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Income Inequality and Demographic Changes in Japan *

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要旨

先行研究では、日本の所得格差の拡大は人口の高齢化によるものと言われている。しかしながら、先行研究では、年齢構造の把握に世帯主年齢が用いられており、世帯主年齢には世帯内で誰が世帯主となるかという選択の問題がある。特に、近年の日本では、未婚化が進み親と同居する未婚者が増加する一方、高齢者においては 3 世代同居が減少し、単身や夫婦のみ世帯が増加している。したがって、世帯主年齢の変化は人口における年齢構造の変化だけではなく、家族形態の変化も反映することになってしまうと考えられる。

そこで、本研究では、「全国消費実態調査」を用い、世帯主年齢だけではなく本人年齢により所得格差の寄与度分解を行う。また、子ども、若年、壮年、高齢者の各年齢層における所得格差の変化について、家族形態の変化から所得格差の寄与度分解も行う。主な分析結果は、世帯主年齢を用いた場合は、先行研究と同様に主に年齢構造の変化によって所得格差の拡大が引き起こされているが、本人年齢の場合は、主に各年齢内格差の拡大により全体の所得格差の拡大が引き起こされていることを示す。また、若年層や壮年層における所得格差拡大は、親同居未婚者の増加とそのグループ内での格差拡大によって引き起こされており、高年齢層では 3 世代同居の減少は格差拡大に寄与するものの、各グループ内での所得格差の変化により、全体での所得格差は低下していた。

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Income Inequality and Demographic Changes in Japan[†]

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Abstract

In the previous studies the increase of aging population mainly account for growing inequality in Japan. However, it would be problem that previous studies grasped the changes in the age structure of population using the age of household heads. Because the age of the household head is entirely dependent on who becomes household head, change in composition of the population based on age of household head may differ from changes in the composition of the population based on age of individual.

In this study, we analyze the change in income inequality in Japan between 1994 and 2009 by decompositions by not only the age of household head but also the age of individual. Then, we conducted decomposition analysis on change in income inequality among youth and middle aged and elderly by the type of co-residence in the same way.

We find that the changing age composition of population does not mainly affect the widening income inequality in Japan. Instead, there is a substantial increase in income inequality within age group. The difference between this study and previous studied is caused by the definition of the age used for the analysis. If the age of household head is used as in previous studies, the effects of population ageing on income inequality appears excessively. The reason is that as young people who become heads of households decrease due to an increase in unmarried people living with their parents, aging process of population looks more advanced than actual change. In addition,

The increasing in unmarried people living with their parents affects inequality within age group. Thus, the widening inequality among youth and middle-aged is caused by this

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increase of unmarried people living with their parents who belong to the age group having high income inequality.

In contrast, the income inequality decreased among elderly people. This decreasing, however, is overestimated by using the age of household head. Although the decline in the share of person living with their married children contributes to increasing the inequality within the own-age group for elderly, many of them are not included elderly population using the age of household head. At the same time, this overestimation of the decline in inequality by using the age of household head underestimates the effect of within-age inequality on overall inequality, as the decline in inequality among elderly excessively cancels the increase in inequality among youth and middle aged.

1. Introduction

The relationship between changes in population structure and changes in income inequality has been discussed for a long time, (see e.g. Lam 1997, Burtless 2009). There is a problem in comparing the inequality without considering the difference in age structure, as the level of income inequality is considered to be different between the working-age and the elderly.

In particular, Japan has not only the highest aging rare at present, but also the speed of aging is remarkable. Therefore, the Japanese case can be a leading example of the effects of the aging of population on income inequality.

Many studies indicated that the widening income inequality in Japan was mainly caused by the changing age composition of population (Ohtake and Saito 1998, Ohtake 2005, Ohtake 2008, Oshio 2006, Shirahase and Takeuchi 2009, Ohtake and Kohara 2014, Shirahase 2018, Kitao and Yamada 2019). Ohtake (2005), which made this assertion early, argued that the income inequality within each age group remained unchanged in the 1980s and 1990s, while older age group has greater income inequality. Thus, the growing income inequality in Japan is caused by increase in the proportion of the total population taken up by those in the middle and old age groups, where income inequality is relatively high.

Similar arguments have been expressed by Japanese government. The 2006 Annual Report from the Japanese Economy and Public Finance attempted to analyze the income distribution and concluded that "the increase in the income disparity as a trend has been attributed mainly to a rapidly aging population." Thus, it is probably true to say that the mainstream view is that the increase in income inequality in Japan is caused by the ageing of the population.

However, it would be problem that previous studies grasped the changes in the age structure of population using the age of household heads. Because the age of the household head is entirely dependent on who becomes household head, change in composition of the population based on age of household head may differ from changes in the composition of the population based on age of individual. Changes in family formation among youth, in particular, are likely to impact the composition of the population by age of household head. In other words, the ratio of young adults based on age of household head would decline because of the increase in the number of young people who remain unmarried and continue to live with their parents, although number of young people is unchanged. On the other hand, many elderly people are no longer living with their married children, while Japanese traditional norm favor the co-residence with married children. If elderly live with their children who are main earners,

the household heads should not become elderly themselves but their children.

Therefore, the effect of age on income inequality will depend on the age of the head of household or the own age. We conduct the decomposition analysis to show effects of the changes in structure of population and family formation on income inequality. First, we analyze the change in income inequality in Japan between 1994 and 2009 by decompositions by not only the age of household head but also the age of individual.[1] Then, we conducted decomposition analysis on change in income inequality among youth and middle aged by the type of co-residence in the same way.

2. The problems about Japanese income data

Income inequality has been increasing in Japan since the 1980s, although this increase is modest compared with the drastic increase in the US and the UK, (Moriguchi and Saez. 2008). However, it is pointed out that the level of income inequality in Japan is much different by which data is used for the measurement, (Ohtake 2005).

Figure1 shows Gini coefficient of Japan and the other selected countries as well. For Japan, the results based on the National Survey of Family Income and Expenditure (NSFIE) and the Comprehensive Survey of Living Conditions (CSLC), both of them are the widely used national representative surveys, are plotted. It is the same results between NSFIE and CSLC that income inequality has been expanded since 1990s, however, the level of income inequality has been significantly different. The level of Gini coefficient based on NSFIE is similar to Germany and France, but based on CSLC, it is mostly equivalent with the UK.

<Figure.1>

The NSFIE has one of the largest sample sizes among national household surveys and it is conducted every 5 years. There are two kinds of questionnaires in the NSFIE to capture household incomes, one is for the household account book and the other one is for the annual household income and asset, all respondents must complete both questionnaires. In the household account book, monthly household expenditure, including tax and premium of social security insurance, and monthly household income are recorded. However, tax and premium of social security insurance are not surveyed for self-employed household for the household account book, because it is difficult for self-employed households to calculate monthly tax. The latter questionnaire grasping

[1] Shikata (2013) analyze the effect of age on income inequality using own age, but does not clarify the difference between own age and age of household head.

annual household income, which is better income unit for analyzing the income inequality, is required to fill out for all household but does not include tax and premium of social security insurance. Therefore, it needs to estimate tax and premium of social security insurance based on annual household income for disposable household income for all surveyed households.

The SCLC is conducted every year and once every three years the sample size is about 4 times larger than the other years. The annual income questionnaire in the SCLC, annual household income, tax and premium of social security insurance are surveyed for all households, so it doesn't need to estimate household disposable income.

Although both of NSFIE and SCLC are national representative data, household income distribution is quite different. Table1 shows gross household income by data source, including other national survey data. It is necessary to pay attention that the share of the bottom income group for NSFIE is much smaller than other surveys.

A household answers gross household income including public pension benefits from a single-selection question in the questionnaire of *Employment Status Survey* (ESS) and *Housing and Land Survey* (HLS). Generally, single-selection questions are easier to answer for households and that would lead less sample bias.

As table.1 shows, the shape of income distribution for SCLC is more similar to ESS and HLS that might imply SCLC is less biased than NSFIE. However, the share of top income is mostly the same between SCLC and NSFIE and even it is higher than other surveys.

In the NSFIE, respondents are required to record household account book for 3 months -2 months for single households. For high income households, it would overload as the opportunity costs are high, and that would more likely cause attrition problems for those households. Regardless of this matter, the NSFIE captures more high income households than ESS and HLS.

The potential reason of this inconsistency is that the NSFIE and SCLC ask household income by household member and by income source, whereas ESS and HLS don't capture income of other household members except for household's head nor other income except for working income. Therefore, annual household income in the ESS and HLS likely have under-report problem that would be the reason the ESS and HLS capture less high income households than the NSFIE and SCLC. However, it doesn't explain that the share of bottom income households is lower for NSFIE than SCLC.

<table.1>

The differences of household income between and SCLC can be explained by the overloading of recording household account books. It is uncertain that low income households hesitate to record the household account book, but it might be effortless for housewife households in which is middle class.

Table.2 shows ratio of labor force participation of married women by each surveys. It is obvious that the ratio is lower in the NSFIE than in other surveys. Particularly, the gap is larger for women aged 25-44 that would represent households in which the both parents is working, hence and having high income, tend to drop out from the survey. As the middle-class housewife households are likely to emerge as respondents in NSFIE, the share of top and bottom income in NSFIE would be smaller than SCLC.

＜table.2＞

Besides of the difference of share of income group, share of household type is not consistent between NSFIE and SCLC, due to the difference of sampling and weighting method. For SCLC, survey sampling is based on population by prefecture of the survey year, but for NSFIE, it is based on Census population which was conducted 4 years before NSFIE survey. When computing data, NSFIE is adjusted by using weight which reflects the share of region, household size, age, and gender based on Labour Force Survey. On the other hand, SCLC isn't adjusted like NSFIE so that if non-respondent happened non-randomly, share of household type isn't consistent with the population distribution.

Figure.2 shows the share of household by age of household head. In NSFIE, the share of household where the age is 75 and over is between the Census 2005 and Census 2010. But in SCLC, the ratio is much higher than other surveys.

When we look at the younger age group, in both of NSFIE and SCLC, the share of household where the age is 20s is smaller than Census data. In addition, the share of household where the age is 30s and 40s is much same with NSFIE and Census but is smaller for SCLC than Census.

Sano et al. (2015) mentioned that the average characteristics of household is not so much different with NSFIE and SCLC for household size is tow or over, but the share of single household is smaller for SCLC than Census and the share of single elderly households is larger for SCLC. As we pointed out, SCLC doesn't do adjustment by weighting, there is serious bias particularly in single households.

To sum up this section, NSFIE is less likely to capture top and bottom income household precisely, as overburdening households with the household account books. On the other hand, SCLC is likely to capture single elderly households excessively due to

the survey design. In this paper, in order to investigate the relationship between population structure and income distribution, we use NSFIE that is considered to be closer to actual demographic structure.

＜Figure.2＞

3. analysis methods

The data used are from the National Survey of Income and Expenditure (Ministry of Internal Affairs and Communications Statistics Bureau) from 1994 to 2009. The survey is conducted every five years by the Statistics Bureau based on a national representative sample, with the number of observation each time being around 50,000 households. As previously mentioned, the survey does not have income tax and social insurance premiums for annual income, and so our study uses Tanaka and Shikata (2012) micro simulation model to estimate each household's tax and social insurance premiums and calculate disposable income. Please note that, in line with previous research, our study uses equivalent disposable income (EDPI), which is disposable income (DPI) divided by the square root of the number of people in the household. Although EDPI is calculated from the household income, each member of the household has the same EDPI, which means that the unit of analysis is each individual person. For example, where a four-person household has DPI of yen 5 million, the EDPI calculation produces four individuals with EDPI of yen 2.5 million (yen 5 million/$\sqrt{}$4). Use of this method allows decomposition analysis of income inequality based on the attributes of each individual, including those who are not the household head.

The two decomposition methods were used in the following analysis. First, Mean log deviation (MLD) was used as an indicator of inequality, and decomposition analysis of the change in inequality (i.e. change in MLD) between two points in time was carried out, looking at the contribution to the change in inequality from change in "group share", in "within-group inequality", and in "inter-group inequality", where the groups were derived from age structure and then from type of co-residence. MLD as an indicator of inequality reacts relatively sensitively to changes in income strata. In concrete terms, we used the method formulated by Mookherjee and Shorrocks (1982) as well as Jenkins (1995).

Consider a population of n individuals with mean income μ, and let yi denote the income of individual i. If n_k represents the number of individuals in group k, and this group mean μ_k, then we can use the following definitions for the decompositions:

$v_k \equiv n_k / n$, the population share of group k.

$\lambda_k \equiv \mu_k / \mu$, group k's mean income relative to the population mean.

$\theta_k \equiv \nu_k \lambda_k$, group k's share of total population income.

The MLD can be written

(1) $I_0 = (1/n)\sum_i \log(\mu / y_i)$,

and (1) becomes

(2) $I_0 = \sum_k \nu_k I_{0k} + \sum_k \nu_k \log(1/\lambda_k)$.

The change in I_0 between two years, I_0 and I'_0, can be written as

$$\begin{aligned}(3)\quad \Delta I_0 &\equiv I'_0 - I_0 = \sum_k \bar{\nu}_k \Delta I_{0k} + \sum_k \bar{I}_{0k} \Delta \nu_k - \sum_k \overline{\left[\log(\lambda_k)\right]} \Delta \nu_k - \sum_k \bar{\nu}_k \Delta \log(\lambda_k) \\ &\approx \sum_k \bar{\nu}_k \Delta I_{0k} + \sum_k \bar{I}_{0k} \Delta \nu_k + \sum_k \left[\bar{\lambda}_k - \overline{\log(\lambda_k)}\right] \Delta \nu_k + \sum_k \left(\bar{\theta}_k - \bar{\nu}_k\right) \Delta \log(\mu_k)\end{aligned}$$

term A termB termC termD

where $\triangle$ is difference operator, and $\bar{\nu}_k = (\nu_k + \nu'_k)/2$, $\bar{\lambda}_k = (\lambda_k + \lambda'_k)/2$, $\overline{\log(\lambda_k)} = [\log(\lambda_k) + \log(\lambda'_k)]/2$, $\bar{I}_{0k} = (I_{0k} + I'_{0k})/2$. Then, overall MLD changes can be decomposed into "within group inequality (term A)", "age-group shares (term B+C)" and in "mean income of the age-groups (term D)".

Second, we employ the method of RIF-regression to decompose Gini coefficient (Firpo et al. 2009, Firpo et al.,2011).

$$\hat{I}_G = RIF\left(y, Gini_y\right) = 1 + \frac{2}{\mu_Y^2} R_Y - \frac{2}{\mu_Y} R_Y \left[y\left(1 - F_Y(y)\right)\right]$$

where μ_Y stands for the mean of the sample and R_Y is the integral of the cumulative income distribution function $F_Y(y)$.

By using this method, multiple variables can be submitted and detailed decomposition can be performed known as Oaxaca-Blinder decomposition (Oaxaca1973, Blinder 1973) for which the overall difference in the mean of a dependent variable of two groups can be written as:

$$\Delta \hat{I}_G = \underbrace{\left(\hat{\beta}'_0 - \hat{\beta}_0\right) + \sum_{k=1}^{k} \bar{X}'_k \left(\hat{\beta}'_k - \hat{\beta}_k\right)}_{\text{Unexplained}} + \underbrace{\sum_{k=1}^{k} \left(\bar{X}'_k - \bar{X}_k\right) \hat{\beta}_k}_{\text{Explained}}$$

4. Income inequaliy by age

Figure.3 shows the Gini coefficients for each five-year age group. It contains two types of Gini coefficient by age group; one based on the age of the household head and one based on own-age. Panel (a) is the Gini coefficient for the age of household head, and it shows that income inequality increases as the age of household head rises. The tendency for income inequality to increase with age is clear in the 1994 data but, from 1994 to 2009, while inequality expands in the younger age groups, it contracts in the older age groups, and the relationship of income inequality expansion weakens as age rises.

However, Panel (b) is the Gini coefficient for their own-age, and it indicates no simple relationship, even in 1994, of increase in income inequality with age. Income inequality is greater in the groups of 20-24 and 25-29 than in the under 20 age group or in the age groups of 30s and 40s. Also, the inequality expands as age rises from the age group of late 40s, but there is no clear relationship of inequality expansion with ageing in the age group of 60s and above age groups.

Income inequality is high in the own-age group of 20-24 and 25-29 because income inequality is high among unmarried children in that age group who are living with their parents and who are therefore not heads of households. They belong to households where the household heads are in the fifties and sixties age groups, for which income inequality is large when looking at data by age of household head. Thus, the income inequality among people in their twenties is greater when looking at the own age rather than of the age of household head.

Figure.3 also shows changes of income inequality by age group from 1994 to 2009. Whether looking at the age of the household head or the own age group income inequality is expanding from 1994 to 2009 in the younger age groups where people are in their twenties and early thirties. In the prime age group of late thirties and forties, income inequality is expanding from 2004 to 2009. Income inequality in old age group of household head is decrease largely from 1994 to 2009, although this change is rather small in own age group of old people.

＜Figure.3＞

Figure.4 shows distribution of the age groups by the definition of age. In 1994, distribution of the age groups of household head (a) is monomodal either side of a peak in the 40s age group, with 15% of the heads of household aged 40-44, and another 15% aged 45-49. This is followed by a figure of under 10% for the 30-34 and the 50-59 age

groups, with under 5% of the heads of households to be found in the 25-29 and 70-74 age groups. Also, the proportion of heads of household aged in the age groups of the forties falls gradually, so that, in 2009, 10-11% were in the 40-44 age group and another 10-11% in the 45-49 age group, a similar proportion to those in the 50s and 60s age groups. In addition, between 1994 and 2009, the proportion in the 30-34 age group declined 1.7%pts and the proportion in the 35-39 age group declined 2%pts. As a result, in 2009, the monomodal structure of distribution has disappeared.

Meanwhile, Panel (b) shows the distribution of the own-age group, unlike distribution of the age group of the household head, is multimodal. While the age group accounting for the highest proportion in 1994 was undoubtedly the age group of 40s, difference of the proportion between this age group and the other age groups was not large. Please note that the low proportion in the 15-19 and the 20-24 age groups in all survey years is attributable to the fact that students living on their own are not covered by the National Survey of Income and Expenditure. In 2004, the proportion in the 30-34 and 65-69 age groups formed high twin peaks. In 2009, with the pattern translated by five years, the twin peaks are even clearer.

As regards changes over time in age group distribution based on the own-age, with the decline in the fertility rate, the proportion of young people in the early 20s age group and younger declines each year. Nevertheless, proportion of age group 25-29 seems to be peak in 1999, and this same cohort has continued to represent the higher proportion, in the 30-34 age group in 2004 and in the 35-39 age group in 2009. The population in this cohort is higher than that in the previous and next cohorts, as it represents the second-generation baby boomers. However, the proportions of these same age groups within the age group distribution of the household heads do not rise over the same period, but rather decline. The impact of the second-generation baby boomer cohort can therefore be seen in a boost to the proportion of the population in their late 20s and 30s in data based on the own age, but it cannot be seen in the figure based on the age of household head.

There is such a significant difference between the change in recent years in the distribution of the age of household head and that of the own-age because the youth in their late 20s and 30s age group are less likely to be the household heads because they are less likely to get married and more likely to live with their parents. As a result, the second-generation baby boomers, numerous by definition, did not appear in the figure of the distribution of household head, even in their 30s.

＜Figure.4＞

In the following, we show the differences attributable to the effect of the impact of the ageing population on income inequality, according to whether age is defined as age of the household head or own age. To this end, we conduct decomposition analysis of the changes in income inequality from 1994 to 2009 for each age group of household head and for each own age group, looking at the contribution to the overall change of change in "within group inequality", in "age-group shares", and in "sub-group mean incomes". As mentioned in section.3 MLD is used for "within group inequality" and relative mean of income is used for "sub-group mean incomes". These figures are posted in appendix.

Table.3 shows the results of decomposition analysis according to the age of household head, in line with earlier studies. Between 1994 and 2009, MLD rose 12.7pts (x 1,000). The "% change" column shows that MLD rose 10.8% over that period. The bottom row shows a 4.8-point contribution from change in inequality within each age group over the period, a 11.3-point contribution from change in the age-group shares, and a minus 3.4-point contribution from change in mean income by age group, implying that the overall expansion in income inequality is mainly attributable to change in the age structure. As regards each time period, the income inequality within each age group contributed to an increase in overall income inequality between 1999 and 2004, this factor reduced income inequality between 1994 and 1999. Meanwhile, change in age structure of household head contributed to growing of income inequality in all time periods.

＜table.3＞

Next, Table.4 shows decomposition analysis for income inequality according to the own age group. Between 1994 and 2009, there was a more significant contribution from change in inequality within each age group (9.4 points) than from change in the age structure (5.1 points). Thus, growing income inequality between 1994 and 2009, when looking at the age group of the household head, can be largely explained by change in the age structure, and, when looking at the own age group, can be largely explained, not by age structure, but by change in income inequality within each age group.

This difference between the results of decomposition by the own age and by the age of household head is attributable to the fact that population of the younger own age groups would belong to the middle and older age groups of household head where income inequality is high. Then, using the age of household head causes over-evaluation of demographic changes. Also, the difference in the contribution from change in income inequality within age groups may be attributable to the fact that, although income inequality increases during the twenties and forties age groups of both the age of

household head and own age as in Figure.3, looking at the result of age of household head, there is a significant decrease in income inequality in sixties and above age groups, which cancel the impact of an increase in income inequality within working-age age groups.

＜table.4＞

Table 5 shows the results of the decomposition analysis of the Gini coefficient using the RIF-regression, showing the impact of the change in the composition of five-year age groups and the impact of the change on the income of each age group as a percentage of the change in the Gini coefficient between 1994 and 2009 when the change in the Gini coefficient is set at 100%. In the contribution to the Gini coefficient by age of head of household, the contribution from the composition changes is 65.7% and the contribution from the unexplained effects is 34.3%. In the unexplained effects, the age of 60 and older contributed to the narrowing of the disparity, while the compositional change in the 60 and older age group significantly increased the disparity. This is consistent with the fact that disparities are widening as the population ages, while disparities within the elderly are narrowing. It can be seen that the unexplained effects widen the disparities due to the constant term, but this is offset to some extent by the narrowing of the disparities within older adults.

In the analysis using own age, the contribution of the compositional changes in age was 30.2% and the contribution of unexplained effects was 69.8%. The magnitude of the contribution of each effects to the overall inequality is the opposite of the case of age of household head. For each age group, the composition effects of the older age groups increased the inequality, as was the case for the age of household heads, while the unexplained effects narrowed the gap. However, as can be seen from the constant term, the unexplained effects widened the overall disparity.

＜Table.5＞

5. Results of decomposition analysis by changes in co-residence among aged 0-19

Figure 5 shows the change in population share, MLD, and relative income by family type for children (0-19 years old) from 1994 to 2009. Based on the type of parental cohabitation and marital status, we divided the family into five categories: (1) married couples and children (parents and children only), (2) three generation (married couples, children and grandparents), (3) single parents (single parents and their children only),

(4) third generation single parents (single parents and their children and grandparents), and (5) others.

First, with respect to the population share, between 1994 and 2009, the percentage of parents living together as a "couples" increased and the percentage of three generations living together decreased. For MLD, the intra-typical disparity in the couples is the smallest, and the intra-single parent disparity is the smallest. However, between 1994 and 2009, disparities within the COUPLE also gradually widened. In terms of relative income, single parents have a significantly lower level of income than other family types, and there has been a downward trend from 1994 to 2009.

＜Figure.5＞

Table 6 shows the results of the analysis of the change in MLD among children (0-19 years), decomposed by contribution by population share, MLD, and relative income by family type; between 1994 and 2009, MLD increased by 13.7 points (15% of the rate). Of these, the contribution from changes in MLD within each family type is 9.2, the contribution from changes in the share of the family type is 1.7, and the contribution from changes in relative income is 2.9. Although the decline in the share of "three generation families" and the increase in the share of "couples" and "single parents" have slightly widened the inequality, the main reason is growing the within-inequality among "couples". The decline in the relative income of "single parents" also seems to have widened the disparity.

＜Table.6＞

Table 7 shows the results of the contribution decomposition of the Gini coefficient for children (0-19 years old) by RIF-regression with family type and head of household age as the variables used. The explained contribution of age of household head is 0.9 and the explained contribution of type of family is 4.2, which may explain the widening gap between the two groups to some extent. However, unexplained effects are large at 8.8.

＜Table.7＞

6. Results of decomposition analysis by changes in co-residence among aged 20-64

Figure.6 shows the share of individuals in each type of co-residence (and for own

age group) from 1994 to 2009. Even as included in the same household type, the observation means something different depending on whether the respondent is the parent or the child. Then, the type of co-residence is reported in terms of marital status of individuals and whether or not they live with their own parents. These individuals are classified into five types, namely “single” (living alone), “single living with parents” (an unmarried person who live with their parents), “couple” (a married person who does not live with their parents), “couple living with parents”, and “others”.

As shown in figure.6, the share of individuals who are “single” and “single living with parents” in 20-34 and 35-49 age groups have risen between 1994 and 2009. For people aged 35-49, there was a rise in the proportion of single persons living with their parents and in persons living alone, with a sharp decline in the proportion of married couples living with their parents.

＜Figure.6＞

Figure.7 shows income inequality within each type of co-residence as MLD (×1000) from 1994 to 2009. MLD is high for “single with parents”, while MLD for couple is low in all age groups. It is clear that the income inequality among “single living with parents” is higher than that among other types of co-residence. This should be because income disparity is higher in their parents’ age group than in the younger age group and because, while many young people live with their parents because their income is low, many other young people do not leave home even though they can afford to live independently.

In the age group 20-34, the smallest within-group inequality is for “single”, but within-group inequality for “single” increase as the age rises; for the age group 50-64, within-group inequality for “single” is higher than that for other type of co-residence.

＜Figure.7＞

Finally, figure.8 shows relative equivalent disposable income (EDPI). Here, EDPI is the mean of the income of each group relative to the average of overall EDPI in each age group, average overall relative EDPI set to be 100.

A group with high relative income would have a value higher than 100 and a group with low relative income a value lower than 100. Among persons aged 20-34 years, “Single” and “couple” have low relative income and “single with parent” have high relative income. Among persons aged 35-49 years, “Single”, however, has a high relative income, and “single with parent” has low relative incomes; the relative income of single person living

with parent falls as the age grows. In the 50-64 age group, both “single” and “single living with parent” have lower incomes than the other family types.

In almost cases, the relative inequality between different types of co-residence changed little between 1994 and 2009, though for single person living with their parents in all age groups relative EDPI fell.

＜Figure.8＞

Following on from the decomposition analysis relating to age group in the previous section, the decomposition analysis of the changes in MLD was conducted to examine how income inequality in each age group change as a result of change in co-residence. Table.8 shows decompositions of the changes in MLD for all three five-year periods and the total fifteen-year period in terms of the contribution to the overall changes from changes in “within-group inequality”, changes in “group share”, and changes in the “sub-group mean incomes”.

First, for the person in their 20s, changes in “within-group inequality” account for most of overall inequality with little impact from changes in “group share”. As shown in figure.8, though the income inequality within person in their 20s increases in every type of co-residence, the main reason for this change is the inequality change for single person living with their parents, because the group share of them is much larger than other types of co-residence. In addition, the changes in mean income between different groups reduce income inequality. This could be because, as shown in figure.8, inequality in the 20-34 age group is being reduced by the fact that the relative EDPI for single person living with their parents is falling and it is rising for single person living alone, so that inequality between types of co-residence is decreasing in that age group.

For person in their 30s, both the changes in “within-group inequality” and the changes in “group share” are contributing to increase in income inequality. The contribution of changes in “group share” is larger than that of changes in “within-group inequality” for 1994-1999 and 1999-2004. It is clear that there was a greater contribution to increase in overall income inequality from changes in “group share” than from “within-group inequality” largely because the proportion of single person living with their parents has risen and inequality within them is significant large. For person in their 40s, while the contribution of changes in “group share” is larger than that of changes in “within-group inequality” for 1994-1999 and 1999-2004, the changes in “within-group inequality” had a very large impact on growing inequality for 2004-2009.

＜Table.8＞

Table 9 shows the results of the decomposition analysis of the Gini coefficients for people aged 20-64 years by RIF-regression, using own age and work types in addition to family types as explanatory variables. Family types is the category used in this section, and own age is entered as a continuous variable. The employment variables were classified as full-time employment, part-time employment, self-employment, and no work. And between 1994 and 2009, the Gini coefficient (×1000) increased by 15.1. By gender, the Gini coefficient for males and females increased by 19.6 and 10.6, respectively.

In the decomposition analysis, it can be seen that own age and family types have the same impact on the widening of the gap as explained effects. This is a similar trend by gender. However, the explained effects of work type contribute in the direction of widening the disparity for men, while they contribute in the direction of narrowing the disparity for women. Thus, while the total explained effects in men have some effect on widening disparities, the effects is small for women.

＜Table.9＞

7. Results of decomposition analysis by changes in co-residence among old.

Figure.9 shows the share of people in each type of co-residence (and for own age group) from 1994 to 2009 among young old and old old person. They are classified into five types, namely “single” (a person living alone), “couple” (a married person who does not live with his or her children), “with unmarried children” (an person who live with his or her unmarried children and does not live with his or her married children regardless of his or her marital status.), “with married children” (an person who live with his or her married children regardless of his or her marital status.), and “others”.

As shown in figure.8, the proportion who are old couples and old persons with unmarried children have risen between 1994 and 2009 among age group 65-74. Not only these types of co-residence but also single increases among aged 75 and over. There was a sharp decline in the proportion of living with married children for people aged 65-74 and aged 75 and over.

＜Figure.9＞

Figure.10 shows income inequality within each type of co-residence as MLD (×1000) from 1994 to 2009. MLD is high for single old, while MLD for couple is low among age group 65-74. MLD of single, however, has decreased and MLD of living with unmarried children became higher than that of single in 2009 among age-group 65-74. MLD is high and stable for single and persons with unmarried children among aged 75 and over. On the other hand, MLD has decreased rapidly for couple among people aged 65-74 and aged 75 and over.

＜Figure.10＞

Figure.11 shows relative equivalent disposable income (EDPI). Single person has low relative income and person living with their married children have high relative income among old and old people. The relative income of single, however, has grown and the income difference between the types of co-residence has been shrinking among people aged 75 and over.

＜Figure.11＞

Table.10 shows decompositions of the changes in MLD for all three five-year periods and the total fifteen-year period in terms of the contribution to the overall changes from changes in “within-group inequality”, changes in “group share”, and changes in the “sub-group mean incomes”.

For the age-group 65-74, the changes in “within-group inequality” account for almost decrease of overall inequality, although the changes in “group share” increase overall inequality, having a rather small impact. As shown in figure.9, the income inequality within single and couple decrease among young-old people, which is the main reason for the inequality change. The income inequality within young-old people living with their unmarried children, however, has increased and become the highest types of co-residence. As shown in figure.9 increasing in the share of this contributes to grow the total income inequality among young-old people.

For the age-group 75 and over, the changes in “within-group inequality” and “subgroup mean income” decrease overall inequality, while the changes in “group share” increase overall inequality. As shown in figure.10 the inequality within couple decrease, while the inequality within other types of co-residence is stable or increase. These changes contribute to decrease the total inequality among old-old people. As shown in figure.9, the share of person with married children, that has low income inequality, has declined

among old-old people. This change in “group share” contributes to reduce the total income inequality rather than the contribution of “within-group inequality”. The change in “sub-group mean incomes”, however, contribute to increase the total inequality. As shown in figure.11, the relative mean of single has increased rapidly. This change have a large impact on growing inequality for 2004-2009 among old-old people.

＜Table.10＞

Table 11 shows the results of the decomposition analysis of the Gini coefficients by RIF-regression for those aged 65 and older, using the family types as the variables used, as well as the own age and work types. The family types are the same categories used in this section, and the own age is entered as a continuous variable. The Gini coefficient (×1000) decreased by -20.2 between 1994 and 2009. By gender, the decline in the Gini coefficient for men was greater than that for women.

First, the explained effect was that changes in family types and the own age widened the gap, while changes in work types contributed in the direction of narrowing the gap. The above-mentioned increase in the proportion of the single and the couple is widening the gap, and the impact is greater than that due to changes in the age structure within the elderly. These influences are common between men and women. In addition, the decline in self-employment during this period may have contributed in the direction of narrowing income inequality. The unexplained effect, on the other hand, significantly reduces income inequality due to the constant term. In other words, similar to the decomposition analysis by MLD, changes in family type itself contribute to the narrowing of inequality, but change in within-group inequality and the inter-group inequality reduce total inequality among the elderly.

＜Table.11＞

8. Discussion and conclusion

The relationship between income inequality and aging looks different depending on whether using age of household head or own-age. The income inequality increase as the age gets older by using age of household head, but the inequality is larger for the 20s age group than for the 30s or 40s age groups by using their own age. This difference is attributable to the fact that in the former case person who live with their parents belong to the age group of household head which has relatively high income inequality. The

income inequality in their 20s, 30s, and 40s increased between 1994 and 2009, regardless of whether own-age or age of household head is used. On the other hand, the increase in inequality by using own age is smaller than by using age of household head among older people.

In addition, there are observed differences in age structure between using age of household head and using own age. If using the own age, the proportion of age group 25-29 is relatively high in 1999, and the proportion of age group 30-34 is relatively high in 2004, and the proportion of 35-39 age group is relatively high in 2009. This reflects the size of the second-generation baby boomer cohort, who were born in the early 1970s. However, in the figure based on the age of household head, the movement of that cohort through the age groups is invisible. In other words, because of the increase in young people who do not marry and live with their parents, the actual size of the population in each age group did not appear in age structure of household head.

Decomposition analysis of the increase in income inequality between 1994 and 2009 showed that the change in the age structure was a significant factor if using the age of household head, but that, the change in inequality within each age group was a more significant factor than the change in age structure if using the own-age. The difference in the results between using age of household head and using own age is attributable to two factors mentioned above. Thus, the effects of changes in population on the inequality are overestimated if using age of household head, because aging population for the age of household head is more rapidly than that for own-age. The fact that a large proportion of the generation who were in their late 20s and 30s during the first decade of the 21st century (2000-2010) remain unmarried and continue to live with their parents rather than creating their own households, which depresses the proportion of that generation that become heads of households

Moreover, the decreasing in the inequality among old people was higher if using age of household head than if using the own-age. This decreasing inequality among older people should offset the increasing inequality largely among people in their 20s, 30s and 40s if using the age of household head. This means the effects of the within-age inequality on total inequality could be underestimated.

Examining how such the increasing inequality in their 20s, 30s, and 40s and the decreasing inequality in the elderly are related to changes in families, the following results were clarified.

First, growing income inequality in the 20s age group was mainly caused by increase in inequality within each type of co-residence (within-group inequality) rather than to changes in the share of each type of co-residence (group share). It seems that the impact

of increase in within-group inequality for single persons living with their parents was particularly significant. In the 30s and 40s age groups, there was contribution to growing income inequality not only from increase in "within-group inequality" but also from changes in "group share". There was a particularly significant contribution to the increase in income inequality from a rise in the proportion of single persons living with their parents, in which within-group inequality is greater than in other groups.

Second, decreasing inequality among single and couple in the 65-74 age group and among couple in the 75 and over age group caused the growing the total inequality among elderly people included in household head. The level of inequality in these types of co-residence, however, higher than that among old person living with their married children. The change in share of types of co-residence contribute to decrease in total inequality. Since this contribution was not be reflected in the change in inequality using the age of household head, the change in inequality was much larger in using the age of household head than using own-age among elderly people.

In the previous studies the increase of aging population mainly account for growing the inequality in Japan (Ohtake and Saito 1998,Ohtake 2005, Ohtake 2008, Oshio 2006, Shirahase and Takeuchi 2009, Ohtake and Kohara 2014, Shirahase 2018, Kitao and Yamada 2019). In contrast, our analysis suggests that the changing age composition of population does not mainly affect the widening income inequality in Japan. Instead, there is a substantial increase in income inequality within age group. This difference is caused by the definition of the age used for the analysis. If the age of household head is used as in previous studies, the effects of population ageing on income inequality appears excessively. The reason is that as young people who become heads of households decrease due to an increase in unmarried people living with their parents, aging process of population using age of household head looks more advanced than actual change.

In addition, increasing in unmarried people living with their parents affects inequality within age group. Thus, the widening inequality among people in their 30s and 40s is caused by this increase of unmarried people living with their parents who belong to the age group having high income inequality.

In contrast, the income inequality decreased among elderly people. This decreasing, however, is overestimated by using the age of household head. Although the decline in the share of person living with their married children contributes to increasing the inequality within the own-age group for elderly, many of them were not included elderly population using the age of household head. At the same time, this overestimation of the decline in inequality by using the age of household head underestimates the effect of within-age inequality on overall inequality, as the decline in inequality among elderly

excessively cancels the increase in inequality among youth and middle aged.

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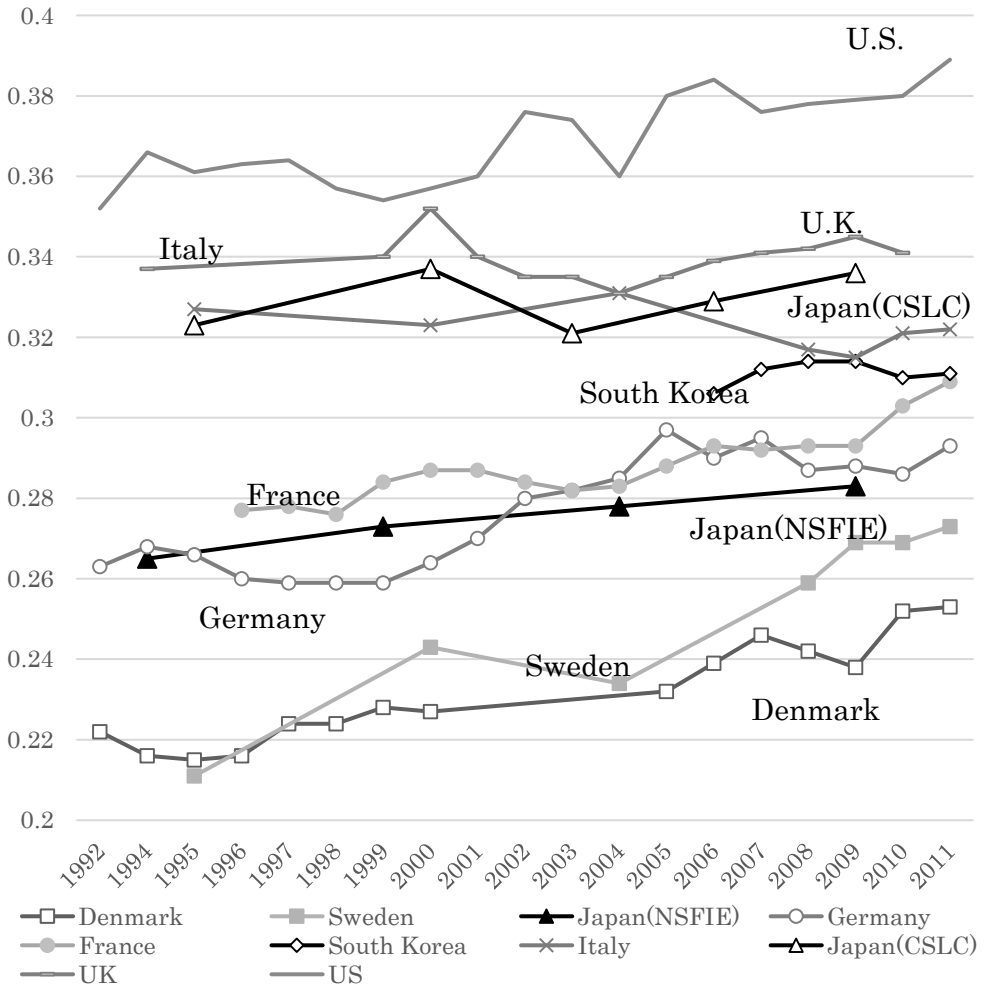


NSFIE: National Survey of Family Income and Expenditure

CSLC: Comprehensive Survey of Living Conditions

Figure.1 Gini coefficients of Japan compared to the ginis of selected countries.

Source: Authors' tabulation from OECD.Stat and Statistics of Japan (e-stat)

Table.1 Income Distribution by Japanese Surveys

	National Survey of Family Income and Expenditure (NSFIE)	Comprehensive Survey of Living Conditions of the People on Health and Welfare (CSLC)	Employment Status Survey	Housing and Land Survey
survey year	2009	2009	2012	2013
In million yens				
Up to 2m	12.7%	19.4%	22.4%	20.7%
2m –< 3 m	13.3	13.9	15.2	17.8
3m –< 4m	15.2	13.3	13.8	15.7
4m –< 5m	13.4	10.0	10.9	12.6
5m –< 10m	34.7	31.1	28.7	26.9
10m –<15m	8.2	8.9	6.8	4.7
15m or more	2.5	3.3	2.2	1.6
	100.0	100.0	100.0	100.0

Source: Authors' tabulation from Statistics of Japan (e-stat)

Table.2 Employment rate of married women by each surveys.

	NSFIE	CSLC	Labor Force Survey	Employment Status Survey
survey year	2009	2010	2009	2007
15–24	40.8	43.9	40.7	34.6
25–34	44.7	49.5	50.4	48.5
35–44	55.7	61.1	59.1	60.7
45–54	67.0	72.1	69.8	70.8
55–64	46.8	50.9	49.5	51.4
15–64	54.0	58.8	57.4	58.0

Source: Authors' tabulation from Statistics of Japan (e-stat)

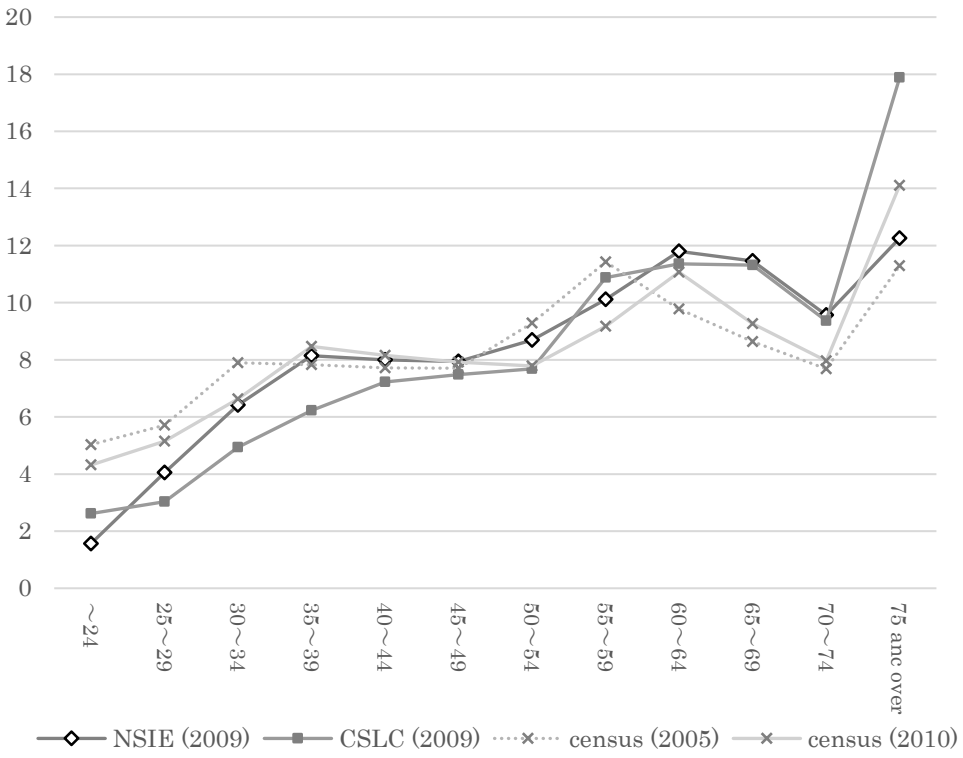


Figure.2 Distribution of age of household head by surveys

Source: Author's tabulation from Statistics of Japan (e-stat)

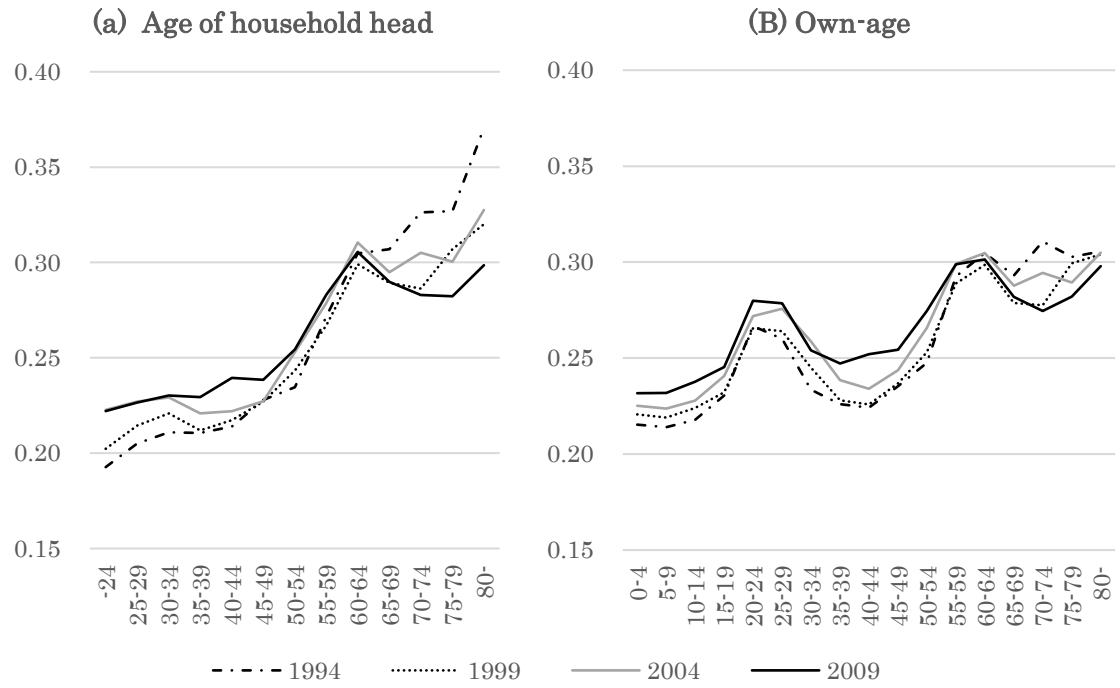


Figure.3 Gini coefficients by age of household head and own-age

Source: Authors' calculation

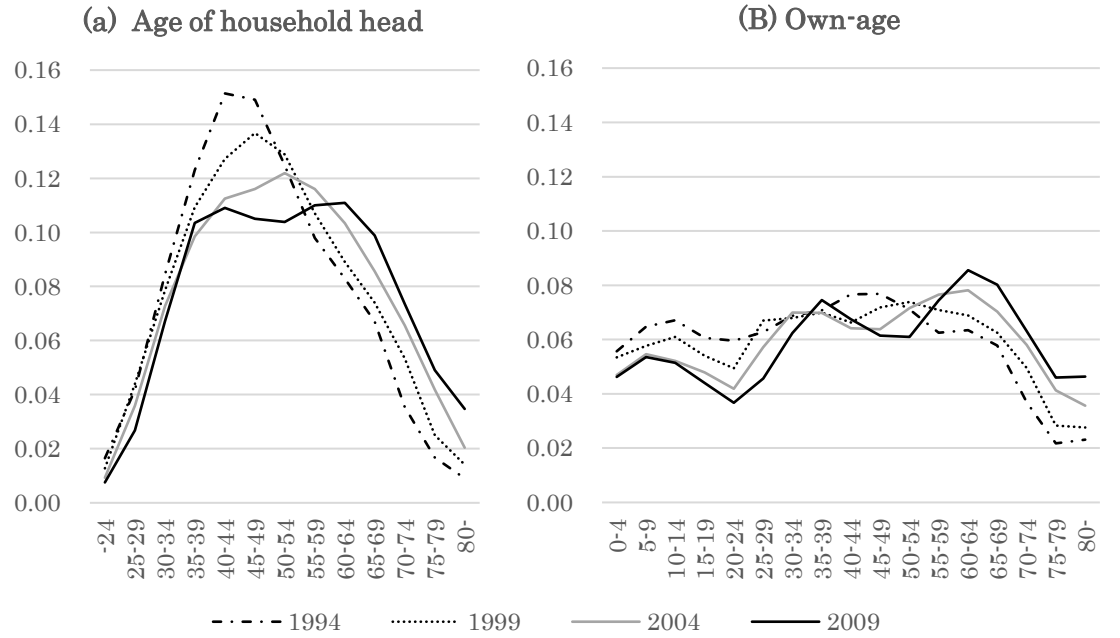


Figure. 4 The distribution of age groups by age of household head and own-age

Source: Authors' calculation

Table.3 Decomposition analysis of change in MLD by age of household head

	MLD at start of period	MLD at end of period	Change in MLD	% change	within-group inequality	group share	Sub-group mean incomes
	$1000*I_t$	$1000*I_{t+1}$	$1000\Delta I_0$	$\%\Delta I_0/I_t$	term A	term B+C	term D
1994–1999	118.4	118.7	0.3	(0.2)	−3.4	4.4	−0.7
1999–2004	118.7	128.0	9.3	(7.8)	7.7	4.4	−2.7
2004–2009	128.0	131.1	3.1	(2.4)	0.9	2.0	0.3
1994–2009	118.4	131.1	12.7	(10.7)	4.8	11.3	−3.4

Source: Authors' calculation

Table.4 Decomposition analysis of changes in MLD by own age

	MLD at start of period	MLD at end of period	Change in MLD	% change	within-group inequality	group share	Sub-group mean incomes
	$1000*I_t$	$1000*I_{t+1}$	$1000\Delta I_0$	$\%\Delta I_0/I_t$	term A	term B+C	term D
1994–1999	118.4	118.7	0.3	(0.2)	−1.4	2.5	−0.8
1999–2004	118.7	128.0	9.3	(7.8)	8.2	2.2	−1.1
2004–2009	128.0	131.1	3.1	(2.4)	2.5	0.5	0.2
1994–2009	118.4	131.1	12.7	(10.7)	9.4	5.1	−1.7

Source: Authors' calculation

Table.5 Decomposition analysis of the change in GINI index by age of household head and own age using the RIF-regression method.： The change in Gini index between 1994 and 2009 is set to 100.

	Age of household head			Own age		
	Composition	Unexplained	total	Composition	Unexplained	total
0–4				−1.0	−5.8	−6.8
5–9				0.1	−5.1	−5.0
10–14				1.0	0.5	1.4
15–19				0.3	−0.7	−0.5
20–24	−5.8	1.5	−4.3	−6.6	−2.6	−9.2
25–29	−2.3	2.5	0.1	−4.1	1.7	−2.4
30–34	−2.0	−0.6	−2.5	−0.4	−0.9	−1.4
40–44	0.2	12.9	13.2	−0.2	7.1	6.8
45–49	−0.4	1.3	1.0	−2.0	0.6	−1.4
50–54	−6.0	−1.6	−7.6	−5.1	2.7	−2.5
55–59	7.0	−7.6	−0.6	6.7	−7.2	−0.5
60–64	15.0	−8.8	6.2	9.5	−11.1	−1.6
65–69	12.9	−15.9	−3.0	6.5	−13.4	−6.9
70–74	16.4	−17.4	−1.0	8.0	−15.8	−7.8
75–79	15.7	−8.3	7.4	8.1	−6.0	2.1
80–	14.9	−7.3	7.6	9.5	−5.0	4.5
cons		83.5	83.5		131.0	131.0
total	65.7	34.3	100.0	30.2	69.8	100.0

Source: Authors' calculation

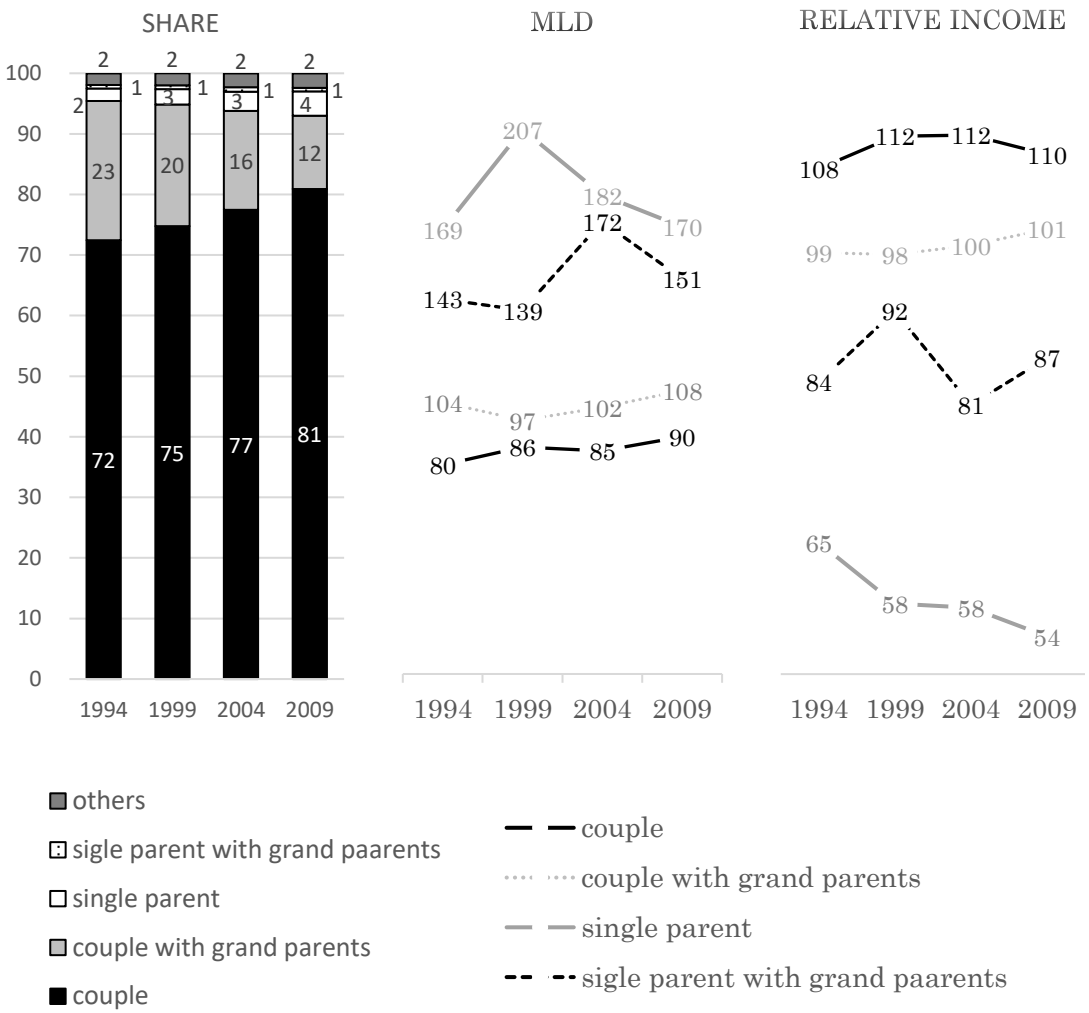


Figure.5 Population Share, MLD(×1000), and Relative income(×100) by Types of Family among Aged 0-19

Source: Authors' calculation

Table. 6 Decomposition analysis of change in MLD by Family Type among aged 0-19

	MLD at start of period	MLD at end of period	Change in MLD	% change	within-group inequality	group share	Sub-group mean incomes
	$1000*I_t$	$1000*I_{t+1}$	$1000\Delta I_0$	$\%\Delta I_0/I_t$	term A	term B+C	term D
1994–1999	91.4	97.5	6.2	(6.8)	4.0	0.4	1.7
1999–2004	97.5	99.7	2.1	(2.2)	0.9	1.1	0.1
2004–2009	99.7	105.1	5.4	(5.4)	3.4	1.0	1.0
1994–2009	91.4	105.1	13.7	(15.0)	9.2	1.7	2.9

Source: Authors' calculation

Table. 7 Decomposition analysis of change in GINI using RIF regression method among aged 0-19

	explained	unexplained
Age of household head	0.9	−2.4
Type of families	4.2	−3.0
Constant term		14.2
total	5.1	8.8
GINI 1994 ×1000	229.6	
GINI 2009 ×1000	243.5	
difference	13.9	

Source: Authors' calculation

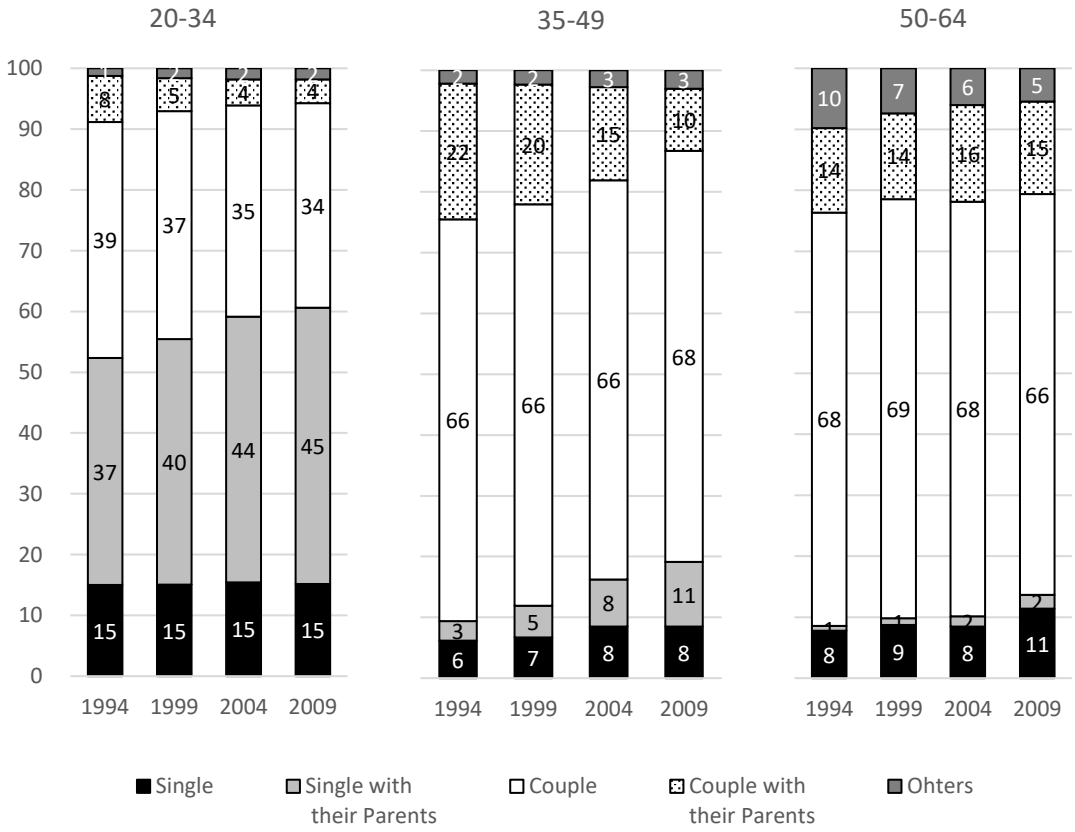


Figure.6 Share of Population by Type of Co-residence among aged 20-34, 35-49 and 50-64

Source: Authors' calculation

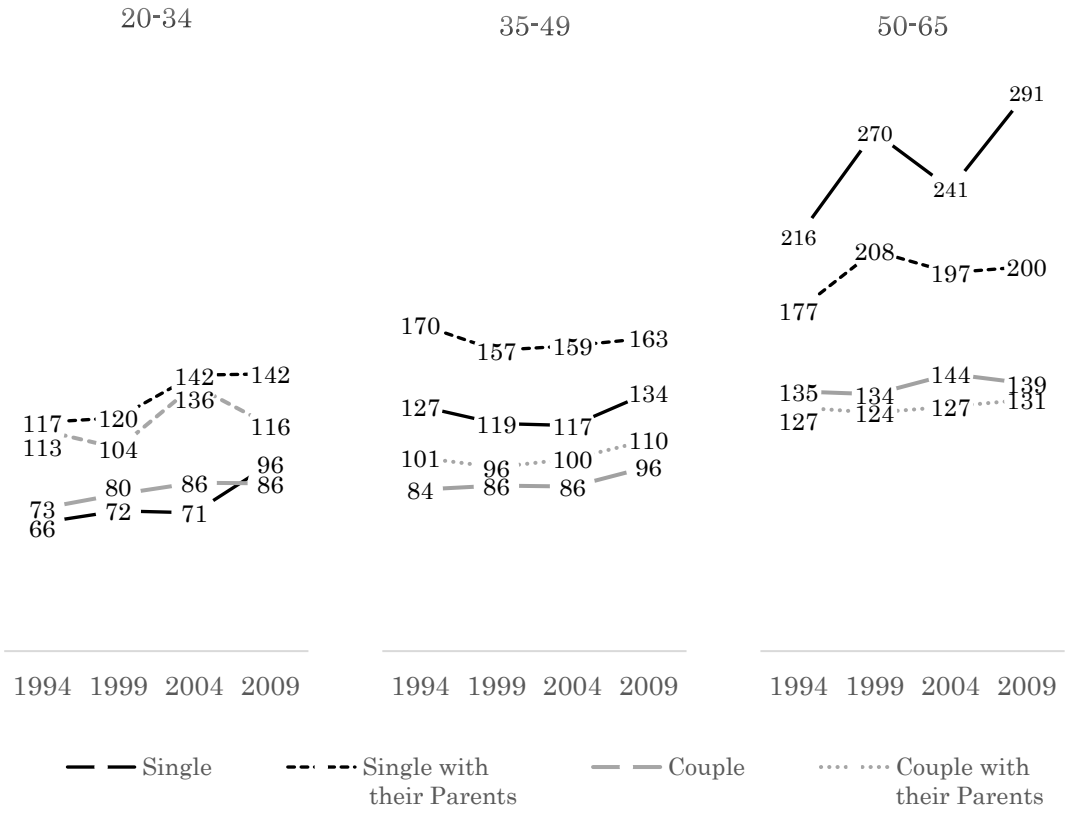


Figure.7 MLD(×1000) by Type of Co-residence among aged 20-34, 35-49 and 50-64

Source: Authors' calculation

Table.8 Relative Equivalent Disposable Income by Type of Co-residence among aged 20-34, 35-49 and 50-64

Source: Authors' calculation

Table.8 Decomposition analysis of change in MLD by Type of Co-residence

		MLD at start of period	MLD at end of period	Change in MLD	% change	within-group inequality	group share	Sub-group mean incomes
		$1000*I_t$	$1000*I_{t+1}$	$1000\Delta I_0$	$\%\Delta I_0/I_t$	term A	term B+C	term D
20–34	1994–1999	112.9	116.5	3.6	(3.2)	4.2	1.6	−2.2
	1999–2004	116.5	126.2	9.8	(8.4)	13.0	1.6	−4.8
	2004–2009	126.2	128.4	2.2	(1.7)	2.9	0.9	−1.5
	1994–2009	112.9	128.4	15.5	(13.7)	19.9	4.4	−8.6
35–49	1994–1999	97.0	98.2	1.2	(1.3)	−1.1	1.7	0.6
	1999–2004	98.2	102.6	4.3	(4.4)	0.7	2.8	0.9
	2004–2009	102.6	114.8	12.3	(12.0)	9.7	1.7	0.9
	1994–2009	97.0	114.8	17.8	(18.4)	9.1	6.5	2.3
50–64	1994–1999	147.1	149.3	2.2	(1.5)	3.3	1.4	−2.4
	1999–2004	149.3	157.3	8.0	(5.4)	7.8	−0.5	0.7
	2004–2009	157.3	165.0	7.6	(4.8)	1.3	4.8	1.5
	1994–2009	147.1	165.0	17.8	(12.1)	12.7	5.7	−0.6

Source: Authors' calculation

Table.9 Decomposition analysis of change in Gini using RIF-regression method among aged 20-64.

	Total		Male		Female	
	explained	unexplained	explained	unexplained	explained	unexplained
Own age	2.8	4.3	2.2	−0.5	2.5	10.3
co−residence	2.6	−28.0	2.8	−46.3	1.5	4.9
work	−2.6	−7.5	3.0	−50.7	−4.4	2.6
Constant term		43.6		109.2		−6.8
total	2.7	12.4	7.9	11.7	−0.3	10.9
GINI 1994 ×1000		263.7		255.9		270.9
GINI 2009 ×1000		278.8		275.5		281.5
difference		15.1		19.6		10.6

Source: Authors' calculation

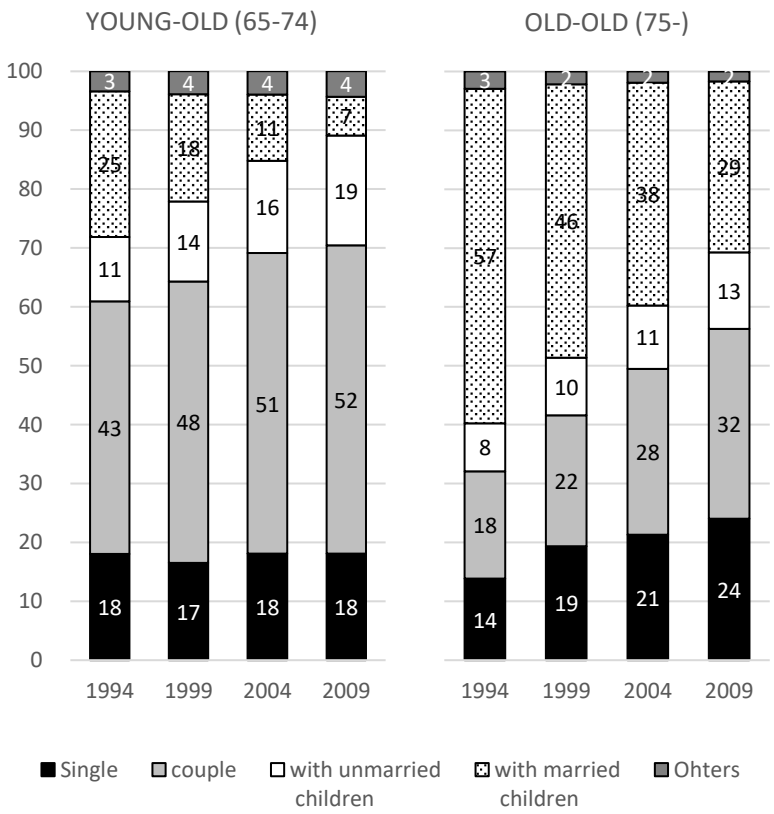


Figure.9 Share of Population by Type of Co-residence e among Young old (65-74) and Old-old (75-)

Source: Authors' calculation

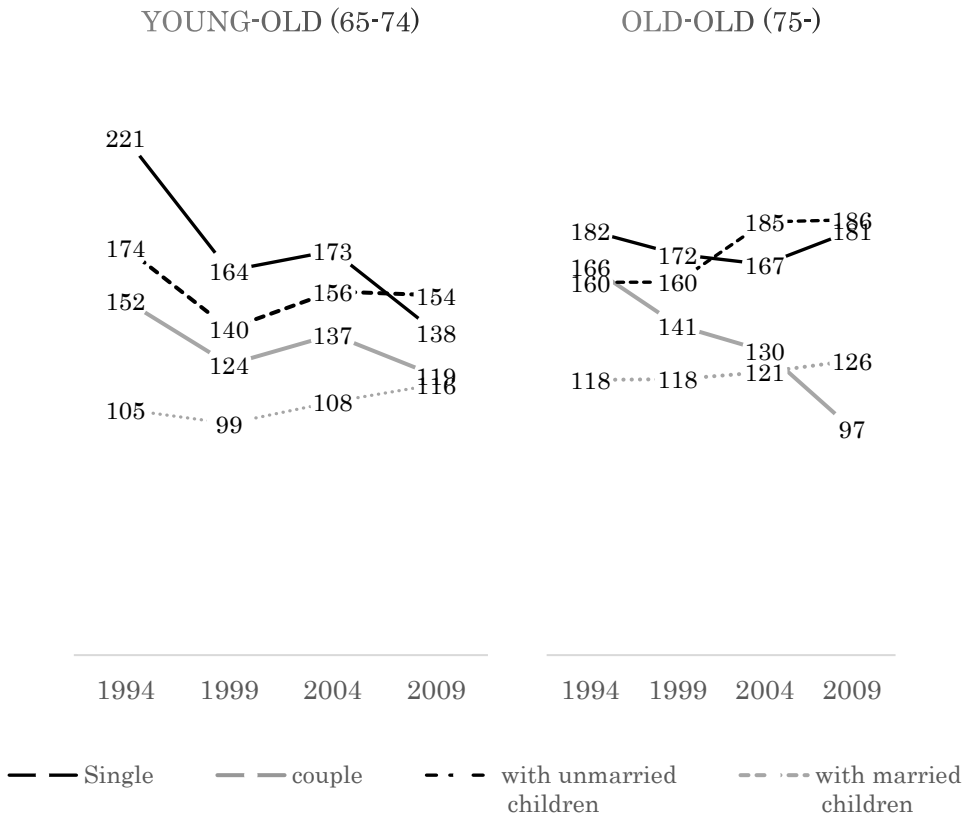


Figure.10 MLD(×1000) by Type of Co-residence e among Young old (65-74) and Old-old (75-)

Source: Authors' calculation

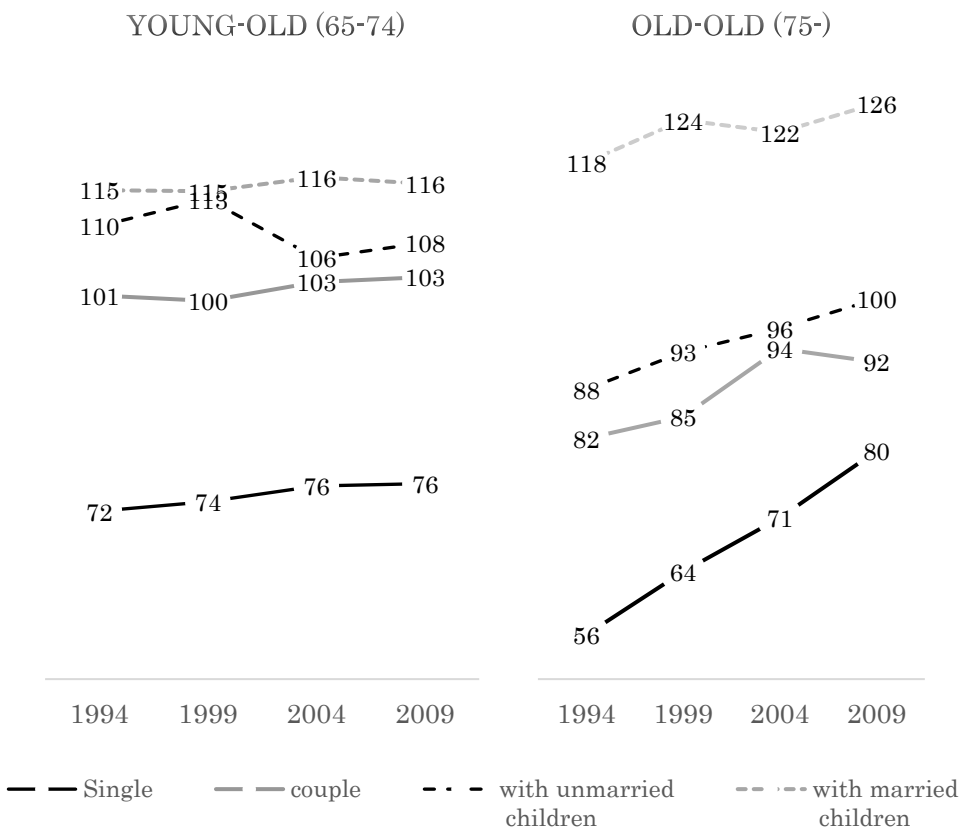


Figure.11 Relative equivalent disposable income by types of co-residence among Young old (65-74) and Old-old (75-)

Source: Authors' calculation

Table. 10 Decomposition Analysis of Change in MLD by Type of Co-residence among Young old (65-74) and Old-old (75-)

		MLD at start of period	MLD at end of period	Change in MLD	% change	within-group inequality	group share	Sub-group mean incomes
		$1000*I_t$	$1000*I_{t+1}$	$1000\Delta I_0$	$\%\Delta I_0/I_t$	term A	term B+C	term D
65–74	1994–1999	166.6	138.7	−27.9	(−16.7)	−28.4	0.9	−0.4
	1999–2004	138.7	152.7	14.0	(10.1)	12.8	2.8	−1.5
	2004–2009	152.7	137.8	−14.9	(−9.8)	−16.0	1.2	−0.1
	1994–2009	166.6	137.8	−28.8	(−17.3)	−32.0	5.3	−2.1
75–	1994–1999	171.8	169.4	−2.4	(−1.4)	−6.5	9.9	−5.7
	1999–2004	169.4	161.4	−8.0	(−4.7)	0.9	2.1	−10.8
	2004–2009	161.4	152.7	−8.6	(−5.4)	−6.4	1.2	−3.3
	1994–2009	171.8	152.7	−19.0	(−11.1)	−12.1	13.6	−17.6

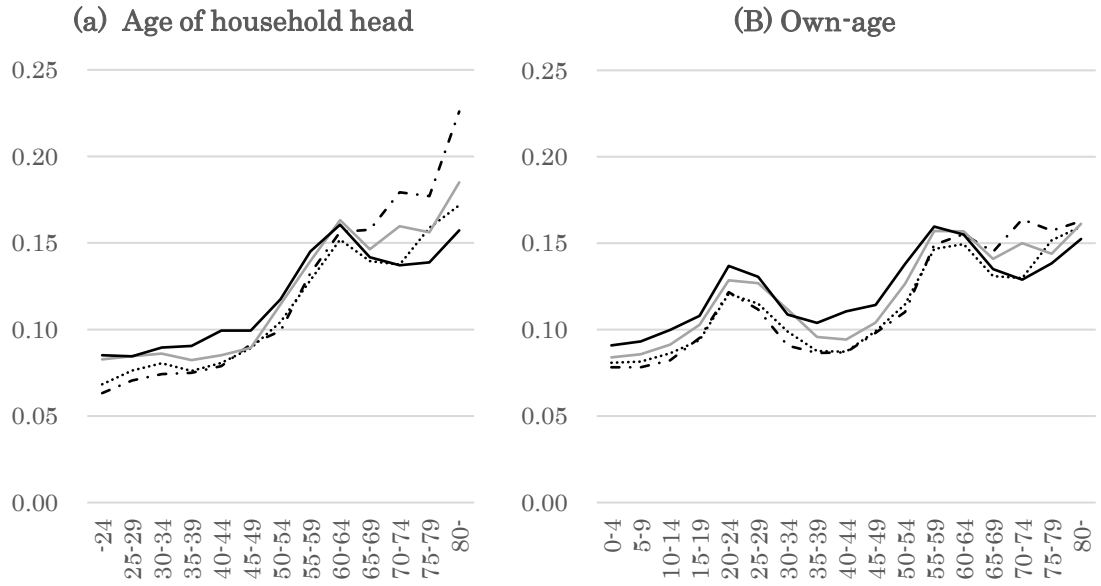
Source: Authors' calculation

Table. 11 Decomposition Analysis of Change in Gini using RIF regression method among aged 65 and over.

	Total		Male		Female	
	explained	unexplained	explained	unexplained	explained	unexplained
Own age	3.6	7.8	5.2	11.4	2.4	6.1
Co-residence	13.8	36.7	13.8	45.8	14.4	32.8
Work type	−4.6	10.2	−11.0	11.2	−1.3	8.8
Constant term		−87.5		−101.0		−79.4
total	12.7	−32.8	8.0	−32.6	15.5	−31.8
GINI 1994 ×1000		305.4		298.8		310.0
GINI 2009 ×1000		285.2		274.2		293.7
difference		−20.2		−24.6		−16.3

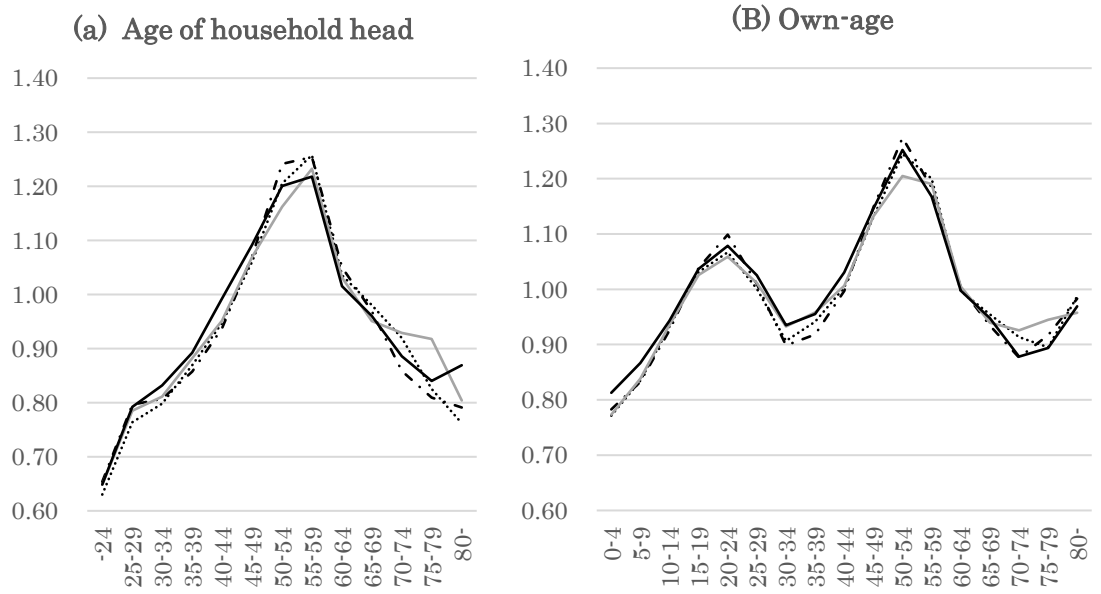
Source: Authors' calculation

Appendix



Appendix.A MLD by age of household head and own-age

Source: Author's calculation



Appendix B Relative incomes by age of household head and own-age

Source: Author's calculation