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Estimating Consumption Inequality in Japan over the Last Three Decades

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Abstract

This study investigates consumption inequality in Japan over the last three decades using data from the Family Income and Expenditure Survey (FIES). A number of scholars have argued that the consumption data in the FIES are biased, suggesting that respondents underreport spending on rarely purchased but expensive goods and that the reporting of consumption declines over the six-month survey period due to "survey fatigue." This study therefore controls for these possible biases and then estimates consumption inequality. When consumption inequality between the top and bottom 10 percent of the income distribution is calculated using the raw, reported consumption data in the FIES, a downward trend in consumption inequality is obtained, implying that it has become more equal than in the past. However, when controlling the measurement error in the consumption, an upward trend in consumption inequality is found, implying that inequality has been rising.

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1. Introduction

This study seeks to examine consumption inequality in Japan over the last three decades. During this period, the Japanese economy has experienced many macro- and microeconomic changes. Glancing back, Japan experienced rapid economic growth in the 1970s and experienced an economic bubble in the 1980s. After the burst of the bubble, Japan experienced a long period of economic stagnation in the 1990s and 2000s that is often referred to as the "Lost Decades." Along with these development, a major factor affecting economic trends is changes in the demographic structure since the 1980s. The share of younger in the population overall began to decrease, while the share of older people started to increase. In addition, continuing migration from rural to urban areas such as the major metropolitan areas of Tokyo, Osaka, and Nagoya accelerated the decrease in household sizes. During the prolonged economic stagnation of the Lost Decades, firms, reflecting the increase in uncertainty, actively restructured their business, reduced the number of regular employees, and curtailed the hiring of new graduates. These developments led to a steady increase in the number of non-regular workers since the 1990s.

An important issue is how these developments have affected inequality in Japan. A useful starting point in this context is the study by Moriguchi (2017), who investigated income inequality in Japan from a historic and international perspective to show the problems that Japan is facing. The author argues that in the 1980s Japan managed to achieve economic without a large increase in inequality and that Japanese-style employment practices may have contributed to this. However, after the 1990s, the increase of people who are not in the typical employment system might lead to the increase in inequality in Japan (Moriguchi, 2017).

Meanwhile, Ohtake and Saito (1998) investigated how population aging affects inequality in Japan. Employing the approach introduced by Deaton and Paxson (1994), they used the variance of the log consumption to measure changes in inequality between 1979 and 1989. They found that within-cohort inequality increased for households with a head aged 40 or over and that approximately half of the consumption inequality in the 1980s can be explained by population aging.

Abe and Yamada (2009) examined consumption inequality between 1984 and 1999 measured with the log consumption variances. They found that age effect was crucial in explaining the consumption inequality in Japan. Meanwhile, focusing on changes in inequality in income, such as wages and disposable income, as well consumption in the 1980s, 1990s, and 2000s, Lise et al. (2014) showed that the variance of the logarithm of disposable income increased from the early 1980s to the late 2000s. They further showed that the variance of the logarithm of non-durable consumption was slightly smaller than that of disposable income but increased through the period. Further, investigating trends in earnings, income, and wealth inequality in Japan from 1984 and 2014, Kitao and Yamada (2019) found that inequality had widening during the period. They also found that demographic changes played a large role in

changes in earnings and income inequality.

There are many studies on inequality in other countries. For instance, for the United States, Cutler and Katz (1991) showed that both consumption and income inequality rose in the 1980s. Meanwhile, Deaton and Paxson (1994) examined consumption and income inequality over the life cycle in the United States, Britain, and Taiwan. Calculating the variance of log consumption to measure within-cohort consumption and income inequality, they showed that the age effect on inequality increased as the average age of the population in the three countries increased. Aguiar and Bils (2015) studied consumption inequality correcting for measurement error in the *Consumption and Expenditure Survey* in the United States. They highlighted the inconsistency between consumption, income, and savings data in the survey, which they regarded as reflecting measurement error in the consumption data. Correcting for this inconsistency, they then focused on the income inequality between the top and bottom 20 percent of the income distribution and found that consumption inequality increased as income inequality increased. Employing Aguiar and Bils' (2015) approach, Zhao et al. (2017) estimated consumption inequality in China between 1993 and 2010. They found that consumption inequality increased between 1993 and 2007 but then decreased from 2008 onward.

In this study, we estimate consumption inequality between the top and bottom 10 percent of the income distribution in Japan over the last three decades using the data from the Family Income and Expenditure Survey (FIES) and employing the approach proposed by Aguiar and Bils (2015). In simple terms, this approach employs the total expenditure elasticities between two types of goods: luxury goods and necessities. At some point in time, the consumption of luxury goods of the higher income group increases more than that of the lower income group. On the other hand, for necessities, the change in consumption of the higher income group does not differ from that of the lower income group. In this approach, the fact that the consumption of those in the higher income shifts to more to luxury goods is regarded as an increase in consumption inequality between the two income groups.

This approach means that it is not necessary to accurately measure a household's total consumption (Aguiar and Bils, 2015); however, it does require an important assumption on the expenditure elasticities of goods. The approach estimates the Engel curve to obtain the expenditure elasticity of each goods category in the first step. It then measures consumption inequality in the second step as the difference in total consumption between the two income groups. For the expenditure elasticities, the approach implicitly assumes that the expenditure elasticities of the two types of goods do not differ among income groups. If this assumption holds, it is possible to predict the true total consumption and calculate consumption inequality between the highest and the lowest income groups in the second stage. This seems to be a strong assumption, since the increase in spending on goods could vary across income groups. For example, it could be that the increase in spending on culture & recreation associated with the

increase in the total spending, or income, for richer people might be larger than that for poorer people. Therefore, to check the robustness of the results, the validity of the assumption is tested for each goods category, and consumption inequality is then estimated using only goods categories that satisfy the constant elasticity assumption.

The rest of the paper is organized as follows. The next section discusses why this study measures inequality in terms of consumption rather than income. Section 3 then discusses the measurement error in the consumption data from the FIES used in this study. Next, Section 4 provides a more detailed explanation of the estimation approach, while Section 5 explains the construction of the dataset used for the analysis. Section 6 then provides summary statistics as well as estimation results of the expenditure elasticities of each goods category and consumption inequality. Section 7 compares trends in income inequality, in consumption inequality using the reported consumption, and in error-adjusted consumption inequality. Section 8 provides the first of two robustness checks. Specifically, another definition of consumption, where consumption is measured in terms of the three-month average of consumption, rather than six-month average of consumption, is used to estimate the trend in error-adjusted consumption inequality. Section 9 provides the second robustness check, in which the validity of the constant elasticity assumption is tested for each goods category and consumption inequality is estimated using goods categories satisfying the assumption. Finally, Section 10 presents concluding remarks.

2. Consumption Inequality and Income Inequality

The reason for measuring inequality in terms of consumption is that it provides a better measure of changes in welfare inequality than measuring inequality in terms of income. The standard life-cycle permanent income hypothesis suggests that people decide their consumption level based on their lifetime assets, so that even if there is a small change in income, people do not change their consumption level and instead smooth consumption. In addition, the full and partial insurance hypotheses imply that people smooth their consumption against transitory income shocks. These hypotheses thus imply that measuring inequality in terms of income would overstate welfare inequality.

Cutler and Katz (1991) examined if changes in the distribution of consumption are reflected in changes in welfare rather than changes in income. They found that the distribution of consumption is more equal than the distribution of income. In addition, they found that in the 1980s the trend in the consumption distribution had a similar pattern to the trend in the income distribution.

Focusing on the United States, Attanasio and Davis (1996) estimated the impact of changes in the wage structure on the distribution of household consumption. They found

evidence supporting the full insurance hypothesis in the case of short-term shocks, while the full insurance hypothesis was rejected in the case of longer-term shocks.

Blundell et al. (2008) also investigated the insurance hypothesis to explain the disjuncture between income and consumption inequality in the United States. Their empirical analyses showed that there was a large degree of insurance against a temporary shock. They also showed that there was some degree of insurance against a permanent shock among people who were highly educated and those who were close to retirement.

In Japan, Kohara (2001) examined the full insurance hypothesis and differences in the degree of insurance across several household demographics. She showed that the full insurance hypothesis was not supported for Japan as a whole. However, people living in urban areas show a large degree of insurance in their consumption against income shocks. Meanwhile, Kohara et al. (2002) examined the insurance hypothesis using Japanese consumption data. They found that while the full insurance hypothesis was rejected, there was some insurance against idiosyncratic shocks through the market or other mechanisms such as risk sharing among households.

3. Measurement Errors in Japanese Consumption Data

The findings in the literature imply that measuring inequality in terms of consumption provides a better gauge of measuring the inequality in society than doing so in terms of income.

In Japan, there are many household consumption surveys conducted by the government and research institutes. Specifically, the government publishes four major consumption surveys. The Statistics Bureau of the Ministry of Internal Affairs and Communication conducts the Family Income and Expenditure Survey (FIES), the National Survey of Family Income and Expenditure (NSFIE), and the Survey of Household Economy (SHE). The FIES, which provides the data used in this study, is a monthly survey available from 1980s. The NSFIE has been conducted every five years since 1959. The SHE is a monthly survey conducted since 2001. In addition, there is the Comprehensive Survey of Living Conditions (CSLC) conducted by the Ministry of Health, Labour and Welfare. The CSLC was initiated in 1986 and full-scale surveys are conducted every three years, with simplified surveys being conducted in other years. These four surveys are primarily conducted to understand trends and changes in households' finances and consumption behavior (Unayama, 2015).

There are several surveys on household consumption conducted by universities and research institutes. Keio University conducts the Japan Household Panel Survey (JHPS/KHPS). The survey originally started in 2004 and has been conducted annually since then. The survey covers a wide range of topics including household structure, the academic background of family members, household members' employment situation and, their time use, and the household's

income and consumption. Further, the Institute for Research on Household Economics conducts the Japanese Panel Survey of Consumers (JPSC). The survey, which started in 1993 and ended in 2016, mainly focuses on the economic activities of young women and reflects changes such as the increase in the female university enrollment rate and female labor force participation, as well as lifestyle changes. It contains a variety of items including income, expenditure, saving, employment, and household structure.

However, it has been argued that some of these surveys suffer from measurement error such as an under-reporting of household consumption. Unayama (2009, 2011, and 2015) examined the measurement error in the FIES by comparing consumption patterns with those in the NSFIE, the SHE, and the CLSC. Unayama (2015) showed that consumption levels in the FIES are similar to those in the NSFIE and the CSLC. On the other hand, although consumption developments in the FIES are similar to those in the SHE, the level of consumption in the FIES is much smaller than that in the SHE. The level of household consumption in the FIES is about 80 percent of that in the SHE.

Unayama (2015) argues that the expenditure data in the FIES may suffer from measurement error and points to the following two possible reasons. The first possible reason is that people forget to report their spending. In the FIES, households are asked to fill in a family account books to record their income and consumption on a daily basis. With this survey method, there would a lot of possibility that people forget what they bought and they do not report rarely purchased goods such as cars and furniture. On the other hand, the SHE employs a pre-coded questionnaire. About 40 items that are rarely purchased and expensive items in the FIES are presented on the questionnaire, and households write down the amount of spending on these goods if they purchased them. In addition, households report their other monthly spending such as spending on food and utilities on a monthly basis.[1] The SHE is conducted to understand true household consumption and to overcome the underestimation of household consumption in the FIES by using a pre-coded questionnaire to reduce to forget reporting the spending for those rarely purchased and expensive goods.

The second possible reason is under-reporting of consumption due to survey fatigue. In the FIES, households are surveyed for six consecutive months. Stephens and Unayama (2011, 2012) have pointed out that average consumption reported in the FIES decreases over the six-month period, suggesting that households struggle to continue with the daily book keeping for six months with the same level of commitment. This survey fatigue bias might be responsible for the under-reporting of consumption (Unayama, 2015).

Despite the shortcomings just described, the FIES provides the best data source for the purpose of this study in that it provides annual data spanning a period of more than three decades.

[1] Since the January 2017 survey, the SHE no longer surveys monthly total spending.

However, given the considerations above, if the consumption data suffering from measurement error were used as they are, this would likely result in a mismeasurement of true inequality and its trend. Therefore, it is necessary to adjust the consumption data for measurement error to obtain the true trend in inequality in Japan.

4. Data

This section provides a more detailed outline of the Family Income and Expenditure Survey and the construction of the dataset used for the analysis.

The FIES is a comprehensive survey on household income and expenditure. It is a monthly survey, in which two-or-more-person households are surveyed for a period of six months and one-person households for three months. The survey covers households from the entire area of Japan. It currently covers approximately 9,000 households in total, consisting of approximately 8,000 two-or-more-person households and approximately 1,000 one-person households that are surveyed each month. One-sixth of two-or-more-person households and one-third of one-person households are replaced with new households each month.

The survey consists of four types of questionnaires: the Household Schedule, the Family Account Book, the Saving Schedule, and the Yearly Income Schedule. The Household Schedule covers information such as the number of family members, the occupation of working members, and the type of dwelling. The Family Account Book covers information such as daily incomes and expenditure such as spending on food, clothing & footwear, and fuel, light, & water. Further, two-or-more-person households (but not one-person households) are asked to fill in the Saving Schedule, which covers information on savings in a bank account and stocks. Finally, the Yearly Income Schedule covers information such as the annual income of the previous year, yearly business profits, annuities and public pensions received in the previous year, etc.

For the analysis here, data for the years from 1984 to 2013 are used. Expenditure elasticities for each good and the coefficients of household demographics are estimated using data from 1984 to 1986, while consumption inequality is then estimated using data from 1987 to 2013. The dataset used for the analysis focuses on two-or-more-person households with a household head aged 25 or above. Non-working households, households employed in agriculture, forestry, or fishery, and households with a household head whose occupation is professional service are excluded from the analysis. Of the households chosen for the dataset, approximately 10 percent failed to provide answers for all months and were dropped[2]. The

[2] Aguiar and Bils (2015: 2732) drop "households in the top and bottom 5 percent of the before-tax income distribution." Taking their approach, this paper constructed the analysis sample without the top and bottom 5 percent of the annual income in the previous year and analyzed the consumption inequality. However, this does not give any significant changes form the results presented in this paper.

remaining sample contains approximately 14,000 households in each year. For the analysis, the following 10 goods categories following the classification of the Statistics Bureau are used: spending on food; housing; furniture & household utensils; clothing & footwear; medical care; transportation & communication; education; culture & recreation; fuel, light, and water charges; and other. Among these 10 goods categories, we use spending on non-durable goods and services and drop spending on durable and semi-durable goods[3]. To compare the trend in consumption inequality over time, nominal consumption are converted into real consumption using the 2015 base year consumer price index. We take the six-month average of consumption of each goods category. Income groups are constructed using the annual income in the previous year. We construct the 10 income groups by 10 percentiles for each year.

5. Estimation Method

As mentioned, this study employs the estimation approach proposed in Aguiar and Bils (2015) to estimate consumption inequality in Japan from 1987 to 2013 by correcting the consumption data for measurement error.

In a nutshell, this approach estimates consumption inequality from changes in consumption of various goods categories by higher and lower income groups. For example, let us assume that we observe that, at some point in time, the consumption of luxury goods by the higher income group increased more than the consumption of luxury goods by the lower income group. Let us further assume that for necessities, changes in consumption by the higher income group do not differ from those by the lower income group. In this case, those in the higher income group allocate more spending to luxury goods, which in this approach is regarded as an increase in consumption inequality between the two income groups.

Using the difference in expenditure elasticities between luxuries and necessities, this approach estimates the total consumption difference between these income groups. First, to calculate the expenditure elasticity of good *g*, the consumption function is assumed to take the following form:

$$\ln x_{hg} = \alpha_g + \beta_g \ln Exp_h + \Gamma_g Z_h + \rho_m M_m + u_{hg}$$

where x_{hg} is the consumption of good *g* by household *h*, Exp_h represents the total consumption of household *h*, *Z* is a vector of household demographic variables, and *M* is a set of dummy variables indicating the first month of the survey for each household. Further, α, β, and Γ are the parameters to be estimated, while *u* is the error term. The parameter β_g is the expenditure elasticity of good *g*, which is assumed to be constant overtime. For simplicity, the following exposition focuses on two types of goods, luxury goods, *Lux*, and necessities, *Nec*.

[3] This paper did the analyses with the data including durables and non-durables in the goods categories. The results were similar to the results reported in this paper.

Second, focusing on the higher income group, the increase in total consumption can be calculated as follows:

$$\Delta_t \ln Exp^H \equiv \frac{\left\{\left(\frac{\Delta_t Lux^H}{Lux^H}\right) - \left(\frac{\Delta_t Nec^H}{Nec^H}\right)\right\}}{Elasticity_{Lux} - Elasticity_{Nec}}$$

$$= \frac{\Delta_t Exp^A}{Exp^A} \times \frac{\left(\frac{\Delta_t Lux^H}{Lux^H}\right) - \left(\frac{\Delta_t Nec^H}{Nec^H}\right)}{\left(\frac{\Delta_t Lux^A}{Lux^A}\right) - \left(\frac{\Delta_t Nec^A}{Nec^A}\right)},$$

where Δ_t represents the first difference between time t and t-1, H denotes households belonging to the higher income groups, and A denotes all households. $Elasticity_{Lux}$ and $Elasticity_{Nec}$ are the elasticities of luxuries and necessities obtained from the above regression using all households. To predict the log change in the average total consumption of the higher income group, the expenditure elasticities of luxuries and necessities are assumed to be the same for higher and lower income households. The last equation shows that the consumption changes of the higher income group can be calculated by comparing the differences in the consumption changes on luxuries and necessities of the higher income group and all households. The ratio of the change of the total consumption of the lower income group and the ratio of the average household can be calculated in the same manner.

Third, taking the difference in the consumption changes between the higher and the lower income groups, the consumption inequality between these two groups is calculated as follows:

$Inequality^{HL} = \Delta_t \ln Exp^H - \Delta_t \ln Exp^L$

$$= \left\{\left(\frac{\Delta_t Lux^H}{Lux^H}\right) - \left(\frac{\Delta_t Nec^L}{Nec^L}\right) - \left(\frac{\Delta_t Lux^H}{Lux^H}\right) - \left(\frac{\Delta_t Nec^L}{Nec^L}\right)\right\} \times \left\{\frac{\frac{\Delta_t Exp^A}{Exp^A}}{\left(\left(\frac{\Delta_t Lux^A}{Lux^A}\right) - \left(\frac{\Delta_t Nec^A}{Nec^A}\right)\right)}\right\}$$

$$= \left\{\left(\frac{\Delta_t Lux^H}{Lux^H}\right) - \left(\frac{\Delta_t Lux^L}{Lux^L}\right) - \left(\frac{\Delta_t Nec^H}{Nec^H}\right) - \left(\frac{\Delta_t Nec^L}{Nec^L}\right)\right\} \times \left\{\frac{\frac{\Delta_t Exp^A}{Exp^A}}{\left(\left(\frac{\Delta_t Lux^A}{Lux^A}\right) - \left(\frac{\Delta_t Nec^A}{Nec^A}\right)\right)}\right\},$$

where L denotes the lower income group.

In the last equation, the first two terms represent the difference in consumption changes with regard to luxury goods between the higher and the lower income group. The third and fourth terms represent the difference in the consumption changes with regard to necessities between the two income groups. This implies that consumption inequality is estimated in difference-in-difference form: we take the difference of consumption changes for each goods category between the two income groups and take the difference of these differences between

the goods categories. Thus, inequality increases when the consumption of luxuries by the higher income group increases relative to the consumption by lower income groups while the difference in the change in consumption of necessities between the two income groups is relatively small. By comparing the consumption of each income group, this approach makes it possible to eliminate the effect of income-specific measurement error when estimating consumption inequality.

More precisely, it is assumed that people report their consumption with the following error:

$$x_{hgt} = x^*_{hgt} e^{\xi_{hgt}} \qquad (1)$$

$$\xi_{hgt} = \psi^g_t + \phi^i_t + v_{hgt} \qquad (2)$$

where * denotes that the true but unobservable value of a variable. Further, ξ is the measurement error with respect to consumption and itself consists of the following three errors, as shown in equation (2). The first, ψ^g_t, is the measurement error with regard to consumption of goods category *g* at time *t*. This error captures the under-reporting by all households of the consumption of goods category *g* at time *t*. The second, ϕ^i_t, represents the income-group specific measurement error at time *t*, which captures the under-reporting of consumption by households belonging to income group *i*. Finally, the third, v_{hgt}, represents other good-household specific measurement error. For v_{hgt}, it is assumed that $E(v_{hgt}) = 0$.

Then, it is assumed that the true consumption of goods category *g* can be modeled as follows:

$$\ln x^*_{hgt} - \ln \bar{x}^*_{gt} = \alpha^*_{gt} + \beta_g \ln X^*_{ht} + \Gamma_g Z_h + \rho_m M_m + \omega_{hgt}, \qquad \left(E(\omega_{hgt}) = 0\right), \qquad (3)$$

were $\bar{x}_{gt}$ represents the average consumption of goods category *g* across all households at time *t*. Next, α_{gt} is a good-time fixed effect to take into account effects such as demand changes due a change in the relative price to other items, while X^*_{ht} represents the true but unobservable total consumption of household *h* at time *t*. Further, Z_h is a vector of time invariant household demographics that includes dummy variables for household head age cohorts; dummy variables for household sizes; dummy variables for the numbers of workers; dummy variables for households with a senior parent in the home and for households with children under the age of 15; a dummy variable for dual income households; and a dummy variable for households owning their home. Finally, ω_{hgt} is an idiosyncratic error term, while β_g is the expenditure elasticity of goods category *g*.

Next, equation (3) is transformed into an estimable equation. The dependent variable, the log difference between a household's consumption of goods category *g* and the average consumption across all households on goods category *g*, is replaced with households' consumption of goods category *g* standardized by the average consumption across all households for goods category *g*. This replacement makes it possible to take into account the fact that some households have zero consumption for certain goods category *g*:

$$\tilde{x}_{hgt} \equiv \frac{x_{hgt} - \bar{x}_{gt}}{\bar{x}_{gt}} = \alpha_{gt} + \beta_g \ln X_{ht} + \Gamma_g Z_h + \rho_m M_m + u_{hgt}, \qquad \left(E\left(u_{hgt}\right) = 0\right), \qquad (4)$$

where $\alpha_{gt} = \alpha^*_{gt} + \beta_g(\ln X^*_{ht} - \ln X_{ht})$ and $u_{hgt} = \phi^i_t + v_{hgt} + \omega_{hgt}$. Further, X_{ht} represents the reported, observable total consumption by household *h* at time *t*.

Equation (4) is estimated using the observation for the period from 1984 to 1986 to obtain the estimates of the goods-specific elasticity, β_g, and the time-invariant parameters for the household demographic variables, Γ_g. A potential concern when estimating Equation (4) is that the log of reported total consumption, $\ln X_{ht}$, and the measurement error in the residuals, u_{hgt}, might be correlated. For example, when total consumption is regarded as a proxy for permanent income, the residual might be correlated with total consumption due to the omission of unobservable variables. One way to deal with this endogeneity due to the omission of unobservables is to employ instrumental variable estimation. Therefore, for the analysis here, the log of the previous year's annual income is used as an instrument for the log of reported total consumption.

In the second stage, consumption inequality between the highest and the lowest income group over the last three decades is estimated. Using the estimate of Γ_g, the demographics-adjusted consumption of each goods category is calculated as follows : $\hat{x}_{hgt} \equiv \tilde{x}_{hgt} - \hat{\Gamma}_g Z_h$. This transformation makes it possible to obtain the consumption of each goods category that cannot be predicted based on household demographics. Thus, equation (3) can be rewritten to yield the following estimation model:

$$\begin{aligned}
\hat{x}_{hgt} &= \alpha^*_{gt} + \hat{\beta}_g \ln X^*_{ht} + \rho_m M_m + \phi^i_t + \omega_{hgt} + v_{hgt} \quad \text{(from Equation (3))} \\
&= \alpha^*_{gt} + \phi^i_t + \hat{\beta}_g \ln X^*_{it} + \hat{\beta}_g(\ln X^*_{ht} - \ln X^*_{it}) + \rho_m M_m + \omega_{hgt} + v_{hgt} \\
&= \alpha_{gt} + \phi^i_t + \hat{\beta}_g \ln X^*_{it} + \rho_m M_m + \varepsilon_{hgt}, \qquad \left(E\left(\varepsilon_{hgt}\right) = 0\right) \qquad (5)
\end{aligned}$$

where $\varepsilon_{hgt} = \hat{\beta}_g(\ln X^*_{ht} - \ln X^*_{it}) + \omega_{hgt} + v_{hgt}$. Further, $\ln X^*_{it}$ shows the true but unobservable average total consumption of income group *i* at time *t*. More specifically, equation (5) can be rewritten as follows to estimate the consumption inequality between the highest and the lowest income group:

$$\hat{x}_{hgt} = \mu + \sum_{i=2}^{10}\sum_{p=2}^{9} \beta'_{ip}\, \hat{\beta}_g D_i^{class} D_p^{time} + \sum_{i=2}^{10}\sum_{p=2}^{9} \phi'^{i}_t\, D_i^{class} D_p^{time}$$

$$+ \sum_{g=1}^{10}\sum_{t=1987}^{2012} \alpha'_{gt}\, D_g^{goods} D_t^{year} + \tau_m M_m + \varepsilon_{hgt}, \left(E\left(\varepsilon_{hgt}\right) = 0\right) \qquad (6)$$

where D^{class} is a dummy variable representing the income group. The term D^{time} represents the three-year time dummy variable. The term D^{goods} is a set of dummy variables representing goods categories. The term D^{year} is a set of year dummies. The terms α', β', and ϕ' are the parameters to be estimated. The terms β' and ϕ' are assumed to be constant within each three

year, while α', the parameters on the good-year dummies, are assumed to vary for each year. The term β'_{9p} represents the true, error-adjusted consumption inequality[4] between the highest and the lowest income group in three-year period p. The term ϕ'_{9p} represents the measurement error with respect to the consumption of the highest income group compared to the measurement error with respect to the consumption of the lowest income group.

In this approach, it is not necessary for the total consumption of a household to be measured accurately. However, as mentioned, it implicitly requires an important assumption regarding the expenditure elasticities of goods. In the first stage discussed above, the Engel curve is estimated to obtain the expenditure elasticity of each goods category. For the expenditure elasticities, the approach assumes that the elasticity of each goods category does not differ across income groups. If this assumption holds, it is possible to predict in the second stage the true total consumption difference between the highest and the lowest income group from the ratios of consumption across any two goods categories with the different expenditure elasticities. This might be a strong assumption. Therefore, as a robustness check, Section 9 investigates the validity of the constant elasticity assumption for each goods categories and estimates consumption inequality using only goods categories that satisfy the assumption.

6. Estimation Results

This section presents summary statistics and the estimation results obtained using the FIES data to estimate the consumption inequality between the highest and the lowest income group.

Starting with the summary statistics, Table 1 shows those for household demographics. The total number of households over the entire observation period from 1984 to 2013 is slightly more than 426,000. The average annual income in the final year of the observation period (i.e., 2013) was about 6.3 million yen yen (approximately 57.8 thousand dollars). The average total monthly consumption, excluding spending on durables and semi-durables, was about 252,000 yen. The average age of the household head was 57 years. The 25-29 age group was 4.4 percent in the analysis sample in 1987. The ratio of the age group decreased through the sample period, and the number reached 1.3 percent in 2013. The ratios of the age groups of 30-39, 40-49, and 50-59 also decreased through the period. On the other hand, the ratio of the age group of 60 or above was 19.9 percent in the analysis sample in 1987. The ratio was increased through the period and reached 50.7 percent in 2013. The number of family members in a household was about three on average. The share of dual-income households was about 48.5 percent – that is, almost half of all households in the sample. Finally, 77.1 percent of households owned their

[4] Villar (2016: 49) argues that the income ratio between the rich and the poor such as the 80-20 ratio, i.e., the ratio between the top 80 and the bottom 20 percent of the income distribution, and the quintile ratio are "very intuitive and require little information and elaboration."

home.

Next, Table 2 shows the summary statistics for the income of each of the 10 income groups. The average income of the lowest group, calculated across the entire observation period from 1984 to 2013, was about 2.3 million yen. The average income of the highest income group was 13.6 million yen.

Finally, Table 3 presents the summary statistics for the consumption of each goods category by income group. For most goods categories, consumption increases the higher the income group. Apart from "other," the goods category accounting for the largest consumption share was food. Households in the lowest income group spent about 58,300 yen per month on food, while households in the highest income group spent about 116,700 yen per month on food. At first glance, the pattern regarding the average spending of housing looks slightly odd in that spending does not increase monotonically and some of the lower income groups spent more on housing the higher income groups. A likely reason is imputed rent: households in higher income groups are more likely to own their home and therefore are may be spending less than lower income groups. In the dataset, approximately 87 percent of households in the highest income group owned their home, while the share among households in the lowest income group was only around 69 percent. Turning to education spending, households in the highest income group spent approximately ten times as much as households in the lowest income group. This ratio between the spending of the highest and the lowest income group was the largest among the different goods categories. In the case of spending on food, medical care, and fuel, light, & water, the ratios were less than two, and the ratio was smallest, 1.2, in the case of medical care spending.

Next, using the observation for the period from 1984 the 1986, the expenditure elasticities for each goods category are estimated. Two consumption definitions are used to estimate the elasticities. To start with, the standardized six-month average consumption of each goods category is used as the dependent variable. This standardized consumption is regressed on the log of the six-month average of total consumption, year dummies, month dummies, and the following demographic dummy variables: the household head's age cohort; the household size; the number of working household members; the number of household members aged 65 years or above; the number of children aged 18 or below; a dummy for dual-income households; and a dummy for home-owning households. The log of the annual income in the previous year is used as an instrument for the log of the six-month average of total consumption. The estimated elasticities are reported in Table 4. Among the 10 goods categories, the elasticities of five categories – education, transportation & communication, culture & recreation, clothing & footwear, and other items – are greater than one, with that for clothing & footwear, at 1.99, being the largest, followed by that for other items with 1.49. The elasticities of the other five goods categories – fuel, light, & water, food, medical care, furniture & household utensils, and

housing – are smaller than one. The smallest is that for fuel, light, & water, at 0.50, with that for food second smallest.

With the elasticities and the parameters of the demographic variables estimated, it is now possible to calculate the demographics-adjusted consumption of each goods category, $\hat{x}_{hgt}$, and estimate equation (6) to estimate consumption inequality. To that end, the demographics-adjusted consumption is regressed on the cross-terms between the elasticities and the income group-time dummies as well as the income group-time dummies, goods-year dummies, and a constant. As discussed in Section 5, consumption inequality between the highest and the lowest income group is estimated using the coefficient on the cross-terms between the elasticities and the income group-time dummies, i.e., β' in equation (6). The measurement error in the good consumption of the highest income group compared to the measurement error of the lowest income group can be estimated from the coefficients of the income group-time dummy variables.

Table 5 shows the regression results. Column (1) presents the results of the baseline specification. On the other hand, column (2) presents the results when dummies for the household head's occupation are added to the baseline specification. The results indicate that the log inequality between the highest and the lowest income group was 1.07 in 1987–1989, implying that the average consumption level of the top income group was about 2.92 times higher than that of the bottom income group. The estimated coefficient gradually increases through the observation period, with log inequality reaching 1.27 in 2011–2013, implying that the consumption level of the top income group was about 3.56 times higher than that of the bottom income group.

In addition to the results for log consumption inequality, Table 5 presents the estimation results for coefficients on the income group-time dummy variables, which gauge the measurement error in the consumption data. A positive coefficient means that those in the top income group over-report their consumption or those in the bottom income group under-report their consumption. Conversely, a negative coefficient means that those in the top income group under-report their consumption or those in the bottom income group over-report their consumption. Table 5 indicates that, with the exception of one coefficient (for the 1993–1995 window), the coefficients are negative throughout the observation period. The results thus suggest that those in the top income group tend to under-report their consumption in the survey. Moreover, more recent coefficients are larger (in absolute value) than those in the first half of the observation period.

Finally, Table 5 shows that the size of the measurement error in the consumption data differs depending on the occupation of the household head. In column (2), the reference category for the estimations is households whose head is an officials office worker. The coefficients on most of the occupation dummies are negative, implying that households in those

occupations tend to under-report their consumption more than officials office worker. Specifically, households whose head is a merchant or an artisan tend to under-report their consumption the most, followed by households whose head is engaged in "other occupations." On the other hand, the coefficient for private office workers is insignificant, indicating that households in this category do not under-report their consumption more than households whose head is an officials office worker.

7. Trends in Income, Consumption, and Estimated Consumption Inequalities

This section describes and compares the trends in inequality in the previous year's annual income, consumption inequality, and the estimated consumption inequality between the top and bottom income groups in Japan. For income inequality, the ratio of the average income of those in the top 10 percent in the income distribution to the average income of those in the bottom 10 percent of the income distribution is calculated for each year. For consumption inequality, the ratio of the average reported total consumption of the top income group to the average reported total consumption of the bottom income is calculated for each year. In addition, using the results in Table 5, the estimated consumption inequality between the top and bottom income groups is calculated by taking the exponential of the estimated log inequality for each three-year period.

Figure 1 shows the trends in these inequalities. The thin solid line depicts the income inequality between the top and bottom income groups. The thick solid line is the fitted line. These lines show that, on average, the average income of the top income group is almost six times higher than that of the bottom income group. Moreover, income inequality appears to have followed an upward trend during the observation period.[5]

Next, the thin dotted line shows the inequality in reported consumption between the top and bottom income groups, while the thick dotted line represents the fitted line. These lines indicate that consumption inequality followed a decreasing trend from 1987 to 2013. In 1987–1989, the average consumption of households in the top income group was about three times larger than that of households in the bottom income group. The difference decreased during the observation period, so that at the end of the period the average consumption of households in the top income group was about 2.5 times larger than that of households in the bottom income group.[6]

On the other hand, when the measurement error in the consumption data is modeled using equations (1) and (2) and the error-corrected consumption inequality is estimated, an upward trend in consumption inequality is obtained. The thin dashed line shows the estimated

[5] The slope of the fitted line is positive and statistically significant.
[6] The slope of the fitted line is negative and statistically significant.

consumption inequality between the top and bottom income groups obtained by transforming the estimated log inequality from Table 5. The thick dashed line is the fitted line. As mentioned in the previous section, the ratio of the consumption inequality between the top and bottom income groups was about 2.9 in 1987–1989. However, the estimated inequality trended upward[7] during the observation period and reached 3.6 in 2011–2013, meaning the average consumption of households in the top income group was 3.6 times higher than that in the lowest income group.

In sum, Figure 1 shows that, on one hand, inequality measured using income seems to have increased over time; on the other hand, inequality measured using reported consumption seems to have decreased over time. This apparent inconsistency likely is due to measurement error in the consumption data. As shown in in Table 5, the gap in the measurement error between the top and bottom income groups increased during the observation period from -0.03 in 1987–1989 to -0.18 in 2011–2013. This finding suggests that the observed inconsistency between the trend in inequality measured in terms of income and the trend in inequality measured in terms of reported consumption is due to measurement error in reported consumption. Appropriately correcting the consumption data for this measurement error indicates that consumption inequality also has increased over the last three decades.

8. Robustness Check A: Using Another Definition for the Consumption Variable

To check the robustness of the results obtained in the section, this section conducts a similar analysis but using another definition for the consumption variable. Since the FIES provides separate consumption data for six months, it is possible to divide the data into two sub-sets, one for the first three months, and one for the second three months, and then calculate the standardized monthly average consumption over the three months of each goods category for each household. Specifically, when using equation (4) to estimate expenditure elasticities, the standardized average consumption of each goods category in the second three-month period is used as the dependent variable and the log of the average total consumption in the second three-month period is used as an independent variable. The log of the average monthly total consumption in the second three-month period was instrumented with the log of the average monthly consumption in the first three-month period along with the year and month dummies variables and demographic variables described earlier. The estimated elasticities are reported in Table 6. Among the 10 goods categories, the elasticities of three goods categories –culture & recreation, clothing & footwear, and other items – are larger than unity. The largest elasticity,

[7] The slope of the fitted line is positive and statistically significant.

for clothing & footwear, is 1.42. The elasticities of the remaining seven goods categories were smaller than unity. The smallest elasticity, for fuel, light, & water, was 0.44. The elasticities in Table 6 are similar to those in Table 4

Table 7 shows the estimated log inequality, the measurement error in the consumption data for the top income group relative to that of the bottom income group, and the measurement error by the household head's occupation using the demographics-adjusted second three-month period monthly average consumption of each goods category as the dependent variable. The demographics-adjusted second three-month period monthly average consumption are regressed on the cross-terms between the elasticities obtained in Table 4 and the income group-time dummy variables as well as the income group-time dummies, goods-year dummies, and a constant term. Column (1) shows the baseline results, while column (2) shows the results when dummies for the household head's occupation are added to the specification. The estimated log inequality between the top and bottom income groups was 1.34 in 1987–1989, meaning that the average consumption of the top income group was 3.82 times as large as that of the bottom income group during this the period. In both columns (1) and (2) the estimated log inequality increased during the observation period, reaching 1.55 in 2011–2013, which means that the average consumption level of the top income group was about 4.71 times higher than the average consumption level of the bottom income group. The estimated coefficients are similar but slightly larger than those in Table 5.

Table 7 also provides the estimation results for the measurement error in the consumption data. This time, the coefficients for the measurement error are negative for all periods. As above, the negative coefficient imply that those in the top income group under-reported their consumption in the survey more than those in the bottom income group. In addition, as in Table 5, the size of the measurement error became larger in later sub-periods.

Furthermore, Table 7 shows that the size of the measurement error in the consumption data differs depending on the occupation of the household head. The reference group is the households whose head is an officials office worker. The coefficients for most of the occupation dummies are negative. This implies that most of the other households would under-report their consumption compared to households with an officials office worker household head. Households whose head is a merchant or an artisan would under-report their consumption most, and the consumption of the households whose head is a temporary and daily laborer would follow it. Households whose head is a private office worker would report the consumption slightly downwardly compared to the households whose head is an officials office worker. These results are similar to those in Table 5.

9. Robustness Check 2: Using Only Goods Categories for Which the

Elasticity is Identical for the Top and Bottom Income Groups

This section provides another robustness test of the estimated consumption inequality. The analyses above focused on ten goods categories: clothing & footwear, education, culture & recreation, food, furniture & household utensils, medical care, housing, transportation & communication, fuel, light & water, and other items. Using these ten goods categories, the total expenditure elasticity for each goods category and consumption inequality between the top and bottom income groups were estimated. However, this approach relied on the assumption that the total consumption elasticities with respect to each goods category are the same across income groups. This section tests for each goods category whether this assumption holds, focusing on the six-month average monthly consumption. Consumption inequality is then re-estimated using only goods categories satisfying the assumption that elasticities are identical between two income groups.

The test whether the assumption holds is conducted as follows. In the first step, using the full sample, the expenditure elasticities for each goods category in the first three years, 1984–1986, are estimated, as in the analysis above. Then, goods categories with a positive and statistically significant elasticity are selected. Since, as seen in Table 4, the elasticities are positive and significant for all ten goods categories, all ten are retained.

In the second step, the standardized six-month average monthly consumption of each goods category is regressed on the log of total consumption, the cross-term between the top income group dummy and the log of total consumption, the cross-term between the bottom income group dummy and the log of total consumption, as well as the year and month dummies and the demographic variables in equation (4). The log of annual income, the cross-term between the top income group dummy and the log of annual income, and the cross-term between the bottom income group dummy and the log of annual income are used as instrumental variable for the log of total consumption and the two cross-terms. It is then tested whether the coefficients on the two cross-terms between the top and bottom income group dummies variables and the log of total consumption are significantly different. Goods categories for which this is the case are dropped, leaving five goods categories: food, housing, furniture & household utensils, medical care, and fuel, light, & water. These five goods categories satisfy the assumption that the expenditure elasticity is identical for the top and bottom income groups, while the other five goods categories do not. The estimated elasticities for these five goods categories were already reported in Table 4.

Using the five elasticities and the parameters of the demographic variables estimated from the regression for each goods category, the demographics-adjusted consumption of each goods category is calculated and equation (6) is estimated using those five goods categories. Specifically, two regressions are run: one excluding and one including the dummy variables for the household head's occupation. Table 8 presents the results. They indicate that in 1987–1989,

log inequality was about 0.80, meaning that the average consumption of the top income group was 2.23 times larger than the consumption of the bottom income group. Further, as above, the size of the coefficients increased over the course of the observation period. Log inequality reached 1.23 in 2011–2013, meaning that the average consumption of the top income group was 3.42 times larger than that of the bottom income group. This result shows that, as in the analysis above, consumption inequality in Japan widened over the last three decades.

Next, looking at the results regarding the measurement error in the reported consumption of the top income group compared to the measurement error for the lowest income group, these are similar to those in Table 5. The negative coefficients imply that the top income group under-report consumption to a greater extent than the bottom income group. Finally, the coefficients on the dummy variables for the household head's occupation are negative and significant for most of the dummies. This means that compared to households whose head is an officials office worker, other households tend to under-report consumption to a greater extent.

10. Conclusion

This study investigated consumption inequality in Japan over the last three decades using data from the Family Income and Expenditure Survey (FIES). Employing Aguiar and Bils' (2015) approach, this study corrected for measurement error to estimate developments in consumption inequality between the top and bottom 10 percent of the income distribution.

The analysis showed the following. If consumption inequality between the top and bottom income groups is calculated using the raw, unadjusted consumption data from the FIES, a downward trend in consumption inequality is found, suggesting that inequality appear to have decline. However, using the adjusted data, an upward trend in consumption inequality is found. While at the beginning of the observation period in the late 1980s the average consumption level of the top income group was 2.92 times larger than that of the bottom income group, the ratio has increased over the following three decades, reaching a factor of 3.56 in the early the 2010s. The same trend was found when the alternative definition of consumption was used. In addition, the estimation results were robust to using only the five goods categories that satisfied the assumption that the expenditure elasticities of goods categories do not differ between the top and bottom income groups: again, an upward trend in consumption inequality was found.

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Table 1: Summary Statistics of Household Demographics

	Mean	*S.D.*
Annual income in the previous year (million yen)	6.36	(3.58)
Total monthly consumption (1,000 yen)	251.79	(140.11)
Household head's age	57	(15.83)
Number of family members	3.16	(1.25)
Number of workers in the household	1.32	(1.01)
Number of children under 18	0.58	(0.94)
Dual-income households (%)	48.47	
Homeowner (%)	77.10	
Observations	426,141	

Source: Family Income and Expenditure Survey.

Notes: Homeowners are defined as households that own a detached house, an apartment, or a row house/other. The observation period is from 1984 to 2013.

Table 2: Summary Statistics of Annual Income in the Previous Year (in Million Yen)

Income group	*Mean*	*S.D.*	*Observations*
1 (Bottom)	2.29	(0.54)	42,574
2	3.28	(0.35)	42,620
3	3.94	(0.41)	42,620
4	4.59	(0.49)	42,610
5	5.28	(0.56)	42,619
6	6.04	(0.64)	42,607
7	6.91	(0.74)	42,623
8	7.99	(0.87)	42,617
9	9.53	(1.10)	42,618
10 (Top)	13.60	(3.66)	42,633

Source: The Family Income and Expenditure Survey.

Note: The observation period is from 1984 to 2013.

Table 3: Summary Statistics of Monthly Consumption of Each Goods Category (1,000 Yen)

	Income group									
	1 (Botton)	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	10 (Top)
Clothing & footwear	0.54	0.75	0.90	1.04	1.14	1.31	1.51	1.83	2.26	3.38
	(1.30)	(1.47)	(1.76)	(1.95)	(2.02)	(2.33)	(2.43)	(2.87)	(3.33)	(4.95)
Education	2.27	3.17	4.73	6.80	9.27	12.31	15.50	19.11	21.87	24.27
	(10.88)	(12.35)	(15.16)	(18.52)	(21.96)	(26.89)	(31.86)	(36.91)	(43.30)	(52.80)
Culture & recreation	12.40	17.18	19.87	21.89	23.71	25.70	27.28	30.17	33.59	44.07
	(13.93)	(17.94)	(20.12)	(23.57)	(23.35)	(25.61)	(25.58)	(29.28)	(32.38)	(46.01)
Food	58.25	67.80	72.86	76.93	81.41	85.80	89.86	95.32	101.79	116.68
	(23.63)	(24.65)	(26.25)	(27.91)	(29.26)	(30.32)	(31.47)	(33.09)	(35.42)	(44.69)
Furniture & household utensils	2.35	2.78	2.93	3.08	3.21	3.34	3.50	3.70	3.92	4.62
	(3.85)	(4.62)	(2.78)	(2.84)	(2.88)	(2.75)	(3.34)	(3.41)	(4.21)	(7.47)
Medical care	2.78	3.43	3.72	3.73	3.74	3.69	3.62	3.77	3.99	4.80
	(4.90)	(5.72)	(6.05)	(6.13)	(6.11)	(5.64)	(5.51)	(5.41)	(5.88)	(7.47)
Housing	13.25	15.66	17.15	18.26	17.37	17.18	15.96	15.86	15.44	17.28
	(26.81)	(33.95)	(34.78)	(39.50)	(35.45)	(38.29)	(37.78)	(42.29)	(41.76)	(50.00)
Transportation & communication	11.39	14.60	16.81	18.76	20.52	22.19	24.23	26.66	29.74	34.53
	(10.33)	(11.76)	(12.93)	(14.31)	(15.39)	(16.38)	(17.69)	(19.12)	(21.78)	(25.78)
Fuel, light, & water	16.19	18.10	19.05	19.86	20.55	21.41	22.21	23.31	24.55	27.59
	(7.61)	(7.97)	(8.26)	(8.57)	(8.81)	(9.23)	(9.40)	(9.89)	(10.53)	(12.60)
Other	30.45	42.10	47.60	52.93	57.60	63.65	71.74	86.29	103.10	137.17
	(40.00)	(48.15)	(50.26)	(61.42)	(61.97)	(66.30)	(72.00)	(87.66)	(103.57)	(146.26)

Source: Family Income and Expenditure Survey.

Notes: The goods categories correspond to those used by the Ministry of Internal Affairs and Communications. The observation period is from 1984 to 2013. The standard deviations are reported in parentheses.

Table 4: Estimated Expenditure Elasticities for Each Goods Category

x:	*Six-month average montly consumption of each goods category*		
	Elasticity	*S.E.*	*Adjusted*
Goods			*R-squared*
Fuel, light, & water	0.50***	(0.01)	0.32
Food	0.59***	(0.01)	0.57
Medical care	0.68***	(0.05)	0.04
Furniture & household utensils	0.71***	(0.08)	0.06
Housing	0.80***	(0.04)	0.21
Education	1.03***	(0.05)	0.23
Transportation & communicatio	1.11***	(0.02)	0.31
Culture & recreation	1.48***	(0.03)	0.26
Other	1.49***	(0.03)	0.53
Clothing & footwear	1.99***	(0.05)	0.13
$\boldsymbol{X}$:	Six-month average of total consumption		
IV for ln$\boldsymbol{X}$:	Ln(Annual income in the previous year) and its square		

Source: Family Income and Expenditure Survey.

Notes: Heteroskedasticity robust standard errors are reported in parentheses. The goods categories correspond to those of the MIAC. The standardized consumption on each goods category is regressed on the log of the six-month average of total consumption, year dummies, and the following demographic dummies: the household head's age (in 10-year ranges); the number of family members; the number of working family members; the number of family members aged 65 or above; the number of children aged 18 or below; and a dummy for home owners. Observations for the years 1984 to 1986 are used. The log of the annual income in the previous year and its square are used as the instrument for the log of the six-month average of total consumption.

Table 5: Estimated Consumption Inequality and Measurement Error

	(1)		*(2)*	
Dependent variable:	*Demographics-adjusted consumption (six-month average)*			
Log inequality between top and bottom income groups				
1987-1989	1.07***	(0.03)	1.07***	(0.03)
1990-1992	1.10***	(0.03)	1.10***	(0.03)
1993-1995	1.06***	(0.03)	1.06***	(0.03)
1996-1998	1.09***	(0.03)	1.09***	(0.03)
1999-2001	1.11***	(0.03)	1.11***	(0.03)
2002-2004	1.06***	(0.04)	1.06***	(0.04)
2005-2007	1.16***	(0.03)	1.16***	(0.03)
2008-2010	1.21***	(0.03)	1.21***	(0.03)
2011-2013	1.27***	(0.04)	1.27***	(0.04)
Measurement error in consumption of housheolds in top income group compared to that of households in bottom income group				
1987-1989	-0.03	(0.03)	-0.11***	(0.03)
1990-1992	-0.03	(0.03)	-0.12***	(0.03)
1993-1995	0.01	(0.04)	-0.09**	(0.04)
1996-1998	-0.01	(0.03)	-0.10***	(0.03)
1999-2001	-0.08**	(0.03)	-0.17***	(0.03)
2002-2004	-0.02	(0.04)	-0.11***	(0.04)
2005-2007	-0.07**	(0.03)	-0.17***	(0.03)
2008-2010	-0.14***	(0.03)	-0.24***	(0.03)
2011-2013	-0.18***	(0.04)	-0.28***	(0.04)
Measurement error by household head's occupation				
Private office workers			-0.00	(0.00)
Corporative administrators			-0.05***	(0.01)
Private administrators			-0.10***	(0.01)
Regular labourers			-0.11***	(0.00)
Temporary & daily labourers			-0.16***	(0.01)
Other occupation			-0.16***	(0.00)
Merchants & artisans			-0.22***	(0.00)

Source: Family Income and Expenditure Survey.

Notes: Bootstrap standard errors from 500 replications are reported in parentheses. In column (1), the demographics-adjusted consumption is regressed on the cross-terms between the expenditure elasticities obtained in Table 4 and the income group-time dummies as well as the income group-time dummies, goods category-year dummies, and a constant. term. In Column (2), dummy variables for the household head's occupation are added to the independent variables of the baseline specification in column (1). Only the coefficients for log inequality and the measurement error for the top income group relative to the bottom income group and the measurement error by the household head's occupations are reported. For the household head's occupation, households whose head is an officials office worker are the reference group.

Table 6: Estimated Expenditure Elasticity for Each Goods Category Using Alternative Definition of Total Consumption

x:	*Second three-month period monthly average consumption of each goods category*		
	Elasticity	*S.E.*	*Adjusted*
Goods			*R-squared*
Fuel, light, & water	0.44***	(0.01)	0.30
Food	0.56***	(0.01)	0.54
Furniture & household utensils	0.61***	(0.04)	0.05
Medical care	0.79***	(0.04)	0.04
Housing	0.85***	(0.05)	0.14
Education	0.87***	(0.03)	0.18
Transportation & communication	0.99***	(0.02)	0.26
Culture & recreation	1.21***	(0.03)	0.21
Other	1.41***	(0.02)	0.47
Clothing & footwear	1.42***	(0.04)	0.12
$\boldsymbol{X}$:	Second three-month period average of total consumption		
IV on ln$\boldsymbol{X}$:	Ln(First three-month period average of total consumption and its square		

Source: Family Income and Expenditure Survey.

Notes: Heteroskedasticity robust standard errors are reported in parentheses. The goods categories correspond to those of the MIAC. The standardized consumption of second three-month period monthly average consumption of each goods category is regressed on the log of the second three-month average of total consumption, year dummies, and the following demographic dummies: the household head's age (in 10-year ranges); the number of family members; the number of working family members; the number of family members aged 65 or above; the number of children aged 18 or below; and a dummy for home owners. Observations for the years 1984 to 1986 are used. The log of the first three-month period average of total consumption and its square are used as the instrument for the log of the second three-month period average of total consumption.

Table 7: Robustness Check 1: Estimated Consumption Inequality and Measurement Error

	(1)		(2)	
Dependent variable:	*Demographics-adjusted consumption (second three-month average)*			
Log inequality between top and bottom income groups				
1987-1989	1.34***	(0.03)	1.34***	(0.03)
1990-1992	1.42***	(0.04)	1.42***	(0.04)
1993-1995	1.36***	(0.04)	1.36***	(0.04)
1996-1998	1.38***	(0.04)	1.38***	(0.04)
1999-2001	1.39***	(0.04)	1.39***	(0.04)
2002-2004	1.32***	(0.05)	1.32***	(0.05)
2005-2007	1.46***	(0.04)	1.46***	(0.04)
2008-2010	1.49***	(0.04)	1.49***	(0.04)
2011-2013	1.55***	(0.05)	1.55***	(0.05)
Measurement error in consumption of households in top income group comared to that of households in bottom income group				
1987-1989	-0.18***	(0.03)	-0.26***	(0.03)
1990-1992	-0.22***	(0.03)	-0.30***	(0.03)
1993-1995	-0.17***	(0.04)	-0.26***	(0.04)
1996-1998	-0.18***	(0.03)	-0.27***	(0.03)
1999-2001	-0.24***	(0.03)	-0.32***	(0.03)
2002-2004	-0.16***	(0.05)	-0.25***	(0.05)
2005-2007	-0.25***	(0.03)	-0.33***	(0.03)
2008-2010	-0.28***	(0.03)	-0.37***	(0.03)
2011-2013	-0.32***	(0.04)	-0.40***	(0.04)
Measurement error by household head's occupation				
Private office workers			-0.00	(0.00)
Corporative administrators			-0.03***	(0.01)
Private administrators			-0.09***	(0.01)
Regular labourers			-0.12***	(0.00)
Other occupation			-0.14***	(0.00)
Temporary & daily labourers			-0.16***	(0.01)
Merchants & artisans			-0.21***	(0.00)

Source: Family Income and Expenditure Survey.

Notes: Bootstrap standard errors from 500 replications are reported in parentheses. In column (1), the demographics-adjusted consumption of second three-month period average of each goods category is regressed on the cross-terms between the expenditure elasticities obtained in Table 6 and the income group-time dummies as well as the income group-time dummies, goods category-year dummies, and a constant. term. In Column (2), dummy variables for the household head's occupation are added to the independent variables of the baseline specification in column (1). Only the coefficients for log inequality and the measurement error for the top income group relative to the bottom income group and the measurement error by the household head's occupations are reported. For the household head's occupation, households whose head is an officials office worker are the reference group.

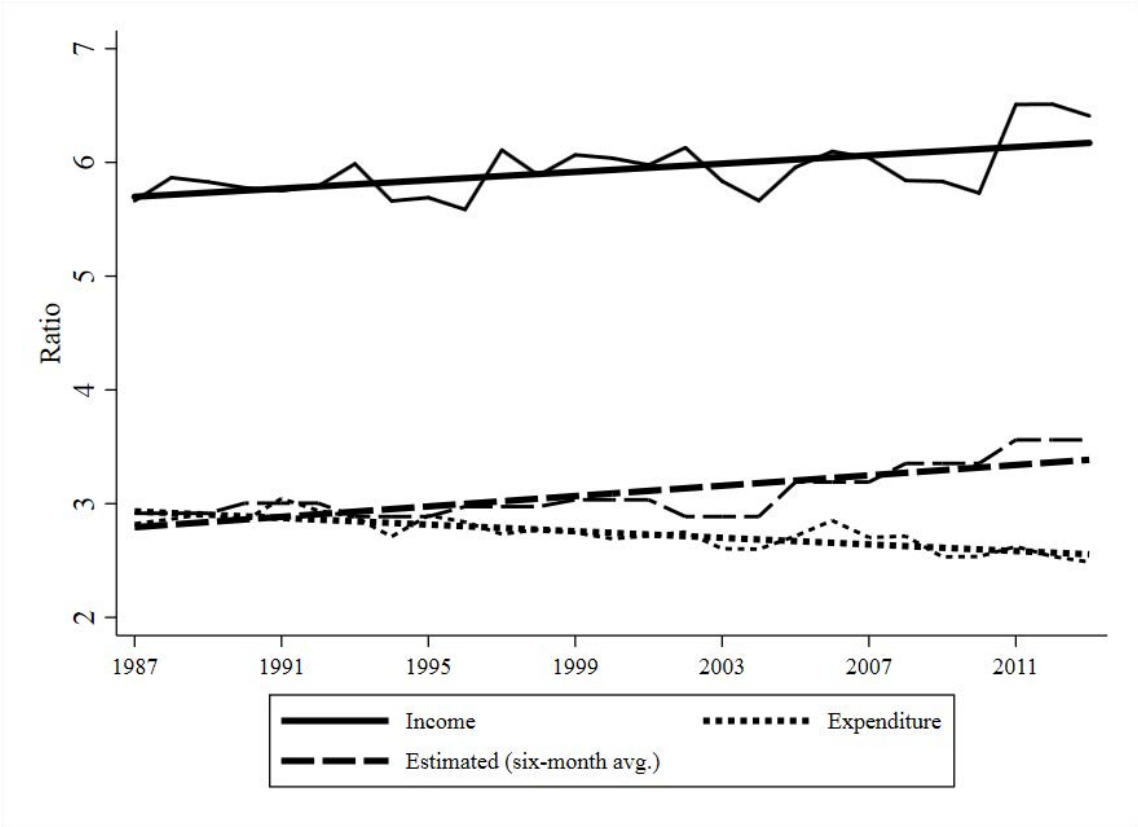
Table 8: Robustness Check 2: Estimated Consumption Inequality and Measurement Error

	(1)		*(2)*	
Dependent variable:	*Demographics-adjusted consumption (six-month average)*			
Log inequality between top and bottom income groups				
1987-1989	0.80***	(0.03)	0.80***	(0.03)
1990-1992	0.84***	(0.04)	0.84***	(0.04)
1993-1995	0.77***	(0.03)	0.77***	(0.03)
1996-1998	0.92***	(0.03)	0.92***	(0.03)
1999-2001	0.96***	(0.03)	0.96***	(0.03)
2002-2004	1.01***	(0.03)	1.01***	(0.03)
2005-2007	1.06***	(0.03)	1.06***	(0.03)
2008-2010	1.10***	(0.03)	1.10***	(0.03)
2011-2013	1.23***	(0.04)	1.23***	(0.04)
Measurement error in consumption of households in top income group compared to that of households in bottom income cgroup				
1987-1989	-0.00	(0.03)	-0.05*	(0.03)
1990-1992	-0.02	(0.03)	-0.07**	(0.03)
1993-1995	-0.02	(0.03)	-0.06**	(0.03)
1996-1998	-0.07***	(0.03)	-0.12***	(0.03)
1999-2001	-0.06**	(0.03)	-0.11***	(0.03)
2002-2004	-0.07**	(0.03)	-0.13***	(0.03)
2005-2007	-0.11***	(0.03)	-0.16***	(0.03)
2008-2010	-0.13***	(0.03)	-0.19***	(0.03)
2011-2013	-0.22***	(0.03)	-0.28***	(0.03)
Measurement error by household head's occupation				
Private office workers			-0.00	(0.00)
Regular labourers			-0.10***	(0.00)
Other occupation			-0.12***	(0.00)
Temporary & daily labourers			-0.16***	(0.01)
Private administrators			-0.17***	(0.01)
Corporative administrators			-0.19***	(0.01)
Merchants & artisans			-0.19***	(0.00)

Source: Family Income and Expenditure Survey.

Notes: Bootstrap standard errors from 500 replications are reported in parentheses. We use goods categories of six goods: good, housing, culture & recreation, transportation & communication, education, and fuel, light, and water charges. In column (1), the demographics-adjusted consumption is regressed on the cross-terms between the expenditure elasticities obtained in Table 4 and the income group-time dummies as well as the income group-time dummies, goods category-year dummies, and a constant. term. In Column (2), dummy variables for the household head's occupation are added to the independent variables of the baseline specification in column (1). Only the coefficients for log inequality and the measurement error for the top income group relative to the bottom income group and the measurement error by the household head's occupations are reported. For the household head's occupation, households whose head is an officials office worker are the reference group.

Figure 1: Trends in Income Inequality, Consumption Inequality, and Estimated Consumption Inequality



Source: Family Income and Expenditure Survey.

Notes: For income inequality, the ratio of the average annual income in the previous year of the top income group, the 90^{th}–100^{th} percentile of the distribution, to the average annual income in the previous year of the bottom income group, the 0^{th}–10^{th} percentile of the distribution, was calculated for each year. For consumption inequality, the ratio of the six-month average total consumption of the top income group to the six-month average total consumption of the bottom income group was calculated. For the estimated consumption inequality, the exponential of the estimates in column (1) was taken. The yearly values of the inequality indicators are represented by the thinner lines, while the thicker lines show the fitted lines.