modified scale assigns values are 1.0, 0.5 and 0.3 to the household head, an additional adult and child, respectively. The square root scale divides household consumption by the square of the household size.

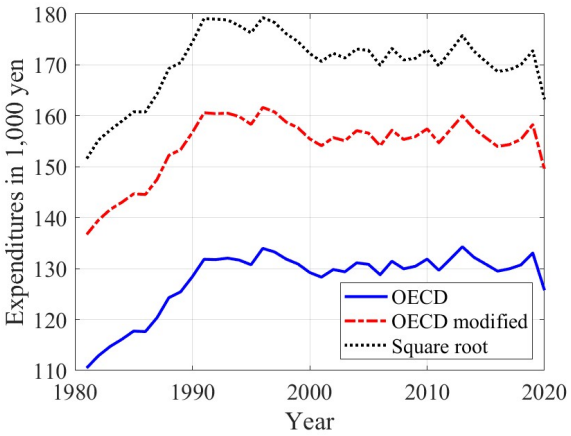
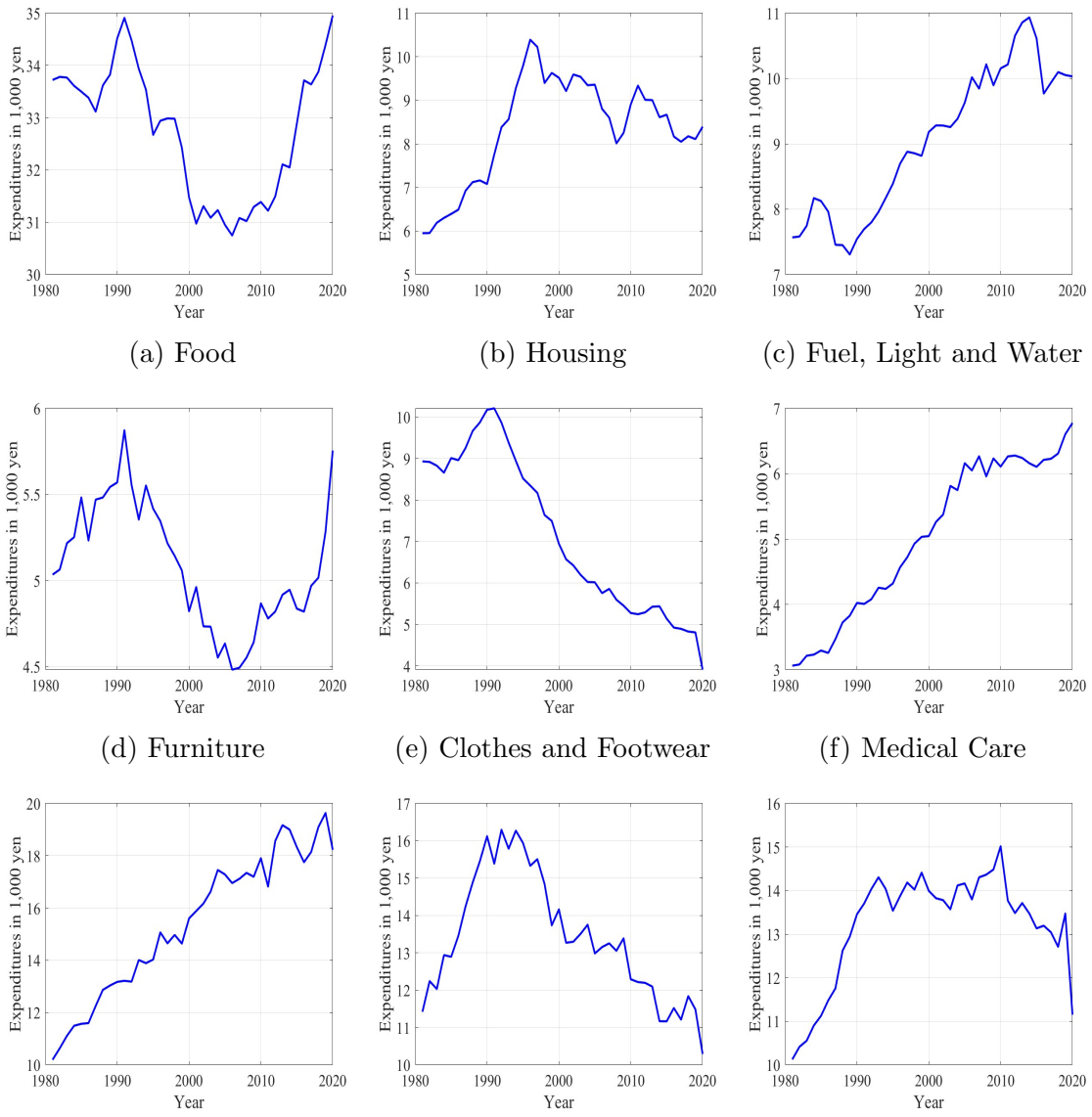


Figure A.1: Total Consumption (Equivalized)

Equivalized Consumption by Item Group: Figure A.2 shows the time trends of equivalized consumption for different item groups, using the OECD equivalence scale.



(a) Food (b) Housing (c) Fuel, Light and Water

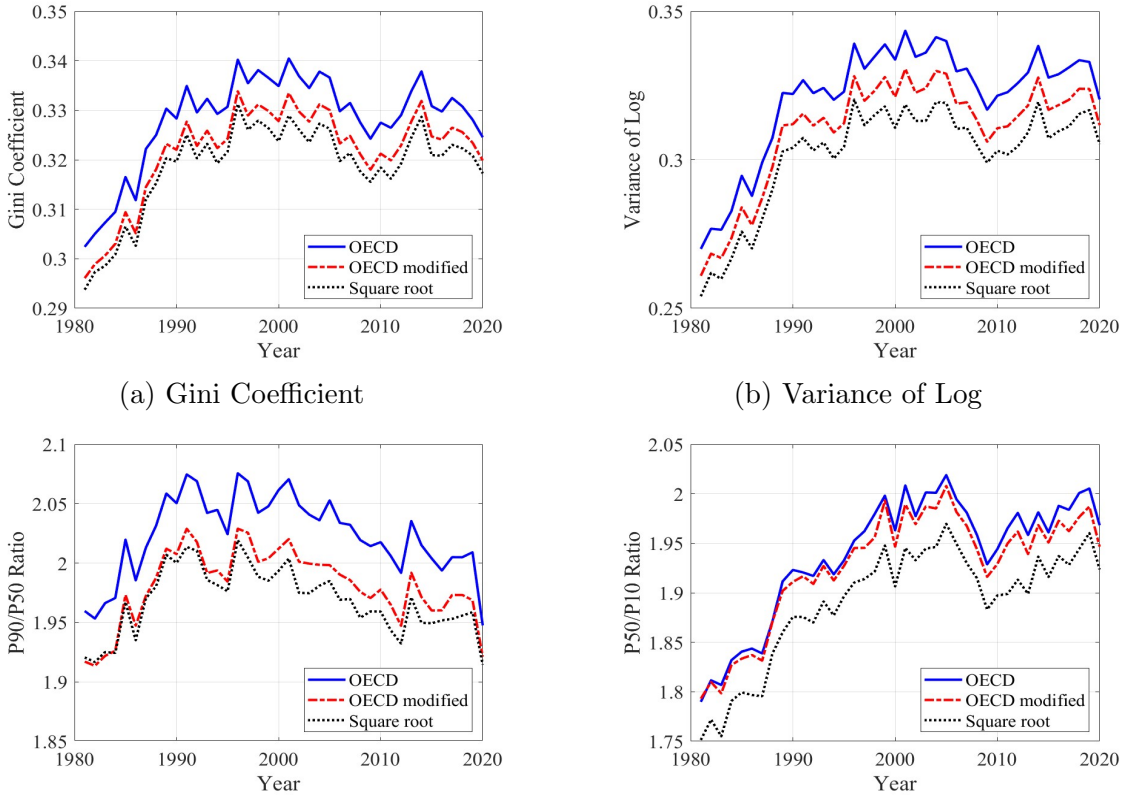
(d) Furniture (e) Clothes and Footwear (f) Medical Care

(g) Transp. and Communication (h) Education (i) Culture and Recreation

Figure A.2: Consumption by Item Group (Equivalized)

Figure 5 showed a large decline of food expenditures. As shown in Figure A.2 above, the decline in the food consumption is much subdued once the expenditures are equivalized, implying that much of the decrease is due to the change (decline) in the family size.

Equivalized Consumption Inequality: Figure A.3 shows the trend of inequality in equivalized consumption, using three different methods. Qualitative trends of inequality remain the same as in those of household consumption, shown in Figure 17, but the decline in Gini coefficient and P90/P50 ratios is milder in the equivalized profiles.



(a) Gini Coefficient

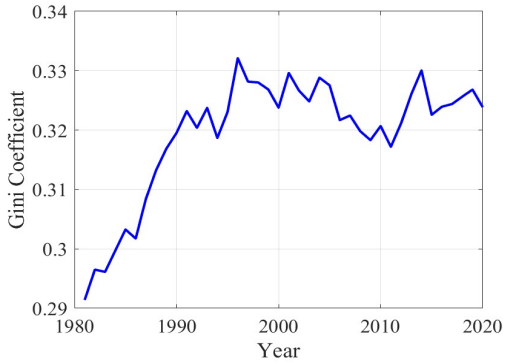
(b) Variance of Log

(c) P90/P50 Ratio

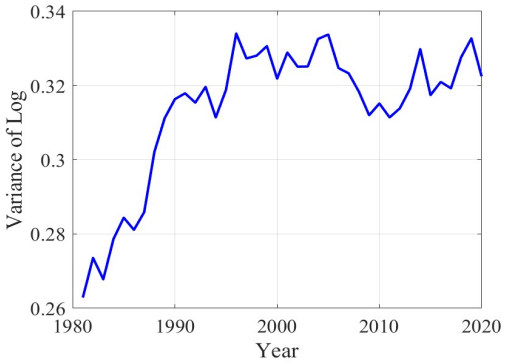
(d) P50/P10 Ratio

Figure A.3: Consumption Inequality: Total Consumption (Equivalized)

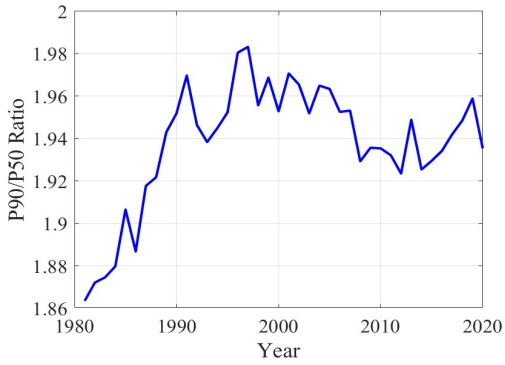
Consumption Inequality without Month Effects: Figure A.4 show the trend of inequality in total consumption when we remove month effects. We regress our monthly consumption data on month dummies and compute inequality statistics of the data after removing the effects. The degree of inequality is slightly lower, but the trends are the same as those in Figure 17.



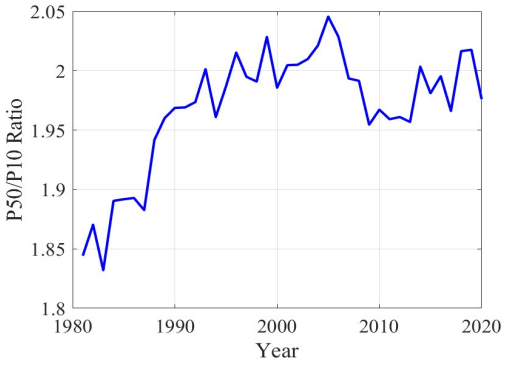
(a) Gini Coefficient



(b) Variance of Log



(c) P90/P50 Ratio

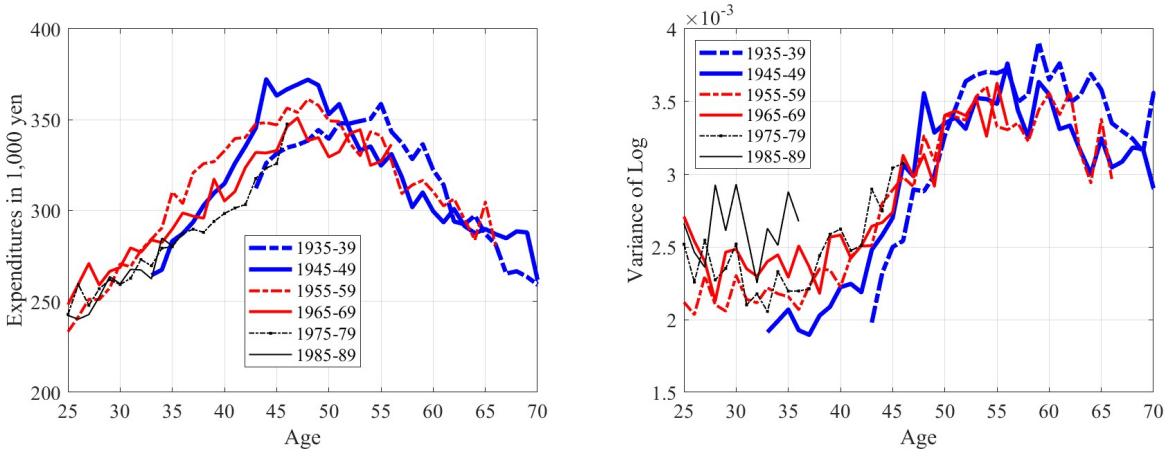


(d) P50/P10 Ratio

Figure A.4: Consumption Inequality without Month Effects: Total Consumption (Households)

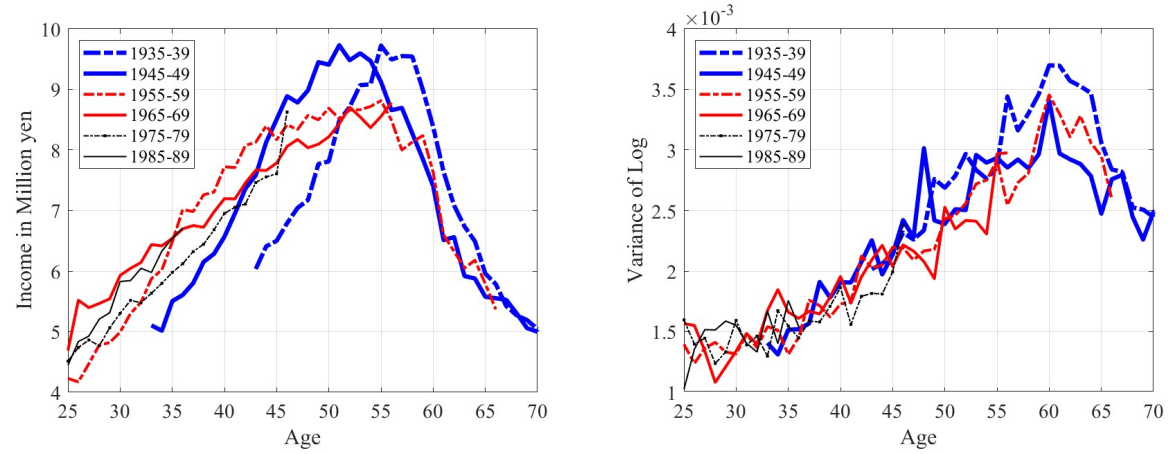
C Consumption by Cohort

Figure A.5 shows the age profile of total consumption and variance of log for different cohorts. The shapes of the profiles are the same across cohorts, but the levels differ across them. Figure A.6 shows the income profile by cohort and Figures A.7 and A.8 are the equivalized versions of consumption and income profiles.



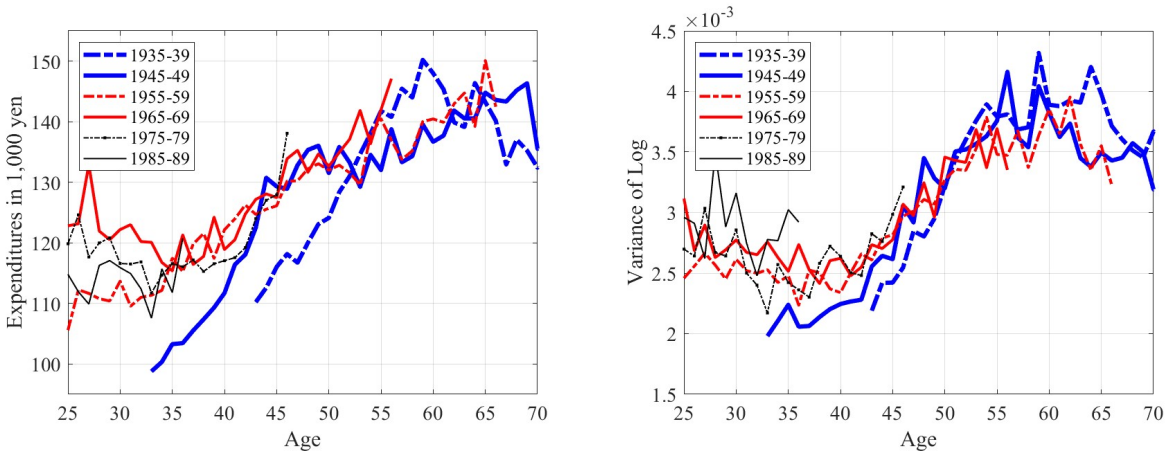
(a) Levels (b) Variance of Log

Figure A.5: Total Consumption by Cohort (Household)



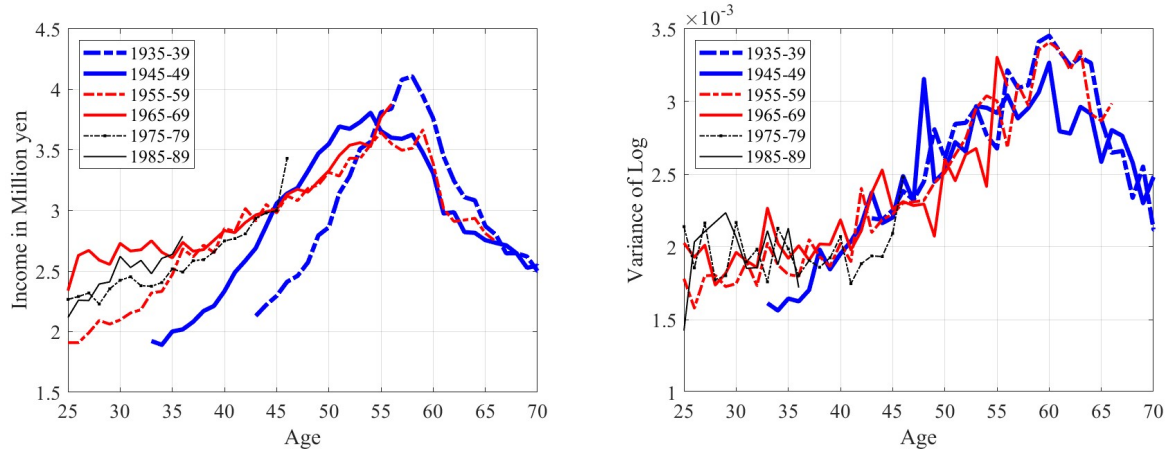
(a) Levels (b) Variance of Log

Figure A.6: Annual Income by Cohort (Household)



(a) Levels (b) Variance of Log

Figure A.7: Total Consumption by Cohort (Equivalized)



(a) Levels (b) Variance of Log

Figure A.8: Annual Income by Cohort (Equivalized)

D Quarterly Series of Inequality

Throughout this paper, we have taken advantage of the characteristics of monthly data from household surveys and analyzed them asset monthly variables. Quarterly data may be more convenient when analyzing the relationship between the business cycle and economic inequality since most business cycle-related variables are quarterly data. In this appendix, we plot the time-series trends of the economic inequality in terms of quarters. As already mentioned, the FIES is monthly panel data: the same household can be tracked for six months. Following Inui et al. (2017), we focus on the five categories of variables; (i) labor income, (ii) total income, which include labor income and asset

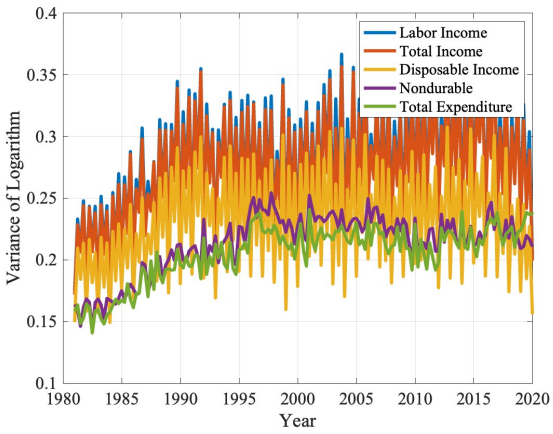
incomes, (iii) disposable income, (iv) non-durable consumption expenditure, and (v) total consumption expenditure.[16]

We use three measures of inequality: log variance, Gini coefficient, and the ratio of the 90th percentile to the 10th percentile. The left-hand side plots the inequality index estimated using the household variable, and the right-hand side plots the economic inequality index for the equivalent variable.

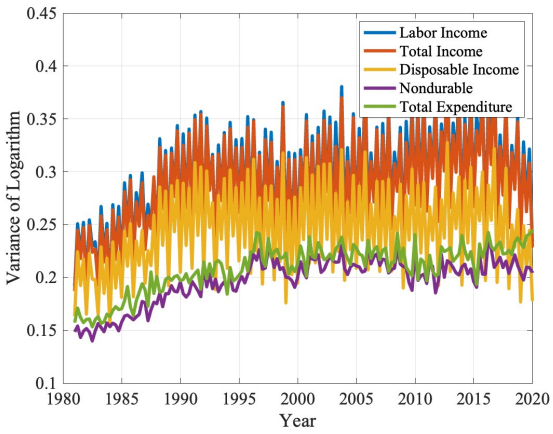
Figure A.9 shows that, compared to consumption expenditures, income inequalities are highly seasonal. Second, as pointed out by Inui et al. (2017) and Lise et al. (2014), the period of widening economic inequality was marked from the 1980s to the mid-1990s, and although it has remained high in recent years, a clear upward trend cannot be found.[17]

[16]For more details on the data construction, see Lise et al. (2014).

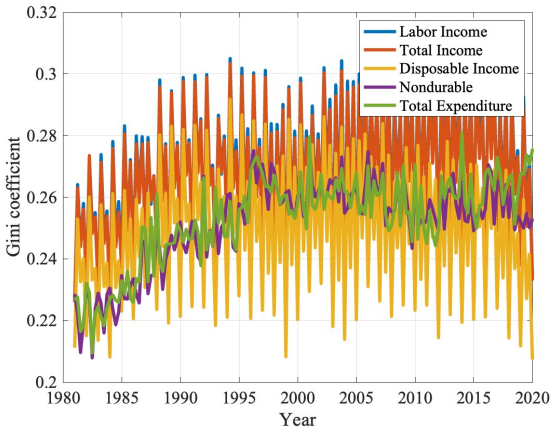
[17]Inui et al. (2017) conduct a time series analysis of the relationship between monetary policy and economic inequality in Japan after seasonally adjusting quarterly data to clean up the data series.



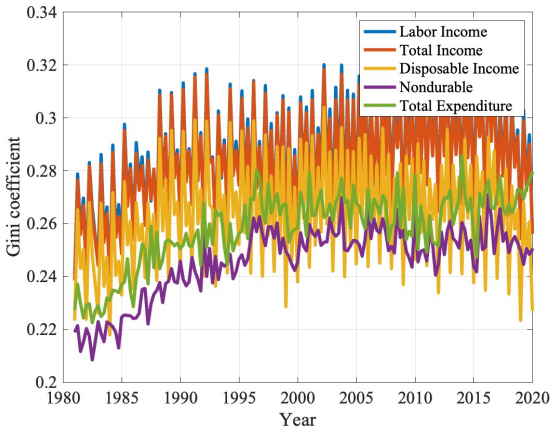
(a) Variance of Log: Raw



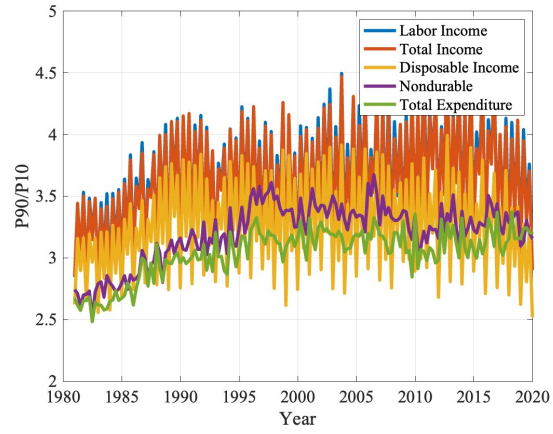
(b) Variance of Log: Equivalized



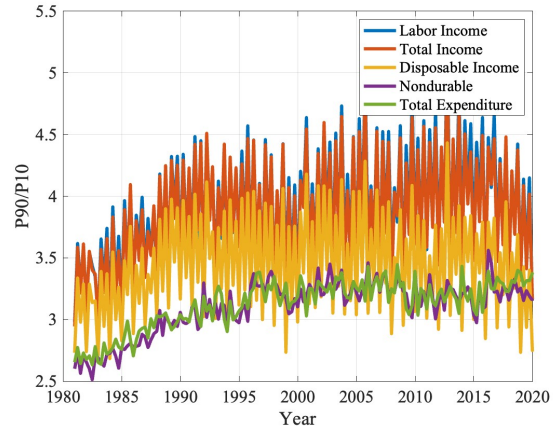
(c) Gini Coeficient: Raw



(d) Gini Coefficient: Equivalized



(e) P90/P10: Raw



(f) P90/P10: Equivalized

Figure A.9: Quarterly Series of Economic Inequality

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