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Empirical Study of Poverty in Japan

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Chapters 2 and 3 in this dissertation are an English version of

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Several institutions provided datasets for the analyses described in Chapters 2 through 4. Specifically, the Ministry of Health, Labour, and Welfare made anonymized data available for my work. The Comprehensive Surveys of Living Conditions and the Keio University Panel Data Research Center provided data from the Japan Household Panel Survey. Moreover, when I reported the contents of Chapters 2 through 4 at conferences, Michihito Ando, Yuji Takabatake, and Masatoshi Murakami respectively offered valuable insightful comments about Chapters 2, 3, and 4. I extend my appreciation to these institutions and researchers.

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Abstract

This dissertation consists of six chapters. Chapter 1 explains our background and the outlines of the remainder of the paper. According to the Comprehensive Surveys of Living Conditions (CSLC) provided by the Ministry of Health, Labour and Welfare, poverty rates in Japan vary at around 16% recently, which is the fourth highest value among the OECD countries, presenting an international perspective on the severity of Japan's poverty issue. Moreover, the take-up rate of public assistance is about 20%: half or more of poor people do not receive benefits. Based on those explanations presented above, we conducted the following analyses as explained in Chapters 2 through 5.

Chapter 2 presents an investigation of the determinants of change in poverty measures during the twenty-first century. To this end, we decompose changes of poverty measures (poverty rate and squared poverty gap) into four components: mean income change, income inequality change, individual share change for each household type, and poverty line change. These components are calculated for households of several types to ascertain their effects on the poverty measure changes. The dataset we use includes results of four-wave surveys of the CSLC (2001, 2004, 2007, 2010). Results demonstrated that both a decrease in mean income and an increase in the shares of elderly households affected the poverty rate increase of the 2000s. Their effects were offset by a decrease in the poverty threshold, leading to little change of the poverty rate. Compared with poverty headcounts, the change found in the squared poverty gap ratio was significant and negative because of the negative effect of inequality reduction among poor people. Results obtained for the respective household types revealed that the poverty line effect influenced couples with children, and affected households including two or more elderly members and three-generation households, and underscored the importance of low-income persons near the poverty line. Other household groups headed by someone older than 65 were strongly associated with increases in the two poverty measures.

Chapter 3 presents an investigation of poverty by examination of income and liquid assets. Using data from the "Japan Household Panel Survey (JHPS)" for 2009−2014, we measured poverty rates of three types for demographic and socioeconomic subgroups in terms of income, income plus (liquid) assets, and (liquid) assets only. Asset poverty rates are calculated only for non-income poor persons. Logistic regression models were applied to assess the effects of variables such as household type and education on poverty incidence. Results of calculations of income-plus-asset poverty rates revealed decreasing poverty headcounts for household subgroups: those headed by a woman, an elderly person, a less-educated person, and a non-employee. Measuring income poverty alone can engender overestimation of the magnitude of the poverty rate. Results of logistic regression analysis further indicated that addition of wealth to income did not necessarily reduce poverty risks compared with reference groups in the analyses. Asset poverty rates, which are calculated only for non-income poor persons, had high values for many subgroups, revealing that, when people become income-poor because of shocks such as economic crises, many might be unable to escape poverty even if they were to reduce assets to compensate for a low income.

Chapter 4 presents results of studies examining poverty exits and entries. Specifically, using life tables, variations of exit and entry rates were examined as poverty or non-poverty durations become extended. In addition, a discrete-time hazard rate approach was applied to capture factors affecting movements into and out of poverty. The dataset used for these analyses was the JHPS for 2009–2014. Results of life table analysis demonstrated that exit rates were higher than entry rates, and that they declined sharply as poverty duration lengthened. Results also demonstrated that people fell into poverty at least once within four or five years, at a probability of 20% (when left-censored spells were included) or of 40% (in when they were dropped). From discrete-time hazard models, we were able to conclude that movements out of poverty were more likely to occur than those into poverty even if attributes of households and household heads were controlled for. This result coincides with those obtained from the life table analysis. For characteristics of households and household heads, results elucidated that a change in the number of workers in a family was associated with transitions between the two events.

Chapter 5 presents estimates of subjective poverty lines and equivalence scales by household type and region, along with calculated results indicating subjective poverty rates with the thresholds obtained for comparison with relative poverty rates, using a nationwide internet survey of Japan. Results showed that when the subjective equivalence scale for single female households was set to 1, the equivalence scales of many household types were almost unity, which demonstrates large economies of scale by an increase in the number of household members. Furthermore, subjective poverty rates were less than relative ones for households with many members, although the opposite result was obtained for single-person households. Results of analysis for respective regions showed that household types such as couples with children and three-generation households had subjective equivalence scales that were significantly higher than unity, which is assigned for single female households, in Southern Kanto including metropolitan areas. This result might be attributable to the higher costs of dwellings and childcare affecting subjective poverty thresholds. Moreover, in Southern Kanto and Kinki, relative poverty rates with poverty lines that vary from region to region were close to the subjective poverty rates more than those based on a nationwide single threshold were, revealing that the former relative poverty rates reflect residents' ideas of poverty better.

Chapter 6 is a summary of the preceding chapters, stating several policy implications, highlighting several social necessities: (i) publish poverty rates calculated with a fixed poverty line, with asset-based poverty rates as well as relative poverty rates, (ii) prolong the period of employment insurance receipt to reduce poverty risks that people must confront because of a lack of assets, and (iii) tackle poverty persistence by raising the take-up rate of public assistance.

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Chapter 1

Background and Outlines of This Dissertation

Poverty in Japan is attracting much attention in recent years, particularly because of higher poverty rates and the low take-up rate of the public assistance. Before 2009, the Japanese government published no official poverty rate data, although results of many studies intimated that Japan's poverty issue was becoming severe (Förster and Mira d'Ercole 2005; Oshio and Urakawa 2008). In 2009, the Ministry of Health, Labour and Welfare (MHLW) announced the 2009 official poverty rate based on results of the Comprehensive Surveys of Living Conditions (CSLC) for that year, and subsequently published poverty rates derived from the most recent survey for every three years. Moreover, poverty rates dating back to 1985 became openly available in 2011. According to the results of the CSLC, poverty rates in Japan were 12.0% in 1985, exhibiting fluctuations at a little more than 15% during the 2000s. The 2012 poverty rate was 16.1%, which is the fourth highest value among the OECD countries, indicating the relative international severity of Japan's poverty circumstances.

Second, some studies revealed a low take-up rate of the public assistance, which is around 20%, despite the importance of the system for poverty exit (Komamura 2003; Tachibanaki and Urakawa 2006; Tomuro 2016). Furthermore, the MHLW estimates the take-up rate as approximately 30% using the 2007 CSLC data (MHLW 2010). This fact indicates that half or more of poor people entitled to benefit receipt of the public assistance do not receive benefits and remain in poverty. Failure of support for poor persons might result in deterioration of poverty and avoidance of health care consultation, which makes movement out of poverty more difficult (Kaneko 2017).

Based on the background presented above, many authors have calculated poverty rates or have conducted multivariate analyses (Komamura 2003; Tachibanaki and Urakawa 2006; Oshio and Urakawa 2008; Oshio 2010; Tanabe and Suzuki 2018). Tachibanaki and Urakawa (2006), using data from the Survey on the Redistribution of Income provided by the MHLW, examined factors that make income lower than the levels necessary for the receipt of public assistance. Evidence shows that single-person households, fatherless households, and households with heads who are employed under a single-year contract or who are unemployed are associated with income below public assistance criteria.

Oshio and Urakawa (2008) and Oshio (2010) measured the transition of poverty rates by age group using CSLC data for 1998, 2001, 2004, and 2007.[1] Moreover, similar calculations were applied with the poverty line constant at the 1997 level.[2] Results demonstrate that poverty rates have fluctuated at a certain level for the entire sample and each age group. In addition, the group in which household heads are older than 60 had

[1] Oshio and Urakawa (2008) use 2006 data instead of 2007 data.
[2] Because the observed income is that of the prior survey year, we write 1997 rather than 1998.

poverty rates exceeding 20% in all years. For a fixed poverty threshold, the poverty rates showed a tendency to increase, revealing aggravation of poverty in terms of an absolute perspective.

Tanabe and Suzuki (2018) estimate poverty rates by Japanese prefecture using data from the Housing and Land Survey published by the Statistics Bureau of Japan. Furthermore, nonlinear multiple regression models are applied to study the determinants of respective-prefecture poverty rates. They find that many prefectures in western Japan have high poverty rates and that unemployment rates are most closely related to levels of by-prefecture poverty rates.

Although those earlier studies mainly emphasize examination of income for their analyses, several studies have emphasized the importance of factors aside from monetary scales, such as income, to ascertain poverty more accurately. Abe (2014) uses statistical tests in attempts to construct deprivation measures by the selection of items needed for indices using data from the National Survey on Social Security and People's Life for 2012 administered by the National Institute of Population and Social Security Research. Whereas deprivation measures describe how items required for the minimum living standard are deprived, their values depend on the selected items. Abe chooses seven items: lack of affordability of food or clothes for daily living, and lack of payment of various fees for electricity, gas service, rent, mortgage, and other expenses. He also assesses the statistical validity of each item. Results demonstrate that lack of payment of a mortgage is invalid as a deprivation index component.

Ishii and Urakawa (2014) implement poverty analyses in terms of both income and housework time using data from the Japan Household Panel Survey for 2011–2013 provided by the Panel Data Research Center at Keio University. Specifically, they define the situation in which people spend less time on housework than the minimum required as *time poverty* and examine the relation between income and time poverty. Evidence illustrates that dual-earner households with a child younger than 6 years old and single-parent households are more likely to fall into time poverty. Moreover, assuming that time-poor people can compensate part of the time shortage by housework externalization, income poverty rates can be expected to increase by 2.4 percentage points.

This dissertation focuses on issues that the literature using monetary scales has not adequately addressed. The first is the determinants of poverty rate variation during the 2000s, which are tackled in Chapter 2. Changes in the poverty rates that the MHLW publishes have been slight since 2000. Despite mean income reduction, income inequality increase, and increase in elderly households in this period, the poverty rates show little change, probably because of a poverty line decrease, which makes a criterion by which people are regarded as poor more severe, resulting in restriction of a poverty rate increase. To confirm this expectation, Chapter 2 in this dissertation decomposes the poverty rate change during the 2000s into mean income change, income inequality change, each-household-type share change, and poverty line change, and estimates the respective effects on the poverty rate change by household type. Poverty rates do not satisfy many desirable characteristics such as the monotonicity axiom and the transfer axiom (Sen

1976). Therefore, the decomposition method is also applied to the squared poverty gap ratio (Foster et al. 1984) to compare results for poverty rates.

The second is the anti-poverty effect of liquid assets such as savings, which is addressed specifically in Chapter 3. Even if people become poor, they might yet escape poverty by reducing (liquid) assets. Consequently, poverty rates measured from the sum of income and assets can be expected to be lower than income-based poverty rates. Furthermore, because poverty prevention by assets is important for non-poor people, it is necessary to examine whether they possess sufficient assets, or not. Chapter 3 describes conduct of poverty analyses using income and liquid assets. Specifically, we calculate not only income-based poverty rates, but also income-plus-asset poverty rates to elucidate the degree to which poverty rates decrease. Moreover, to confirm how many people cannot compensate lack of income induced by poverty entries, asset poverty rates are measured for people who are not income poor. In addition, logistic models are estimated for the three-type poverty to clarify the probabilistic effects of variables such as household type and education.

The third is a relation between poverty persistence and exit, which is specifically explained in Chapter 4. As described above, the low take-up rate of the public assistance engenders failure in benefit receipt of many poor people despite their entitlement. In such cases, can they leave poverty by themselves within a short period? To answer this question, Chapter 4 studies poverty exits and entries using methods of survival analysis. First, using life tables (Tutz and Schmid 2016, pp. 15–20), we study variations of exit and entry rates as poverty or non-poverty durations lengthen. Second, a discrete-time hazard rate approach is applied to examine factors affecting exit and entry rates.

The fourth is equivalence scales for poverty analysis, which is examined in Chapter 5. The equivalized disposable income used to calculate poverty rates is usually measured by dividing the disposable income by the square root of the number of household members. In this case, magnitude of equivalence scales is determined solely by the number of household members, although household compositions and regions in which people reside are not considered. Chapter 5 presents calculation of subjective poverty lines and equivalence scales by household type and region. To do so, we compute subjective poverty lines based on answers to the following question: “In your opinion, what is the very lowest annual disposable income that your household would need to make ends meet?,” followed by derivation of subjective equivalence scales with the poverty lines obtained. Poverty rates derived from the subjective thresholds, which reflect the respondents’ ideas of poverty, are compared with relative poverty rates to ascertain how much they reflect the respondents’ ideas of poverty.

Finally, Chapter 6 presents a summary of Chapters 2 through 5, and states policy implications derived from results of the preceding chapters.

Chapter 2

Poverty Variation in Japan during the 2000s: Decomposition Analysis of Poverty Measure Changes

2.1 Introduction

Poverty in Japan has recently attracted much attention. Förster and Mira d'Ercole (2005) reported that Japan's poverty rate is high among the OECD countries. Oshio and Urakawa (2008) demonstrated that Japan's poverty rate has been increasing from the second half of the 1990s to the mid-2000s. In 2009, The Ministry of Health, Labour and Welfare (MHLW) published an official poverty rate for the first time, based on Comprehensive Surveys of Living Conditions (CSLC). In 2011, poverty rates since 1985 were announced, as calculated using results obtained from earlier surveys showing that the poverty rate was 12.0% in 1985, but it increased to 16.1% during 1985–2012, thereby indicating the importance of ascertaining the determinants of this increase.

Change in the poverty rate was slight throughout the decade of the 2000s: The rates were 15.3% in 2000, 14.9% in 2003, 15.7% in 2006, and 16.0% in 2009 (MHLW 2014). Overall income reduction in society lowered the poverty line (50% median equivalent income). Certainly, the criteria by which one is regarded as poor increased in severity. The poverty line was 1.37 million yen in 2000, but it decreased to 1.25 million yen in 2009.

If the poverty line were fixed at the 2000 level (1.37 million yen), then poverty rates in 2003, 2006, and 2009 would be expected to show an increase because more people became poor. This fact is overlooked if one measures relative poverty rates alone. Therefore, some studies calculate poverty rates based on a fixed poverty line (Förster and Mira d'Ercole 2005; Oshio and Urakawa 2008; Oshio 2010).

Poverty measures change mainly because of four elements. The first is income reduction of low-income people. As studies by Oshio and Urakawa (2008) and Oshio (2010) emphasize, the mean incomes of different household types declined during the 2000s. Possibly, this has led to income reduction of low-income people and an increased poverty rate. The second is increased income inequality, which might engender an increase in the poverty rate because of the increased number of low-income people and because of their income reduction, even if mean income were to have remained unchanged. The third is change in the shares of individuals belonging to each household type. For example, increase in the share of individuals belonging to elderly households might affect the increase in the poverty rate because elderly people are more likely to become poor in Japan. In fact, the relation between the increased share of elderly people and increased inequality has been described in the literature comprised of reports of studies investigating income inequality (Ohtake and Saito 1999; Kojima 2002; Oshio 2004; Shirahase and Takeuchi 2009). Therefore, one must consider share changes when assessing changes in the poverty rate. Finally, the fourth is a change in the poverty line. Change in income distribution might engender changes in the poverty threshold and in the poverty rate as calculated based on that threshold.

The determinants of poverty rate change are mixed. Therefore, one must understand the strength of the effects of respective components as exactly as possible. In this study, we decompose change in poverty measures into effects of mean income change, income inequality change, share change, and poverty line change. These components are calculated using the CSLC dataset for households of several types to ascertain their effects on poverty measure changes.

Japanese studies decomposing poverty measures include those by Abe (2006) and Oshio (2010).[1] Abe (2006), who uses the Survey of the Redistribution of Income for 1984–2002, decomposes the poverty rate measured by equivalent income into the poverty rate at the level of market income, the poverty-reducing effect of taxes and transfers, and the population share. Then that study analyzes how much the poverty rate, as measured by equivalent income, would change if one component were to vary. Results of analyses demonstrate that a change in the poverty rate by age group has a stronger effect on the overall poverty rate change than that of population aging.

Using the CSLC for 1997–2006, Oshio (2010) decomposes change in the poverty rate into a population share effect, a poverty line shift effect, and other effects, which are a change in the poverty rate if one sets the poverty line as constant at the 1997 level. Results elucidate that the population share effect and other effects are associated with an increase in the poverty rate, although a downward shift of the poverty line, i.e., a negative poverty line shift effect, offsets this increase. Consequently, the poverty rate change is slight.

In these analyses, two points differ from earlier studies. First, we decompose the poverty rate change using the new dataset during the 2000s (2001, 2004, 2007 and 2010). Second, the decomposition technique developed by Son (2003) is extended to measure four effects: mean income change, income inequality change, population share change, and poverty line change. The method described in this chapter enables us to undertake more detailed analysis by disaggregating the other effects in Oshio's analysis into effects of mean income change and inequality change, although he defined the other effects as an unexplained component of the poverty rate change.

The chapter is organized as follows. Section 2.2 describes a dataset and household types. Section 2.3 discusses our methodology of decomposing poverty measures. Section 2.4 presents the results and salient interpretations. Section 2.5 explains our conclusions.

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[1] Tachibanaki and Urakawa (2006) examined effects of several income components on poverty rates and showed that public pensions and health services in elderly households contributed to poverty rate reductions.

2.2 Data

This chapter uses the CSLC dataset provided by MHLW for 2001, 2004, 2007, and 2010.[2] The data are available on an individual basis, but it is noteworthy that we can grasp household total income in addition to detailed components of taxes, social security premiums, and social benefits.

We use equalized disposable income for these analyses. To begin with, we define household disposable income[3] as presented below.

Household disposable income = Total income − Taxes
−Social insurance premiums,
Total income = Employee's income + Business income
+Agricultural and livestock business income
+Industrial homework income + Property income
+Public and onkyu pensions + Employment insurance
+Child allowance + Other social security benefits
+Remittance + Corporate and personal pensions
+Other incomes,
Taxes = Income tax + Municipal tax + Fixed asset tax,
Social insurance premiums = Health insurance premium
+Pension premium
+Nursing insurance premium
+Others (employment insurance premium, and so on),

Therein, in-kind social security income is not included in total income. For this study, we divide the household disposable income by the root of the number of household members to obtain the equalized disposable income, which is assigned to each household member, and to analyze income poverty on an individual basis. Income is adjusted by the consumer price index (2000 = 100) of the Statistical Bureau of Japan.

The poverty line is defined as 50% median equalized disposable income. A difficulty arises from the use of minimum living expenses in the public assistance system as the poverty line. It becomes impossible to ascertain additional payments, other than those for persons older than 70, for single-mother households and for people rearing school-age children, or cash payments such as occupational, maternity, and funeral assistance.

[2] Data we use are given by MHLW based on Article 36 of the Statistics Act and are obtained from large-scale surveys implemented every three years. Resampling rates, which are the ratio of the number of records before anonymization to those after, were 24.5% in 2001, 22.8% in 2004, 22.5% in 2007, and 22.9% in 2010. Sample sizes differ from data published in "Summary Report of Comprehensive Survey of Living Conditions" by MHLW. For details of the dataset used in this chapter, see the following web page, "anonymized data specifications and precautions for use (Data A and Data B is common)", http://www.mhlw.go.jp/toukei/itaku/dl/chui_h22.pdf.

[3] This definition is based on a 2010 income questionnaire. Although no information exists for 'employment insurance' or 'child allowance' in a 2001 questionnaire, these are included in 'other social security benefits.'

Furthermore, one cannot ascertain the locations of households. To protect privacy, the CSLC data provide no information related to areas or regions of households. Therefore, we use a 50% median equivalent income instead of minimum living expenses.[4]

Households for which taxes and social security premiums are unknown, or households that have equalized disposable income of less than zero were dropped from the sample to maintain data reliability. Moreover, people who were alone away from family were included in single-person households, which can affect interpretations of results related to single-person households, but they were also excluded from the sample because of the small sample size. Through these procedures, the sample size decreased from 21,301 to 19,071 in 2001, from 16,070 to 11,861 in 2004, from 14,293 to 11,420 in 2007, and from 15,901 to 11,093 in 2010.

For this study, we classified the data into 13 household types: 'single male person younger than 65 (*sinmale.u65*)', 'single female person younger than 65 (*sinfemale.u65*)', 'only couple (*onlycouple*)', 'couple with children, of which the youngest child was younger than 6 (*children.u6*)', 'couple with children (youngest child aged 6–19) (*children6–19*)', 'couple with children (youngest child aged 20 and older) (*children20+*)', 'single mother (*sinmother*)', 'male elderly single person (*sinmale65+*),' 'female elderly single person (*sinfemale65+*)', 'two or more elderly members (*elderly2+*)', 'three generations (*3gens*)', 'others with a head younger than 65 (*others.u65*)', and 'others with a head aged 65 and older (*others65+*)'.[5] Single-person households with a head younger than 65 and with one aged 65 and older wer classified by sex to elucidate differences in risks of poverty. Couples with children were disaggregated into three types to elucidate the relation between the educational stages of children (preschool, primary, and secondary education, and afterward) and poverty risks. Other household groups mainly included households composed of one parent and children aged 20 and older. The scope of *children* of three types and *elderly2+* was limited. *Children* comprised households only with a couple and their unmarried children. Households with other members were classified as *others.u65* or *others65+*. *Elderly2+* included only households with elderly member. Households with non-elderly people were classified as *others.u65* or *others65+*.

Finally, we state three noteworthy points related to the data. First, some observations were dropped or changed to avoid identifying individuals. Observations were dropped if the number of household members was greater than or equal to eight, a household was a single-father household, a household had two or more members requiring long-term care, a household had a couple whose difference in an age group was large, a household had parents and children who had a large or small difference in age, or a household had

[4] Yamada (2014) calculated poverty rates with both the relative poverty line and minimum living expenses to study how much poor people overlap for the two criteria. Results demonstrated that 50–90% of low-income people overlapped, depending on the settings of minimum living expenses.

[5] The following people were dropped from the survey: (i) those who are absent from a household, which include business bachelors, migrant workers, extended business trips (for more than about 3 months), students overseas, people living in a social welfare institution, long-term inpatients (whose resident registrations are transferred to the hospital), boarded-out foster children, prisoners, and persons living apart from their households; and (ii) households and household members who have moved in or out after the date of the survey on the household questionnaire, and one-person households living in a dormitory or a boarding house.

four or more members belonging to the same age group. Some of the total income, taxes, and social security premiums were changed if they exceeded upper limits. If so, the observations were replaced with the values of the upper limits.[6] Second, the dataset, as described above, did not include information related to weights, regions in which households exist, or detailed information related to taxes and transfers. Third, observed incomes were those of the previous survey year. For example, the survey in 2001 examined income amounts reported for 2000. Therefore, we used numbers from 2000, 2003, 2006, and 2009 rather than those from 2001, 2004, 2007, and 2010 when presenting results of our analyses.

2.3 Decomposition Methodology

As described in Section 2.1, the determinants of change in poverty measures include change in mean income, change in income inequality, change in the poverty line, and change in the share of household members belonging to respective household types. Measuring these effects requires decomposition of the change in poverty measures. Datt and Ravallion (1992) decompose this into three components: change in poverty measures attributable to change in mean income (growth component), change in poverty measures resulting from change in the Lorenz curve (redistribution component), and a residual. Kakwani (2000) reports a method to decompose change in poverty measures into growth and redistribution components that generate no residual. Son (2003) provides a technique that decomposes poverty measure changes into growth and redistribution components for population subgroups, in addition to the effects of population share changes.[7]

This study specifically examines the share change effect and the growth and redistribution components, making use of the Son's decomposition methodology. However, that methodology decomposes poverty measure changes with the poverty line fixed. Therefore, the point of time at which the poverty line was fixed is arbitrary. To address this problem, his technique is applied to decompose poverty measure changes when the poverty line changes.

Before proceeding, we introduce the FGT measure, as proposed by Foster et al. (1984). This measure can be written as the weighted average of each-subgroup FGT measure. It is a suitable measure for decomposition (Zheng 1997). When there are q poor people in a society of n people, the FGT measure is defined as

$$(1)\quad P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{z-y_i}{z}\right)^\alpha,$$

[6] The upper limits of 'total income' are 11 million yen for single-person households, and 22 million yen for two-or-more-person households, whereas those of 'taxes and transfers' are 2.5 million yen for single-person households, and 4.9 million yen for two-or-more-person households.

[7] Son (2003) also presents an equation that decomposes the growth component into the overall growth effect and into effects that incorporate differences in growth rates between subgroups.

where z represents the poverty line and y_i stands for individual i's income. In addition, the α parameter represents the degree of income shortfall from the poverty line. If $\alpha = 0$, then P_0 becomes the poverty rate. If $\alpha = 1$, then P_1 becomes the poverty gap ratio, which is a measure reflecting the income shortfall from the poverty line. If $\alpha = 2$, then P_2 becomes the squared poverty gap ratio, which is a measure by which the greater the poverty gap becomes, the more severely it is assessed.

This study uses not only the poverty rate P_0 ($\alpha = 0$) but also the squared poverty gap ratio P_2 ($\alpha = 2$) to capture exact poverty situations. The poverty rate is interpreted easily. However, as Sen (1976) has described, it does not satisfy the monotonicity axiom. In other words, the poverty rate is problematic: it does not change even if poor people become poorer. However, the squared poverty gap ratio P_2, is calculated considering the shortfall from the poverty line. Moreover, P_2 satisfies many axioms that poverty measures should satisfy, e.g., the transfer axiom[8] (Zheng 1997; Tachibanaki and Urakawa 2006). Poverty gap ratio P_1 also incorporates the shortfall from the poverty line, but it does not satisfy some axioms including the transfer axiom. Therefore, we did not use P_1.

The FGT measure is calculable using information related to the poverty line z, mean income μ, and Lorenz curve $L(p;\pi)$ (Datt 1998). Therefore, it can be written as

(2) $$P(z, \mu, L(p;\pi)),$$

where p represents the cumulative share of individuals whose incomes are arranged in non-decreasing order, L signifies the cumulative share of the incomes corresponding to p, and π is a three-dimensional vector of parameters. Equation (2) enables us to interpret change in μ as the change in mean income, and change in $L(p;\pi)$ as the change in inequality. The FGT measure based on equation (2) is calculated as

(3) $$P_0 = -\frac{1}{2m}\left[n + r(\hat{b} + 2z/\mu)[(\hat{b} + 2z/\mu)^2 - m]^{-1/2}\right],$$

(4) $$P_1 = P_0 - (\mu/z)L(P_0;\hat{\pi}),$$

(5) $$P_2 = 2P_1 - P_0 - \left(\frac{\mu}{z}\right)^2\left[\hat{a}P_0 + \hat{b}L(P_0;\hat{\pi}) - \frac{r}{16}\ln\left(\frac{1 - P_0/s_1}{1 - P_0/s_2}\right)\right],$$

where

$$e = -(\hat{a} + \hat{b} + 1 + \hat{d}),\ m = \hat{b}^2 - 4\hat{a},\ n = 2\hat{b}e - 4\hat{d},$$
$$r = (n^2 - 4me^2)^{1/2},\ \ s_1 = (r - n)/2m,\ s_2 = -(r + n)/2m.$$

[8] The transfer axiom is one by which, other things being equal, income transfers from the poorer to the richer among poor persons must increase a poverty measure.

Therein, $\hat{a}$, $\hat{b}$, and $\hat{d}$ are the elements of the estimated vector of parameters, $\hat{\pi}$.[9] Because calculation of the FGT measure based on equation (2) requires estimation of π, it differs slightly from the measure based on equation (1), which uses y_i.

Hereinafter, we discuss the methodology that decomposes poverty measure changes for 2000–2009. First, the effect of mean income change is an FGT measure change when only the mean income changes. The poverty line and Lorenz curve are kept constant. However, two ways of fixing the poverty line and the Lorenz curve exist: fixing them at the 2000 level or at the 2009 level. If they become fixed at the 2000 level, then the change in the FGT measure is $P(z_{00}, \mu_{09,k}, L_{00,k}(p;\hat{\pi})) - P(z_{00}, \mu_{00,k}, L_{00,k}(p;\hat{\pi}))$; if they become fixed at the 2009 level, then it is $P(z_{09}, \mu_{09,k}, L_{09,k}(p;\hat{\pi})) - P(z_{09}, \mu_{00,k}, L_{09,k}(p;\hat{\pi}))$ ('00' and '09' respectively denote 2000 and 2009), where μ_{tk} is the mean income of household k at time t. In addition, $L_{tk}(p;\hat{\pi})$ is the Lorenz curve of household k at time t. The poverty line and the Lorenz curve can also be kept constant separately. Therefore, one can be fixed at the 2000 level and the other at the 2009 level. Four ways of fixing them exist. To overcome this difficulty, we calculate the average of the four FGT measure changes.[10] In doing so, the effect of mean income change in household k $(= 1, 2, \ldots, 13)$ can be written as shown below.

$$(6)\quad \begin{aligned}(\Delta P_k)_{Inc} = \frac{1}{4}[&P(z_{00}, \mu_{09,k}, L_{00,k}(p;\hat{\pi})) - P(z_{00}, \mu_{00,k}, L_{00,k}(p;\hat{\pi})) \\ &+P(z_{00}, \mu_{09,k}, L_{09,k}(p;\hat{\pi})) - P(z_{00}, \mu_{00,k}, L_{09,k}(p;\hat{\pi})) \\ &+P(z_{09}, \mu_{09,k}, L_{00,k}(p;\hat{\pi})) - P(z_{09}, \mu_{00,k}, L_{00,k}(p;\hat{\pi})) \\ &+P(z_{09}, \mu_{09,k}, L_{09,k}(p;\hat{\pi})) - P(z_{09}, \mu_{00,k}, L_{09,k}(p;\hat{\pi}))].\end{aligned}$$

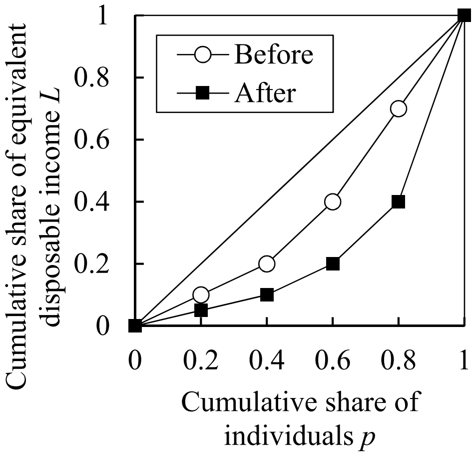
The effect of inequality change can be ascertained as the FGT measure changes when only the Lorenz curve $L_{tk}(p;\hat{\pi})$, changes. The poverty line and mean income remain unchanged. In the same way as the effect of mean income changes, four ways exist to keep the poverty line and the Lorenz curve constant. Actually, FGT measure changes are calculable in four ways. It is useful to calculate the four FGT measure changes and to obtain their average. Therefore, the effect of inequality change is defined as

$$(7)\quad \begin{aligned}(\Delta P_k)_{Ineq} = \frac{1}{4}[&P(z_{00}, \mu_{00,k}, L_{09,k}(p;\hat{\pi})) - P(z_{00}, \mu_{00,k}, L_{00,k}(p;\hat{\pi})) \\ &+P(z_{00}, \mu_{09,k}, L_{09,k}(p;\hat{\pi})) - P(z_{00}, \mu_{09,k}, L_{00,k}(p;\hat{\pi})) \\ &+P(z_{09}, \mu_{00,k}, L_{09,k}(p;\hat{\pi})) - P(z_{09}, \mu_{00,k}, L_{00,k}(p;\hat{\pi})) \\ &+P(z_{09}, \mu_{09,k}, L_{09,k}(p;\hat{\pi})) - P(z_{09}, \mu_{09,k}, L_{00,k}(p;\hat{\pi}))].\end{aligned}$$

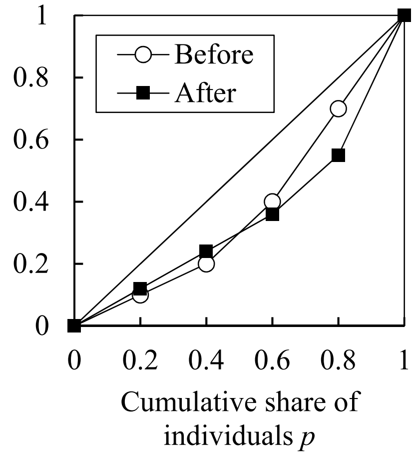
---

[9] The parameter vector of a Lorenz curve, π, is estimated as follows. We begin with a quadratic curve, $ap^2 + bpL + cL^2 + dp + eL + f = 0$. Because Lorenz curves must pass through $(p, L) = (0, 0), (1, 1)$, we derive $f = 0$ and $e = -(a + b + c + d)$. Assuming $c = 1$, we obtain $e = -(a + b + 1 + d)$. Substituting e to the quadratic curve and arranging it, we obtain $L(1 - L) = a(p^2 - L) + bL(p - 1) + d(p - L)$. Applying OLS without an intercept to this equation provides estimates of parameters $\hat{a}$, $\hat{b}$, and $\hat{d}$ (see Villaseñor and Arnold (1989) for details).

[10] Kakwani (2000) and Son (2003) use the same method as that used for this chapter.



(a) Increased inequality throughout society



(b) Increased income share of poor people

Figure 2.1 Examples of changes in Lorenz curves

The change in the Lorenz curve, $L_{tk}(p;\hat{\pi})$, affects the level of the FGT measure through changes in $\hat{b} \in \hat{\pi}$ and m, n, r for poverty rate P_0, although the level of the squared poverty gap ratio P_2 is subject to $\hat{a}, \hat{b} \in \hat{\pi}, r, s_1, s_2, P_0, P_1$ along with $L(P_0;\hat{\pi})$, which is a percentage of the net equivalent income that poor people have to the total income in the whole society. Equation (5) shows that if $L(P_0;\hat{\pi})$ increases (decreases), then P_2 decreases (increases). For instance, presuming that the P_0 increased from 0.2 (20%) to 0.3 (30%), then an increase in inequality, as shown in Figure 2.1(a), increases P_0 and reduces $L(P_0;\hat{\pi})$. This result must cause P_2 to increase. By contrast, in Figure 2.1(b), inequality increases throughout society, but it decreases at the bottom of the population. In this case, if P_0 increases, then $L(P_0;\hat{\pi})$ might also increase, which can engender decreased P_2. Therefore, inequality among poor people is reduced: their lives improve. However, this improvement is accompanied by an increase in P_0. Therefore, the number of poor people increased. Because such a situation might arise, one must bear in mind that the inequality change effect $(\Delta P_k)_{Ineq}$ can have an opposite sign for P_0 and P_2.

Finally, the poverty line change effect is changed in the FGT measure when the mean income and Lorenz curve remain constant, and when the poverty line alone changes. For this effect, we fix the mean income and the Lorenz curve period simultaneously, as shown for equation (10) later, which is necessary for decomposition. The mean income and the Lorenz curve can be kept constant at the two points of time. Therefore, the poverty line change effect is defined as

$$(8)\quad (\Delta P_k)_{Line} = \frac{1}{2}[P(z_{09}, \mu_{00,k}, L_{00,k}(p;\hat{\pi})) - P(z_{00}, \mu_{00,k}, L_{00,k}(p;\hat{\pi})) + P(z_{09}, \mu_{09,k}, L_{09,k}(p;\hat{\pi})) - P(z_{00}, \mu_{09,k}, L_{09,k}(p;\hat{\pi}))].$$

Son (2003) presents the decomposition of the FGT measure[11] as

$$(9)\quad \Delta P \fallingdotseq \sum_{k=1}^{13} \bar{f}_k \, \Delta P_k + \sum_{k=1}^{13} \bar{P}_k \, \Delta f_k,$$

where Δf_k denotes the share change of household type k $(= 1, 2, \ldots, 13)$, $\bar{f}_k = (f_{2001,k} + f_{2010,k})/2$, and $\bar{P}_k = (P_{2000,k} + P_{2009,k})/2$. In addition, because

$$(10)\quad \Delta P_k = (\Delta P_k)_{Inc} + (\Delta P_k)_{Ineq} + (\Delta P_k)_{Line},$$

equation (9) can be rewritten as

$$(11)\quad \Delta P \fallingdotseq \sum_{k=1}^{13} \bar{f}_k \, (\Delta P_k)_{Inc} + \sum_{k=1}^{13} \bar{f}_k \, (\Delta P_k)_{Ineq} + \sum_{k=1}^{13} \bar{f}_k \, (\Delta P_k)_{Line} + \sum_{k=1}^{13} \bar{P}_k \, \Delta f_k.$$

In (11), the first term includes the mean income change effect $(\Delta P_k)_{Inc}$. Similarly, the second one includes the inequality change effect. The third incorporates the poverty line change effect. The fourth has the change effect. Therefore, in the following, we designate the first to fourth terms respectively as the income effect,[12] inequality effect, poverty line effect, and share effect.

2.4 Results

Table 2.1 presents each-household-type mean incomes (calculated using the net equivalent income) and their changes during 2000–2009. The values in the table clarify that the overall mean income is reduced by about 180 thousand yen for 2000–2009. For respective household types, the mean income of *children20+* decreases by about 480 thousand yen, *others65+* by about 400 thousand yen, and *sinfemale.u65* by about 290 thousand yen.

Table 2.2 shows the shares of household members belonging in each household type and their changes. From the table, the share of *elderly2+* is shown to increase by 4.2 percentage points, whereas those of *3gens* and *children6–19* remarkably decrease respectively by 7.6 and 3.1 percentage points.

Table 2.3 shows each-household-type poverty rate P_0, squared poverty gap ratios, P_2, and their changes. The table shows that P_0 and P_2 decrease for many household types.

[11] Son provides (9) given a fixed poverty line, while the equation holds even if the poverty line changes. Additionally, in his study, both sides of the equation are combined with the equality sign. This is valid if P_t and P_{tk} in both sides of (9) are calculated with (1), whereas this chapter estimates Lorenz curves using the method provided by Villasenor and Arnold (1989), and employs (2) to calculate the poverty measures. In this case, because calculations of each P_t and P_{tk} require estimations of π, the values obtained differ slightly from those from (1); for that reason, the equality sign of (9) does not hold. Therefore, we use the sign for approximate equality for (9), which is also the case for (11) derived using (9) and (10).

[12] 'Income effect' used in this chapter is not related to the term 'substitution effect'.

Table 2.1 Mean income by household type
(equivalent disposable income, ten thousand yen)

	2000	2003	2006	2009	Change (2000–2009)
Sinmale.u65	275.8	295.1	269.2	257.9	−18.0
Sinfemale.u65	228.3	215.7	201.2	199.5	−28.8
Onlycouple	358.1	352.2	336.6	338.1	−20.0
Children.u6	236.2	260.6	255.7	254.2	18.0
Children6–19	323.6	320.9	312.7	329.1	5.6
Children20+	384.0	369.9	346.9	335.7	−48.4
Sinmothers	124.2	126.5	121.7	157.4	33.2
Sinmale65+	215.7	208.7	209.6	218.2	2.5
Sinfemale65+	158.5	149.2	165.7	156.3	−2.2
Elderly2+	257.7	236.9	234.6	241.8	−15.9
3gens	329.6	309.8	314.0	330.0	0.5
Others.u65	302.5	300.4	306.2	280.9	−21.6
Others65+	295.1	273.2	261.0	254.7	−40.4
All	311.2	298.5	292.3	293.4	−17.8

Source: Author calculations using the CSLC.

Table 2.2 Member share by household type

	2001 (%)	2004 (%)	2007 (%)	2010 (%)	Change (2001–2010) (Percentage point)
Sinmale.u65	2.0	2.0	2.5	2.4	0.4
Sinfemale.u65	1.7	1.6	1.8	1.9	0.2
Onlycouple	9.4	10.9	10.7	11.5	2.1
Children.u6	10.7	13.7	11.2	10.6	−0.1
Children6–19	17.2	17.2	14.6	14.1	−3.1
Children20+	14.4	12.6	14.5	15.0	0.6
Sinmothers	1.0	1.3	1.6	1.1	0.1
Sinmale65+	0.6	0.8	1.0	1.4	0.8
Sinfemale65+	2.6	3.3	3.2	3.2	0.6
Elderly2+	6.3	8.8	9.0	10.5	4.2
3gens	23.2	16.8	18.2	15.6	−7.6
Others.u65	7.3	7.3	6.8	7.4	0.1
Others65+	3.4	3.7	5.0	5.3	1.9

Notes: Shares are those of interviewed years of the CSLC, 2001, 2004, 2007, and 2010.
Source: Author calculations using the CSLC.

Regarding P_0, *sinmother*, *sinmale65+* and *elderly2+* have values that decrease respectively by 26.5 percentage points, 6.1 percentage points, and 6.2 percentage points.[13] For

[13] Yamada and Shikata (2016) calculate poverty rates of elderly households of several types based on the National Survey of Family Income and Expenditure provided by the Ministry of Internal Affairs and

Table 2.3 FGT measures by household type

	Poverty rate, P_0			Squared poverty gap ratio, P_2		
	2000	2009	Change	2000	2009	Change
Sinmale.u65	23.92	30.41	6.49	4.11	5.63	1.52
Sinfemale.u65	34.50	34.32	−0.18	5.94	5.71	−0.23
Onlycouple	14.39	12.81	−1.59	1.88	1.85	−0.04
Children.u6	16.82	14.35	−2.47	2.22	2.13	−0.09
Children6–19	8.44	9.61	1.16	1.00	1.07	0.07
Children20+	9.79	10.02	0.23	1.12	0.99	−0.12
Sinmothers	68.65	42.14	−26.51	17.76	8.26	−9.50
Sinmale65+	34.08	27.94	−6.14	7.35	3.81	−3.54
Sinfemale65+	51.03	48.92	−2.11	11.30	8.99	−2.31
Elderly2+	20.05	13.86	−6.19	2.81	1.64	−1.17
3gens	12.05	10.75	−1.30	2.48	1.25	−1.23
Others.u65	19.93	22.20	2.27	3.75	3.51	−0.24
Others65+	23.93	23.45	−0.48	3.75	3.94	0.19
All	15.86	15.82	−0.04	2.48	2.18	−0.30

Notes: The poverty line was ¥1,382,000 in 2000 and ¥1,278,000 in 2009. The poverty rate is shown as a percentage.

Source: Author's calculations using the CSLC.

P_2, *sinmother*, *sinmale65+*, and *sinfemale65+* have values, which decrease respectively by 9.5, 3.5, and 2.3. However, *sinmale.u65* has experienced an increase in P_0 of 6.5 percentage points, and in P_2 of 1.5. These increases are the highest among all the household types. Finally, the overall change in the poverty rate is −0.04, which is quite small. The overall change in the squared poverty gap ratio is −0.30.

Next, results of decomposition of the poverty measure changes for 2000–2009 into income effects, inequality effects, poverty line effects, and share effects are presented in Table 2.4. The lower left 'Total' in the table shows how much the four effects infiuence the overall changes. The reason that $\Delta P_0 = -0.04$ and $\Delta P_2 = -0.30$ in Table 2.3, and $\Delta P_0 = -0.003$ and $\Delta P_2 = -0.36$ in Table 2.4 are not the same is that ΔP_0 and ΔP_2 in Table 2.3 are calculated from the left side of equation (11); those in Table 2.4 are calculated from the right side. As described in footnote 11, if using equation (2) for calculations of the poverty measures, then the equality of equation (11) does not hold because of the estimation of π. The values in Tables 2.3 and 2.4 are calculated using equation (2). Therefore, ΔP_0 and ΔP_2 in the two tables will have slightly different values.

We first confirm results for P_0. The lowest row headed 'Total' shows that the income and share effects are significant and positive values of 0.87 and 1.10 at 1%. These effects are associated with a 2 percentage point increase in the poverty rate for 2000–2009. Poverty line effects, however, exhibit a large negative value of −2.20. This negative

Communications. Comparing their results with those we derived, poverty rates in the former are less than in the latter. Cabinet Office et al. (2015) attribute this to sampling scheme differences.

value offsets the increase in the poverty rate caused by income and share effects (and inequality effects), and engenders little change in the poverty rate.[14]

Next, each-household-type has four effects. Income effects for *children20+* are the largest value of 0.40. *Others65+* has the second largest value of 0.23. *Others65+* includes households with members composed only of a single parent and children aged 20 and older. Their proportion reaches 30–40%. In other words, household types living together with children who have reached adulthood show especially large income effects.

Inequality effects are significant and positive for *sinmale.u65*, *children.u6*, *children6–19*, and *others.u65*. Increasing inequality is apparent for these household types, which causes the poverty rate to increase. By contrast, the value of *elderly2+* is significant and negative. Those of many other household types are not significant, which provides a non-significant total inequality effect of 0.23.

The total share effect exceeds the total income effect. For each household type, *elderly2+* has a value of 0.72: the highest value. *Others65+* has a value of 0.46; the values of *sinmale65+* and *sinfemale65+* are, respectively, 0.25 and 0.31. These values are high relative to the remaining household types. These results demonstrate the effects of share increases in elderly households on the increase in overall poverty level.

Poverty line effects are significant and negative at 1% for all household types. Household types that have high absolute values on the effects are *children* of three types (−0.28, −0.24, and −0.23), *elderly2+* (−0.25), and *3gens* (−0.31). This result suggests the existence of numerous low-income people near the poverty line. In fact, the diminished number of poor people by the poverty line reduction[15] increases as the absolute values of the poverty line effects increase (their correlation coefficient is 0.93).

Which household type affects the overall poverty rate change, ΔP_0? The sixth column headed 'Total' shows each-household-type total effects on ΔP_0. Household types for which total effects are significant and positive are *sinmale.u65*, *sinmale65+*, and *others65+*. *Sinmale.u65* has significant inequality and share effects that affect the sum of the four effects. In addition, *sinmale65+* has a significant share effect. *Others65+* has significant income and share effects.

Next, we ascertain the results of the squared poverty gap ratio P_2. The total change ΔP_2 $(= -0.36)$ is significant at 5%, unlike the poverty rate, because the total inequality effect of P_2 is significant and negative. However, the signs and significance of the income, poverty line, and share effects are the same as those shown for the results of P_0.

The total inequality effect $(= -0.28)$ is significant and negative because several household types exhibit effects that differ from those of the poverty rate P_0. In P_0, because *sinmale.u65*, *children.u6*, *children6–19*, and *others.u65* exerted significant and positive effects, they canceled the significant and negative effect of *elderly2+*, and made the total inequality effect non-significant. However, for P_2, no household type had a

[14] For poverty rates, the sum of income, inequality, and share effects was significantly positive at the 1% level.

[15] The declined number of poor persons because of the poverty line change is 51, 26, and 36 in *children* of three types, 44 in *elderly2+*, and 71 in *3gens*.

Table 2.4 Decomposition of FGT measure

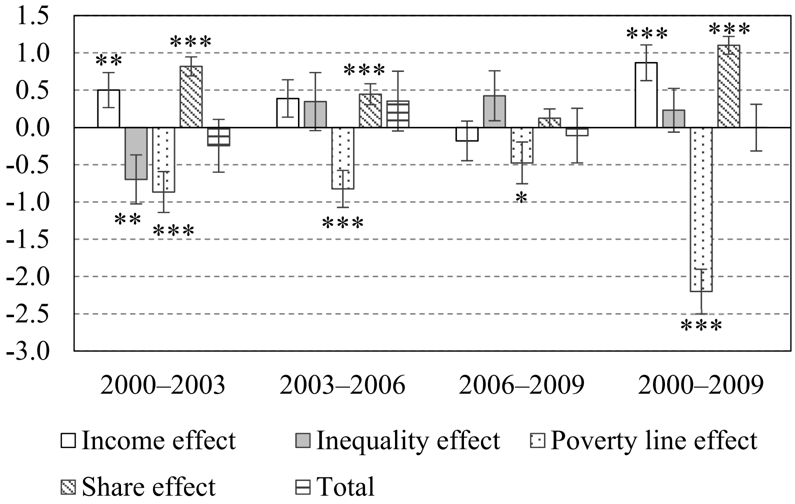
	Poverty rate P_0					Squared poverty gap ratio P_2				
	Income effect	Inequality effect	Poverty line effect	Share effect	Total	Income effect	Inequality effect	Poverty line effect	Share effect	Total
Sinmale.u65	0.06	0.15***	−0.06***	0.11**	0.25***	0.02	0.04	−0.02***	0.02**	0.05*
	(0.05)	(0.05)	(0.01)	(0.05)	(0.08)	(0.01)	(0.03)	(0.003)	(0.01)	(0.03)
Sinfemale.u65	0.13**	−0.06	−0.08***	0.07	0.07	0.03**	−0.02	−0.02***	0.01	0.01
	(0.06)	(0.05)	(0.01)	(0.06)	(0.09)	(0.02)	(0.02)	(0.003)	(0.01)	(0.03)
Onlycouple	0.15**	−0.11	−0.20***	0.28***	0.11	0.03**	0.01	−0.04***	0.04***	0.03
	(0.06)	(0.09)	(0.03)	(0.05)	(0.12)	(0.01)	(0.04)	(0.01)	(0.01)	(0.05)
Children.u6	−0.26***	0.27***	−0.28***	−0.03	−0.29**	−0.04***	0.08*	−0.04***	−0.004	−0.01
	(0.06)	(0.09)	(0.04)	(0.06)	(0.12)	(0.01)	(0.04)	(0.01)	(0.01)	(0.05)
Children6–19	−0.05	0.47***	−0.24***	−0.28***	−0.10	−0.01	0.06	−0.04***	−0.03***	−0.02
	(0.05)	(0.10)	(0.03)	(0.04)	(0.12)	(0.01)	(0.04)	(0.01)	(0.01)	(0.04)
Children20+	0.40***	−0.13	−0.23***	0.06	0.09	0.07***	−0.05	−0.04***	0.01	−0.01
	(0.06)	(0.09)	(0.03)	(0.04)	(0.12)	(0.01)	(0.04)	(0.01)	(0.01)	(0.04)
Sinmothers	−0.18***	−0.05	−0.06***	0.01	−0.26***	−0.05***	−0.03*	−0.02***	0.003	−0.10***
	(0.06)	(0.03)	(0.01)	(0.07)	(0.09)	(0.02)	(0.02)	(0.003)	(0.02)	(0.03)

Table 2.4 (*Continued*)

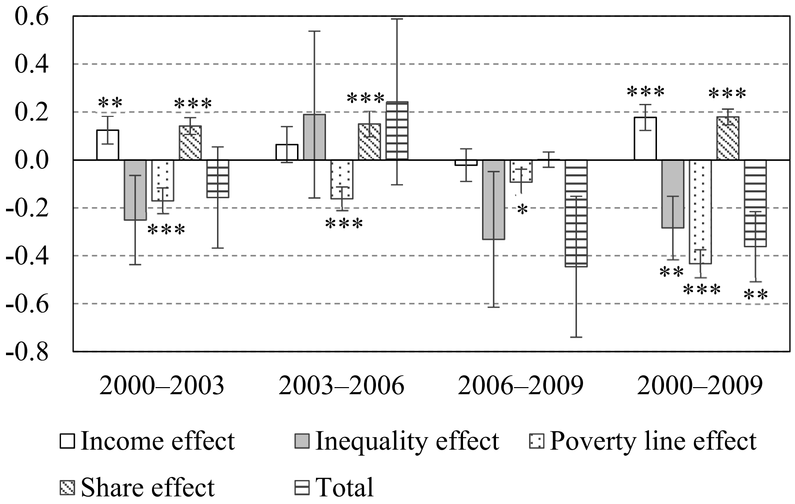
	Poverty rate P_0					Squared poverty gap ratio P_2				
	Income effect	Inequality effect	Poverty line effect	Share effect	Total	Income effect	Inequality effect	Poverty line effect	Share effect	Total
Sinmale65+	−0.01	−0.02	−0.04***	0.25***	0.18***	−0.001	−0.03	−0.01***	0.04***	0.01
	(0.05)	(0.05)	(0.01)	(0.04)	(0.06)	(0.01)	(0.02)	(0.001)	(0.01)	(0.02)
Sinfemale65+	0.03	0.06	−0.15***	0.31***	0.25*	0.01	−0.03	−0.04***	0.06***	−0.004
	(0.10)	(0.07)	(0.02)	(0.10)	(0.14)	(0.03)	(0.03)	(0.01)	(0.02)	(0.04)
Elderly2+	0.21**	−0.48***	−0.25***	0.72***	0.20*	0.03**	−0.09***	−0.04***	0.09***	−0.004
	(0.09)	(0.12)	(0.04)	(0.06)	(0.11)	(0.01)	(0.04)	(0.01)	(0.01)	(0.04)
3gens	−0.01	0.07	−0.31***	−0.87***	−1.13***	−0.001	−0.18***	−0.06***	−0.14***	−0.38***
	(0.06)	(0.11)	(0.04)	(0.06)	(0.14)	(0.01)	(0.06)	(0.01)	(0.02)	(0.06)
Others.u65	0.17**	0.18**	−0.18***	0.02	0.19	0.04**	−0.02	−0.05***	0.003	−0.02
	(0.07)	(0.08)	(0.03)	(0.06)	(0.13)	(0.02)	(0.04)	(0.01)	(0.01)	(0.05)
Others65+	0.23***	−0.13*	−0.13***	0.46***	0.43***	0.06***	−0.02	−0.03***	0.07***	0.08**
	(0.06)	(0.07)	(0.02)	(0.06)	(0.11)	(0.02)	(0.03)	(0.004)	(0.01)	(0.03)
Total	0.87***	0.23	−2.20***	1.10***	−0.003	0.18***	−0.28**	−0.43***	0.18***	−0.36**
	(0.24)	(0.29)	(0.30)	(0.12)	(0.31)	(0.05)	(0.13)	(0.06)	(0.03)	(0.15)

Notes: The poverty line was ¥1,382,000 in 2000 and ¥1,278,000 in 2009. Poverty rate values are percentage points. Standard errors calculated using bootstrap methods (1,000 replications) (Wooldridge 2010, pp. 438–442) are provided in parentheses. Concrete procedures for bootstrap methods are as follows: (i) Construct a new sample by selecting with replacement individuals for whom the number is the same as the sample size each year; (ii) calculate each effect using the new sample; (iii) repeat processes of (i) and (ii), and obtain 1,000 estimates of each effect; (iv) compute unbiased standard deviations using 1,000 estimates. These obtained standard errors enable us to calculate t statistics and to test the null hypothesis. ***, **, and * respectively denote estimates that were found to be significant at 1%, 5%, and 10%.

Source: Author calculations using the CSLC.



(a) Poverty rate, P_0



(b) Squared poverty gap ratio, P_2

Notes: Error bars show standard errors calculated using bootstrap methods (1,000 replications) (Wooldridge 2010, pp. 438–442). Details are presented in notes in Table 2.4. ***, **, and * respectively denote estimates that are significant at 1%, 5%, and 10%.

Source: Author calculations using the CSLC.

Figure 2.2 FGT measure decomposition results for time periods

significant and positive inequality effect (alternatively, significance was found only at 10%). As a result, the significant and negative effects of *elderly2+* and *3gens* were not offset.

Actually, *3gens* had a non-significant inequality effect on poverty rate P_0, but had significant and negative effects at 1% in the squared poverty gap ratio P_2. As described in section 2.3, this might be true because an inequality change effect $(\Delta P_k)_{Ineq}$ is affected by a change in an income share among poor persons: $L(P_0; \hat{\pi})$. In other words, we can infer that inequality among the poor reduced in this household type, which led to the decrease in P_2.

Household types that affect ΔP_2 $(= -0.36)$ differ from the case of P_0. For P_0, the total effects of *sinmale.u65*, *sinmale65+*, and *others65+* were significant and positive at 1%. In contrast, for P_2, *others65+* alone had a significant and positive effect. The effects of the other two groups were non-significant or significant at 10%.

Using the dataset for 2004 and 2007, we also conducted decomposition for 2000–2003, 2003–2006, and 2006–2009. Figures 2.2(a) (P_0) and 2.2(b) (P_2) show that all poverty line effects are significant and negative at 1%, except for 2006–2009. Income effects are significant and positive for both P_0 and P_2 in 2000–2003. Share effects are significant and negative for P_0 in 2000–2003. For 2006–2009, poverty line effects are only significant and negative at 10%, but the other effects were non-significant.

Based on the results presented above, we can discuss household types that particularly affected the poverty measure changes for 2000–2009. First, *others65+* had significant and positive total effects for both P_0 and P_2. Therefore, we can infer that this household type had a strong effect on the poverty measure increases during the 2000s. Second, *sinmother* and *3gens* had significant and negative total effects for both P_0 and P_2. The reason that *sinmother* had a significant and negative value is mainly that its poverty rate decreased by approximately 26.5 percentage points during 2000–2009. In the 2000s, the age of eligibility for receiving a child allowance was raised (from 9 to 12 years old in 2006). The allowance amount for persons rearing children younger than three years old was raised (up to ¥10,000 per month for a first and a second child in 2007), this result might be affected by changes in social security institutions.[16]

2.5 Conclusion

For this study, we measured the causes of the poverty measure changes using data from the Comprehensive Surveys of Living Conditions (2001, 2004, 2007, and 2010) conducted by the Ministry of Health, Labour and Welfare of Japan. We estimated the effects of the mean income change, inequality change, the share change, and the poverty line change by application of a method explained by Son (2003) to capture the effects on the poverty measure changes. We also estimated effects for household types. As poverty measures, we used the poverty rate P_0 along with the squared poverty gap ratio P_2, which incorporates shortfalls from the poverty line and which satisfies many desirable characteristics (axioms).

The analyses demonstrated that decreases in mean incomes (income effects) and increases in the shares of elderly households (share effects) affected the poverty rate increase, whereas the poverty line decrease offset these effects, leading to a slight change

[16] The poverty rates calculated from our data and official poverty rates are remarkably different. In Table 2.3, poverty rates of *sinmother* are 68.7% in 2000 and 42.1% in 2009. Conversely, official poverty rates in the CSLS are 58.2% in 2000, and 50.8% in 2009 for ‘one adult’ out of active households with children. (*sinmother* and ‘one adult’ differ in the upper limit of children’s age and whether single-father households are included) (Ministry of Health, Labour and Welfare 2014). Because our dataset does not include information on weights, this chapter calculates the poverty measures without the weights. This outcome is probably associated with the difference in the estimates.

in the poverty rate. By contrast, the change in the squared poverty gap ratio was found to be significant and negative because inequality reduction among poor people produced the significant and negative total inequality effect.

Results for household types were obtained as explained below. First, household types with large income and share effects had some features. For the income effect, mean income decreases in *children20+* and *others65+*, which are households with adult children, infiuenced the poverty measure increases. For the share effect, the share increases of *sinmale65+*, *sinfemale65+*, and *elderly2+* contributed to the increased poverty measure. Second, significant and positive inequality effects for P_0 were found for several household types, but because P_2 is affected by an inequality change among poor people, no such significant effect (or significance at 10%) was found for P_2. Third, *children* of three types, *elderly2+*, and *3gens* showed strong poverty line effects in absolute values. This fact demonstrates the existence of many poor people near the poverty line. Finally, a significant and positive total effect was found for both P_0 and P_2 for *others65+*.

We finally state two challenges that must be confronted in future research. First, the determinants of mean income changes must be analyzed because some household types such as *children20+* and *others65+* were found to have strong income effects. Second, *children.u6* and *sinmother* did not sustain mean income decreases in the 2000s, but showed significant and negative income effects. Future studies must assess the effects on poverty reduction of taxes for households that are rearing children, and of transfers such as a child allowance. We expect to analyze these points in future research after overcoming barriers imposed by a lack of information in the dataset related to the contents of social transfers.

Chapter 3

Poverty Analysis for Japan Using Income and Liquid Assets

3.1 Introduction

Studies of poverty in Japan have used analyses incorporating income (Komamura 2003; Tachibanaki and Urakawa 2006; Oshio and Urakawa 2008; Oshio 2010). In these studies, the authors calculate poverty rates using the equivalized disposable income or income obtained by subtracting taxes, social insurance premiums, and different deductions from household income (Komamura 2003). In addition, the Ministry of Health, Labour and Welfare (MHLW) publishes poverty rates measured by equivalized disposable income (MHLW 2017a).

(Liquid) assets such as savings play an important role in preparing for poverty risk, but they have rarely been considered in the Japanese literature. People already in poverty can sustain above-poverty-line living standards by drawing upon assets. Assets help non-poor persons to decrease the risks of poverty because possession of a certain amount of assets enables one to address increased risks arising, for instance, from unemployment.

This chapter describes implementation of poverty analysis incorporating income and (liquid) assets. To this end, analyses of three types are applied: The first is that we add assets to income and calculate income-plus-asset poverty rates to ascertain how it decreases the income poverty rates. The second is that, for people who are not income-poor, we compute the asset poverty rates. The words *asset poverty* do not indicate a situation in which one has no minimally required assets, but where one has no assets for compensating income shortfalls if one enters income poverty. The third is that we estimate logistic models with longitudinal data (Frees 2004, pp. 329–339) to clarify the probabilistic effects of variables such as household type and education level.

One Japanese study that has examined the relation between assets and poverty is that reported by Yamada et al. (2011).[1] Using data from the National Survey of Family Income and Expenditure administered by the Ministry of Internal Affairs and Communications, they simulate the degree to which the rate of households in need of public assistance would increase if asset holding conditions in the system were relaxed. Results indicate a moderate increase in the percentage of households requiring public assistance if a household head is 30–39 years old.

Studies conducted abroad include those reported by Rendall and Speare (1993), Brandolini et al. (2010), Azpitarte (2012), and Kuypers and Marx (2016). Rendall and Speare (1993) calculate income-plus-asset poverty rates for elderly people using a method described in section 3.2 to convert wealth, which is a stock, into a flow. Evidence

[1] Suzuki (2009) examines the determinants of no-savings and no-asset situations. He reports that unemployment, low income, and youth have effects on the probabilities of no savings and no assets.

shows that, for 75–79 and over 80-year-old persons, adding assets to income substantially reduces poverty rates and that, for unmarried elderly women, income-plus-asset poverty rates are higher than for other groups.

Brandolini et al. (2010) calculate income poverty rates, income-plus-asset poverty rates, and asset poverty rates for Finland, Germany, Italy, and the United States (including Britain, Canada, Sweden, and Norway for several analyses). They find that most countries have asset poverty rates about three times higher than income poverty rates. However, by changing the definition of wealth and using net worth rather than liquid assets to calculate asset poverty rates demonstrates that they are at most twice as high as income poverty rates.

Azpitarte (2012) performs analyses based on a multi-dimensional framework for the United States and Spain. He divides individuals into four groups: a *twice-poor* group in which people are income-poor and asset-poor, a *protected-poor* group in which people are income-poor but not asset-poor, a *vulnerable-non-poor* group in which people are not income-poor but asset-poor, and a group in which people are neither income-poor nor asset-poor. Based on this classification, he estimates the rate for each subgroup. To identify asset-poor people, he uses three thresholds for robustness, the levels of which are 1/2, 1/4, and 1/12 of the income poverty line. Evidence indicates that, irrespective of the threshold, the United States has higher rates of the twice-poor group, the protected-poor group, and the vulnerable-non-poor group.

Kuypers and Marx (2016) also use a multi-dimensional framework for poverty, dividing poor people into a twice-poor group, a protected-poor group, and a vulnerable-non-poor group (although a group in which persons are neither income-poor nor asset-poor is not considered). For Belgium and Germany, they change the wealth definition and the asset poverty line and measure the degree to which these changes cause the rates of the groups to vary. Wealth definitions adopted are (i) net worth including housing wealth and debts, (ii) net worth excluding them, and (iii) only liquid assets. They find that, as the wealth definitions change from (i) to (iii), the percentage of the protected-poor group becomes smaller. For the asset poverty line, they use 12 thresholds, which are the income poverty line divided by 1–12. Results demonstrate that the nearer a threshold is to the income poverty line, the lower the rates of the twice-poor group and the protected-poor group become.

The analyses presented in this chapter differ from those of earlier studies in two respects. First, calculations of asset poverty rates are limited to people who are not income-poor. The purpose of calculating asset poverty rates is to examine a question: if people fall into income poverty because of an economic shock, then can they compensate for an income shortfall by reducing assets? Naturally, we cannot know how much wealth they must have. Consequently, the analyses presented in this chapter use three asset poverty lines (section 3.3) when calculating asset poverty rates. In contrast, for those who are already income-poor, we know the required amount of assets to leave poverty; therefore, calculating income-plus-asset poverty rates is preferred. For that reason, we calculate asset poverty rates only for those who are not income-poor. Second, to estimate the effects of different variables on the probability of becoming poor, we apply a logistic analysis that incorporates unobserved heterogeneity. It has the following advantages. One shortcoming of cross-sectional analysis is that it does not incorporate unobserved heterogeneity and the serial correlation of error terms (including individual-specific effects). We can obtain consistent estimators by eliminating unobserved heterogeneity if we use fixed-effect models. By contrast, random-effect models enable us to derive more accurate standard errors because the models use serial correlation of the error terms (Wooldridge 2013, pp. 492–493). We apply the Hausman test to select either a fixed or a random effects model.

This chapter is organized as described below. Section 3.2 describes a way of adding wealth to income. Section 3.3 explains a dataset and variables. In this section, we discuss the definitions of income, assets, and poverty lines. Section 3.4 presents the results and related interpretations. Section 3.5 explains our conclusions.

3.2 Methods for adding liquid assets to income

To capture the relation between the addition of (liquid) assets to income and a reduction in the poverty rate, we will calculate the income-plus-asset poverty rate. To do this, we must discuss a method for the addition of assets to income. The earlier studies convert wealth, which is a stock, into a flow and add it to income. This section first describes a methodology used in earlier studies. Based on that, we will consider how to add assets to income.

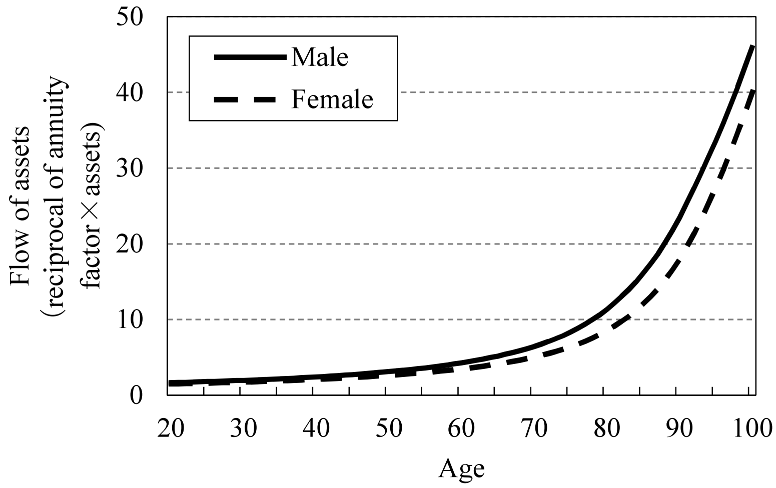
Weisbrod and Hansen (1968) present a method that translates the stock of assets into a flow using the reciprocal number of the annuity factor.[2] It is a number to measure the present value of a constant annuity, which is received for n years. The reciprocal of the annuity factor enables us to calculate an annual pension value. Replacing the present value with the stock of wealth and using the reciprocal of the annuity factor, we can obtain the flow of wealth. Therefore, in Weisbrod and Hansen's description, the sum of income and assets is given as

$$(1) \quad Y_t + \frac{r}{1-(1+r)^{-n}} W_t,$$

where Y_t represents income at time t excluding the property income, W_t denotes wealth at time t, $r/[1-(1+r)^{-n}]$ stands for the reciprocal number of the annuity factor, r signifies the interest rate, and n expresses the number of years within which all assets are used.

Many earlier studies used the method presented above to implement analyses, with different values of n used in these studies. Rendall and Speare (1993) restrict the scope of their analysis to elderly households, setting n at life expectancies. Kuypers and Marx (2016) extend the scope to all households instead of elderly households alone, setting n at life expectancies for all households. However, Brandolini et al. (2010) set n at life

[2] For a derivation of the annuity factor, see Brealey et al. (2017, pp. 28–29).



Notes: The asset stock is one million yen. We used, for *n*, life expectancies from complete life tables in 2015 (MLHW 2017b). Interest rate *r* is 0.00024 (0.024%), which is an average of the mean interest rates of ordinary deposits for 2009–2014 provided by "BOJ Time-Series Data Search" (https://www.stat-search.boj.or.jp, accessed 2017-10-26).
Source: Author calculations.

Figure 3.1 Relation between age and the flow of assets (ten thousand yen)

expectancies for elderly households and at infinity for other households. If $n \to \infty$, then the reciprocal of the annuity factor converges to r, and equation (1) becomes $Y_t + rW_t$. Because rW_t represents the interest income obtained from assets, $Y_t + rW_t$ stands for the income obtained at time t. Consequently, for households other than elderly households, Brandolini et al. regard people as poor based solely on income.

In this chapter, we use two methods to add wealth to income and mutually compare the results. One is, according to Kuypers and Marx (2016), to set n at life expectancies for all observations. The other is to add assets directly to income instead of altering wealth into a flow. The latter corresponds to the case in which $n = 1$ in equation (1). In other words, we allow for the use of all amounts of assets W_t within time t because an asset amount that income-poor persons can withdraw will not be limited. Setting n at life expectancy, it is possible to restrict the withdrawal of assets extremely. This point is shown in Figure 3.1, which provides changes in the flow of assets with age by sex when $n =$ life expectancy. In the figure, the stock of assets is one million yen. As the figure shows, the flow of assets is lower than 50,000 yen until one becomes about 65 years old. For those aged 65 years and older, assets that are useful within a year are less than 100,000 yen before approximately 80 years old. For these reasons, we adopt $n =$ life expectancy and $n = 1$, and mutually compare the results.

3.3 Data and variables

The dataset we use is the Japan Household Panel Survey (JHPS) for 2009–2014 administered by the Keio University Panel Data Research Center. The JHPS is a survey of around 4,000 individuals aged 20 and older, including information related to the respondents, their spouses, and households they live in.

The JHPS includes questions about who is a household head. Based on this question, we restructured the dataset so that its demographic and economic variables would provide information related to a household head. Additionally, we restricted our sample to cases in which the respondents or their spouses are a household head. Observations in which other members are a household head are excluded because that person's educational attainment is unknown. Furthermore, it is noteworthy that, for some subjects, a household head changes from the respondent to the spouse, and vice versa, in the middle of the survey. This is probably true because a household head is defined as the main earner, with it possibly changing by, for example, changed employment status. In those cases, we excluded the subjects from our analyses.

Aside from the operations described above, we also deleted observations that include missing data and single-student households from our sample. As a result, the sample size of the entire dataset became 10,643. The sample size of each year became 2,183 in 2009, 1,995 in 2010, 1,838 in 2011, 1,629 in 2012, 1,553 in 2013, and 1,445 in 2014.

Definitions of income and (liquid) assets are presented below. The income is the equivalized disposable income, which is the household disposable income divided by the square root of the number of household members. However, it does not include an imputed rent for owner-occupied dwellings.[3] For the assets, we use the sum of household savings and securities,[4] which is also divided by the square root of the number of household members.[5] The income and assets are adjusted by the consumer price index (2010=100) of the Statistical Bureau of Japan.

The income is that of the preceding survey year. For example, the survey in 2009 examines an amount of income in 2008. In contrast, the assets are those of the response time. It is noteworthy that part of the income is used for savings and investment in securities, so that part of income plus assets is double-counting, probably resulting in underestimation of income-plus-asset poverty rates.

Poverty lines for income and wealth are defined as follows. An income threshold z is half of the median of the income distribution. For the income-plus-asset poverty, we employ the income poverty line z to investigate how poverty rates decrease when adding

[3] We do not add the imputed rent of owner-occupied dwellings because the difference in estimation methods makes large differences in the imputed rent. Because they are trillions of yen to tens of trillions of yen (Arai 2005), it is expected that non-negligible differences exist in each household's imputed rent.

[4] Securities are shares, bonds, stock investment trusts, open-end bond investment trusts, loan and money trusts, and so on.

[5] Earlier studies use net worth, which subtracts debt from liquid assets, instead of them. The JHPS used in this chapter, however, does not allow us to capture an annual accurate debt. For example, we can ascertain the annual amount repaid for a housing loan, but we only know a monthly amount repaid for the other loans and for a rent. Therefore, we use liquid assets alone for our analysis rather than subtracting a debt.

Table 3.1 Transitions of poverty lines (ten thousand yen)

	2009	2010	2011	2012	2013	2014
Income	124.1	125.0	125.3	125.4	126.1	123.8
Income and assets (n = life expectancy)	124.1	125.0	125.3	125.4	126.1	123.8
Income and assets ($n = 1$)	124.1	125.0	125.3	125.4	126.1	123.8
Assets (poverty line z)	124.1	125.0	125.3	125.4	126.1	123.8
Assets (poverty line $z/2$)	62.1	62.5	62.6	62.7	63.1	61.9
Assets (poverty line $z/4$)	31.0	31.2	31.3	31.3	31.5	31.0

Source: Author's calculations using the JHPS.

assets to income. A noteworthy point in defining an asset poverty line is that because the analysis of the asset poverty focuses only on those who are not in the income poverty, we cannot know in advance how they should have assets for preparation for income poverty. For this reason, we use three thresholds for asset poverty: z, $z/2$ and $z/4$. Under them, one can maintain a z-level living standard for a year, six months, and three months, respectively. Table 3.1 presents the transitions of these poverty lines.

Dependent variables used for the analyses described in this chapter are the dummies that represent whether to be income poor, income-plus-asset poor, or asset poor. There are two dummies for the income-plus-asset poverty because years within which people use all assets, n, have values of life expectancy and unity. Asset poverty has three dummies because we have three poverty thresholds.

Independent variables are those that characterize a household head, household type, region, and the poverty gap. Variables that characterize a household head include the female dummy, age, squared age, education level (secondary school, high school, specialized school or junior college, and university or graduate school), and employment status (regular, non-regular, self-employed, unemployed, non-employed, and other). Regarding the employment status, a difference in "unemployed" and "non-employed" is the following: Unemployed persons are those who did not work at all during the month before the response time, and searched for a job. Non-employed persons are those who did not work at all during the month before the response time mainly because of school attendance, housework duties, or retirement. Those who did not work at all because of absence from work are classified into the category to which they belonged before the absence. The "other" category includes professional workers such as doctors, lawyers and accountants, and those who work independently such as side job workers.

For household types, we use nine dummy variables: (i) single person younger than 65, (ii) single person aged 65 and over, (iii) single parent with children younger than 18, (iv) only couple, (v) only couple (both aged 65 and over), (vi) couple with children under 6, (vii) couple with the youngest child aged 6–17, (viii) couple with the youngest child aged 18 and over, and (ix) others. Couples with children are disaggregated into three types to elucidate the relation between the educational stages of children (preschool, primary and secondary education, and afterward) and poverty risks. "Others" mainly include three-generation households.

Table 3.2 Descriptive statistics (averages every three years)

	Mean 09–11	Mean 12–14	St. dev. 09–11	St. dev. 12–14	Min 09–11	Min 12–14	Max 09–11	Max 12–14
Female	0.11	0.11	0.31	0.31	0	0	1	1
Age	53.78	55.50	14.51	14.14	21.67	24.33	90.67	90.33
Household type								
Single resident younger than 65	0.07	0.06	0.26	0.24	0	0	1	1
Single resident aged 65 and over	0.04	0.04	0.19	0.20	0	0	1	1
Single parent with child younger than 18	0.01	0.01	0.10	0.08	0	0	1	1
Only couple	0.13	0.11	0.34	0.32	0	0	1	1
Only couple (both aged 65 and over)	0.11	0.13	0.31	0.34	0	0	1	1
Couple with child younger than 6	0.11	0.08	0.31	0.28	0	0	1	1
Couple with youngest child aged 6–17	0.17	0.19	0.38	0.40	0	0	1	1
Couple with youngest child aged 18 and over	0.15	0.17	0.36	0.38	0	0	1	1
Others	0.20	0.19	0.40	0.39	0	0	1	1
Education								
Secondary	0.09	0.07	0.28	0.26	0	0	1	1
High	0.43	0.42	0.49	0.49	0	0	1	1
Specialized school or junior college	0.12	0.12	0.32	0.32	0	0	1	1
University or graduate school	0.37	0.39	0.48	0.49	0	0	1	1
Employment status								
Regular	0.52	0.51	0.50	0.50	0	0	1	1
Non-regular	0.12	0.13	0.33	0.34	0	0	1	1
Self-employed	0.14	0.13	0.35	0.34	0	0	1	1
Unemployed	0.02	0.02	0.13	0.13	0	0	1	1
Non-employed	0.18	0.19	0.38	0.39	0	0	1	1
Others	0.02	0.02	0.13	0.13	0	0	1	1
Poverty gap	0.34	0.33	0.26	0.28	0	0.01	0.95	1

Notes: "Mean09–11" in the first row shows that we calculate 2009, 2010, and 2011 means and average them. The other headlines have similar meanings. Descriptive statistics for the poverty gap are calculated only for those who are income-poor.

Source: Author's calculations using the JHPS.

For regions, we generated dummy variables based on each region and on the size of cities in which the respondents reside. Regions are classified as Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Shikoku, and Kyushu. The sizes of cities are of three categories: government-designated cities, other cities, and towns and villages.

Finally, the poverty gap, which is the difference in the poverty line and the equivalized disposable income divided by the threshold, is added to the list of explanatory variables in estimating models for the income-plus-asset poverty. This addition enables estimation of the effect of each covariate, controlling for income poverty severity. Descriptive statistics for the variables described above are presented in Table 3.2.

3.4 Results

3.4.1 Results of respective poverty rates

Table 3.3 presents income poverty rates, income-plus-asset poverty rates, and asset poverty rates by household head characteristic and household type. In the table, empty cells for some groups have a sample size less than 50 in each year. For example, the age group "20–29" has a sample smaller than 50 for 2012–2014. Therefore, its (average) poverty rate for this period is not shown. Finally, for cells that are not empty, the sample size in each year is 50 or larger.

We first confirm results for the income poverty rates. Regarding sex, the female group has a higher poverty rate by around 20 percentage points than that of the male group. Regarding age groups, "20–29", "30–39", and "65 and over" have high poverty rates. Regarding household types, "single aged 65 and over" has a remarkably high poverty rate of around 32 percent. Regarding education level, "secondary" has the highest poverty rate; that of "university or graduate school" is the lowest. For employment status, "regular" has a small value of about 5 percent, but "non-regular" has a value higher than 20 percent.

When adding assets to income and measuring the income-plus-asset poverty rates, then the income poverty rates shows larger decreases if setting years within which all of assets are used, n, at unity. From now, Figure 3.2 rather than Table 3.3 can be viewed to compare differences in poverty rate reductions. Figure 3.2 presents histograms showing how much the poverty rates decrease by adding wealth. In case n is life expectancy, 80 percent of the total number of groups experience reductions under 4 percentage points. In case n is unity, many groups experience reductions of 4–6 percentage points. Figure 3.2(c) shows that the three classes of 2–8 percentage points account for 80 percent of the total number of groups. Conversely, Figure 3.2(d) shows that, because the proportion of 4–8 percentage points is smaller than in Figure 3.2(c), around 60 percent is occupied by the three classes of 2–8 percentage points.

Regarding Table 3.3 again, we can discuss groups for which poverty rate reductions are large. "Female", "65 and over", "single person aged 65 and over", "secondary", and

Table 3.3 Each-group poverty rate every three years (%)

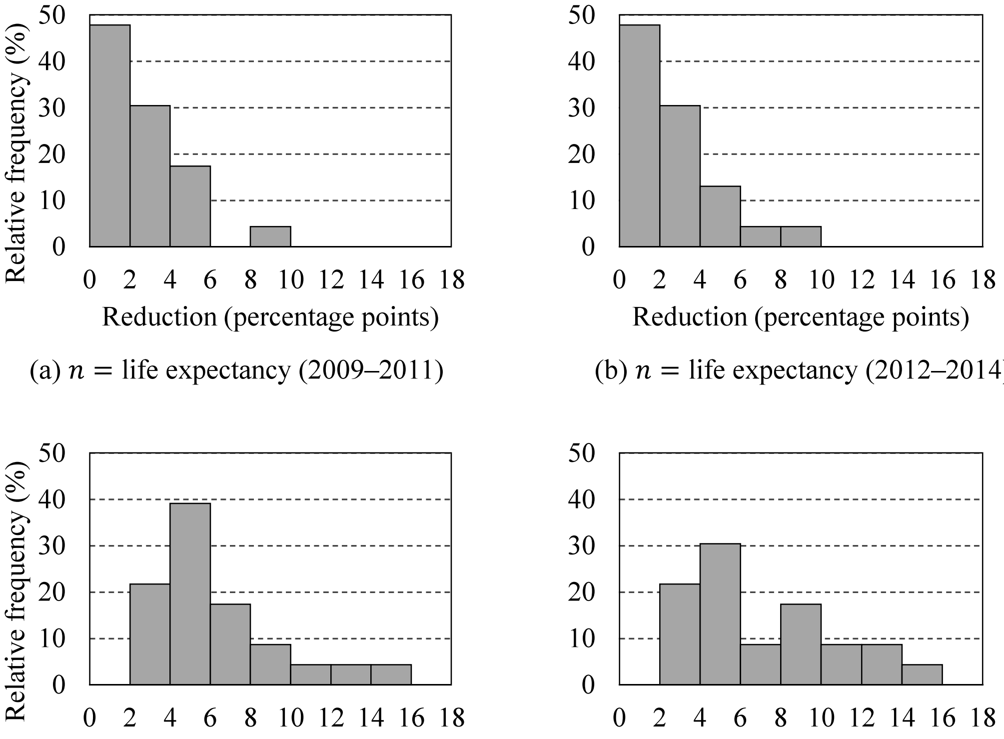
	Income		Income and assets				Assets					
			n = life expectancy		$n = 1$		z		$z/2$		$z/4$	
	09–11 mean	12–14 mean	09–11 mean	12–14 mean	09–11 mean	12–14 mean	09–11 mean	12–14 mean	09–11 mean	12–14 mean	09–11 mean	12–14 mean
Sex												
Male	8.31	8.44	6.65	6.69	3.82	3.14	37.09	35.27	28.49	26.87	22.30	21.05
Female	27.63	27.50	22.90	22.00	15.90	15.11	36.15	32.71	30.27	25.37	27.26	23.39
Age												
20–29	10.04	—	9.49	—	5.63	—	70.62	—	56.36	—	42.78	—
30–39	11.91	10.54	11.82	10.40	6.18	5.63	58.81	58.69	43.98	43.49	33.08	32.92
40–49	7.46	7.85	7.06	7.76	4.58	4.55	46.96	49.38	36.47	36.90	26.55	28.34
50–64	8.65	8.56	6.98	6.96	4.35	3.74	30.43	30.4	23.72	22.98	20.53	19.82
65 and over	14.04	14.28	9.00	9.28	5.69	4.57	18.14	17.23	14.38	14.53	12.60	11.74
Household type												
Single resident younger than 65	11.10	14.32	10.14	12.31	5.60	8.27	50.22	46.49	39.84	36.77	35.26	31.30
Single resident aged 65 and over	32.38	31.92	22.83	22.92	16.56	16.97	23.47	25.72	20.74	21.34	20.74	19.14
Single parent with child younger than 18	—	—	—	—	—	—	—	—	—	—	—	—
Only couple	6.01	8.20	4.23	6.86	2.08	3.85	26.76	28.32	18.50	19.58	16.48	15.94
Only couple (both aged 65 and over)	8.23	6.92	4.60	3.05	1.92	1.13	15.76	10.80	12.62	9.40	11.63	7.50
Couple with child younger than 6	10.82	8.32	10.68	7.92	5.49	4.36	58.41	52.17	45.38	38.62	30.98	26.51
Couple with youngest child aged 6–17	6.29	6.03	6.11	6.03	3.79	3.23	49.98	50.36	38.80	38.70	28.31	30.01
Couple with youngest child aged 18 and over	8.00	7.39	5.41	5.39	3.01	1.75	29.30	31.84	21.50	25.19	17.38	20.32
Others	13.42	14.95	10.98	11.92	7.83	5.46	35.21	33.76	28.50	25.00	23.36	20.99

Table 3.3 (*continued*)

	Income		Income and assets				Assets					
			n = life expectancy		$n = 1$		z		$z/2$		$z/4$	
	09–11 mean	12–14 mean	09–11 mean	12–14 mean	09–11 mean	12–14 mean	09–11 mean	12–14 mean	09–11 mean	12–14 mean	09–11 mean	12–14 mean
Education												
Secondary	26.05	24.58	20.8	20.23	13.68	12.02	42.71	42.44	36.93	38.20	33.43	33.36
High	11.67	11.73	9.49	8.91	6.35	5.13	42.11	40.08	33.74	31.68	27.68	25.77
Specialized school or junior college	12.31	14.64	9.78	12.77	5.09	6.49	43.98	44.29	35.33	32.98	27.19	25.14
University or graduate school	4.41	5.09	3.60	3.98	1.54	1.52	28.43	26.31	19.66	18.34	14.05	13.81
Employment status												
Regular	4.94	4.53	4.62	4.37	2.11	2.09	42.87	42.52	32.18	31.16	24.57	24.32
Non-regular	20.42	20.23	17.31	17.57	13.23	12.13	38.76	32.79	31.85	26.71	27.67	21.79
Self-employed	14.60	15.62	12.26	12.74	7.06	5.61	38.75	39.71	32.01	34.10	25.43	28.44
Unemployed	—	—	—	—	—	—	—	—	—	—	—	—
Non-employed	14.69	13.78	8.72	7.42	5.76	3.25	16.48	13.22	13.17	10.66	11.62	8.42
Others	—	—	—	—	—	—	—	—	—	—	—	—
All	10.37	10.46	8.38	8.31	5.10	4.41	37.01	35.06	28.65	26.75	22.73	21.26

Notes: The sample is restricted to those who are not income-poor when we calculate the asset poverty rate. For groups whose sample size is under 50, their poverty rates disappear.

Source: Author's calculations using the JHPS.



(a) n = life expectancy (2009–2011)

(b) n = life expectancy (2012–2014)

(c) $n = 1$ (2009–2011)

(d) $n = 1$ (2012–2014)

Notes: "2009–2011" denotes that in Table 3.3 we subtract the 2009–2011 averages of income-plus-asset poverty rates from the 2009–2011 averages of income poverty rates. "2012–2014" has a similar meaning.

Source: Author's calculations using the JHPS.

Figure 3.2 Histograms for poverty rate reduction by adding assets

"non-employed" experience large poverty rate decreases.[6] Specifically, they exceed 4 percentage points when n is life expectancy, and 8 percentage points when n is unity. For "female" and "secondary", it is likely that sufficient room exists for the reduction of poverty rates. For "65 and over", "single person aged 65 and over", and "non-employed", many of household heads have brief life expectancy, resulting in a large flow of assets and resulting in greater reductions if n = life expectancy.

Next, we ascertain results of asset poverty rates that are measured for those who are not income-poor. Regardless of the definitions of the poverty lines, numerous groups show high poverty rates. In detail, the proportion of groups whose poverty rates exceed 20 percent is about 90 percent if a poverty line is z, about 80 percent if $z/2$, and about 70 percent if $z/4$. Therefore, when becoming poor because of shocks such as economic

[6] For "others" of household types, "specialized school or junior college", "non-regular", and "self-employed", poverty rate reductions exceed 8 percentage points when $n = 1$ and 2012–2014. This causes the relative frequency of 8–10 percentage points in Figure 3.2(d) to be higher than that of Figure 3.2(c).

crises, many people will be unable to exit from poverty even if reducing assets. By contrast, the poverty rates of “65 and over”, “only couple (both aged 65 and over)”, and “non-employed” are lower than 20 percent, not depending on thresholds.

3.4.2 Results of logistic analysis

Table 3.4 presents results of the logistic analysis. Estimates shown in the table are coefficient estimates, not odds ratios, because we include variables that are not dummy covariates, i.e., age, age squared, and the poverty gap. For analyses of income poverty and asset poverty $(z/2)$, fixed-effect models are chosen. Consequently, the female and schooling dummies, which are constant over time, are excluded from the models. Fixed-effect models eliminate subjects whose values of the dependent variables are constant over time, leading to small sample sizes. Finally, analyses of asset poverty ($z/2$ and $z/4$) do not include the region dummies because inclusion of those variables rendered estimations of fixed-effect models impossible (as log-likelihood functions did not converge) and prohibited the implementation of the Hausman test. This is possibly true because of incorrect identification of models, so that we exclude the region dummies when estimating the models.

We first confirm the results of income poverty. For household types, “couple with children under 6” has a coefficient that is significant and positive if “only couple” is a reference group. However, “only couple (both aged 65 and over)” has a coefficient that is significant and negative. For employment status, the coefficients of “non-regular” and “unemployed” are significant and positive, implying that these groups are likely to enter income poverty relative to “regular”, which is a reference group.

Columns 3 and 4 in Table 3.4 present results of income-plus-asset poverty. Variables that are statistically significant for income poverty analysis are also significant for analysis of the income-plus-asset poverty, and have larger estimates. Coefficients of “single person aged 65 and over” and “self-employed” are significant and positive in both $n =$ life expectancy and $n = 1$. Random-effect models are selected for analyses. Therefore, the female dummy variable and the schooling covariates are included in estimations. As might be readily apparent from their coefficients, the female dummy variable is significant and positive at the 1% level and “secondary” and “university or graduate school” have values that are significant at 1%. The coefficients of the poverty gap, which are added to controlling for intensity of the income poverty, are significant and positive. Their magnitude is 42.7 and 12.6. Therefore, severer income poverty results in difficulties of leaving poverty even if reducing assets.

Next, we ascertain three analyses of asset poverty. “Age” has a value that is significant and negative, which implies that older people are less likely to fall into poverty. “Age squared” coefficients are significant and positive in the poverty lines z and $z/2$ and close to zero. Therefore, this result probably does not affect interpretation of the coefficient of “age”. Regarding household types, “single person younger than 65” and “couple with the youngest child aged 6–17” have significant and positive estimates.

Table 3.4 Results of logistic analysis

	Income	Income and assets		Assets		
		n = life expectancy	$n = 1$	z	$z/2$	$z/4$
Constant	—	−11.624***	−8.285***	10.599***	—	3.467**
Female	—	1.296***	1.070***	−0.287	—	0.194
Age	−0.046	0.126	−0.011	−0.281***	−0.279**	−0.150***
Age squared	0.001	−0.002**	−0.0002	0.001**	0.002**	0.0004
Household type (ref. only couple)						
Single resident younger than 65	0.637	−0.053	0.090	0.981***	1.262**	1.280***
Single resident aged 65 and over	0.592	1.871**	1.594**	1.462***	15.901	1.175**
Single parent with child younger than 18	1.408*	2.174*	1.732*	−1.015	0.728	0.288
Only couple (both aged 65 and over)	−0.918**	−3.362***	−1.361**	−0.564	0.060	−0.014
Couple with child younger than 6	0.964**	1.600**	1.157**	0.757***	0.988***	0.305
Couple with youngest child aged 6–17	0.623	0.813	0.561	1.176***	0.949***	0.775***
Couple with youngest child aged 18 and over	0.185	0.223	−0.523	0.735***	0.753**	0.513*
Others	0.610	1.179**	0.615	0.227	0.527	0.370
Education (ref. high)						
Secondary	—	1.885***	1.132***	2.544***	—	2.372***
Specialized school or junior college	—	−0.145	−0.604	−0.969***	—	−1.025***
University or graduate school	—	−1.929***	−1.963***	−2.842***	—	−2.798***

Table 3.4 (*Continued*)

	Income	Income and assets		Assets		
		n = life expectancy	$n = 1$	z	$z/2$	$z/4$
Employment status (ref. regular)						
Non-regular	0.672***	1.738***	2.429***	0.052	−0.261	0.329
Self-employed	0.292	1.460***	1.266***	0.059	−0.382	0.247
Unemployed	1.172***	2.195***	2.544***	0.015	−0.095	0.913*
Non-employed	0.531	0.847	1.357***	−0.526*	−0.385	−0.468
Others	1.349	0.067	−0.053	−0.549	−0.667	−0.459
Poverty gap	—	42.730***	12.590***	—	—	—
Region (ref. Kanto)	Yes	Yes	Yes	Yes	No	No
Size of city (ref. government-designed cities)	Yes	Yes	Yes	Yes	No	No
σ_α	—	2.855***	3.224***	4.532***	—	4.453***
Selected model	FE	RE	RE	RE	FE	RE
Hausman test (Prob > χ^2)	0.000	0.420	0.056	0.992	0.018	0.280
Log likelihood	−805.69	−903.39	−1014.14	−3674.15	−807.81	−3210.73
Sample size	2,278	10,643	10,643	9,534	2,172	9,534

Notes: We use household heads' information for female dummy, age, education, and employment status. The sample is restricted to those who are not income-poor in analyses of the asset poverty. Standard errors are not shown because of a space constraint. ***, **, and * respectively denote estimates significant at 1%, 5%, and 10%.

Source: Author's calculations using the JHPS.

Regarding education levels, in both z and $z/4$, all coefficients are significant at 1%. For employment status, no coefficient is significant at 5% or 1%.

The results of the logistic analyses present the following implications. First, the variables that are significant in the income poverty analysis are also significant in the analysis of the income-plus-asset poverty, and have larger values of the coefficients. Additionally, some covariates are significant only in the latter case. This leads us to conclude that addition of assets to income engenders poverty rate reductions but does not necessarily engender poverty risk decrease relative to the reference groups. Second, in asset poverty analyses, "single aged 65 and over" and "couple with the youngest child aged 6–17" have significant and positive estimates. Therefore, these household types are less likely to compensate income shortfall by reducing assets. Moreover, the possibility holds not only in case they become severely poor by unemployment, but also in case their income does not fall remarkably below the poverty line. Finally, asset poverty analyses have no coefficients that are significant for the employment status. Consequently, regarding asset poverty, whether or not an individual is a regular worker is less associated with the probability of having income below the poverty line.

3.5 Conclusion

This chapter presented an investigation of poverty by examination of income and liquid assets. Using a dataset from the Japan Household Panel Survey (JHPS) for 2009–2014, we measured poverty rates of three types for demographic and socioeconomic subgroups in terms of income, income plus (liquid) assets, and (liquid) assets only. Asset poverty rates were calculated only for non-income poor persons. Logistic regression models were applied to assess the effects on poverty incidence of variables such as household type and education.

Results of calculations of income-plus-asset poverty rates showed decreasing poverty headcounts for the following subgroups: households headed by a woman, an elderly person, a less-educated person, and a non-employee. Measuring only income poverty can lead to overestimation of the poverty rate magnitude. Logistic regression analyses results revealed that addition of wealth to income did not necessarily reduce poverty risks compared with reference groups examined in these analyses.

Asset poverty rates were high for many subgroups, irrespective of the poverty line definition. That result indicates that when people become income poor because of shocks such as economic crises, many might be unable to escape poverty even if they must reduce assets to compensate for low income. The logistic analyses demonstrated that "single person younger than 65" and "couple with the youngest child aged 6–17" had coefficients, all of which were significant and positive. This result shows robustness of a high chance of entering the asset poverty. However, no coefficient for heads' employment status was significant (or significant at the 10% level), indicating that whether or not an individual is a regular worker has no contribution to the probability of asset poverty entries.

Based on the results described above, the government must publish asset-based poverty rates as well as income poverty rates to capture poverty more accurately. Second, high asset poverty rates show that if people become poor by, for example, unemployment, then they are unlikely to escape poverty even if reducing assets. Although employment insurance helps them to address the risks, as Shikata and Komamura (2011) and Sakai (2012) have underscored, a short period of benefits receipt makes it difficult to address long-term unemployment, resulting in a low proportion of benefits received. Consequently, the government must relieve vulnerability that asset-poor people face by prolonging the receipt period.

Finally, we state two challenges that must be confronted in future research. First, years within which all assets are used, n, must be determined objectively. The chapter adopted $n =$ life expectancy and $n = 1$ and compared the results mutually. Proper values of n, however, might be between the two criteria. To conduct a more elaborate analysis, we must define n based on objective criteria. The values might vary from person to person if so. Second, income and wealth must be defined more strictly. Specifically, it is necessary to examine how our conclusions change by (i) adding the imputed rent to income, (ii) subtracting housing debts from liquid assets, and (iii) eliminating the portion in which income plus assets are double-counted.

Chapter 4

Analysis of Poverty Exits and Entries

4.1 Introduction

Recently, several panel surveys, which include the Japan Household Panel Survey and the Japanese Panel Survey of Consumers, have enabled us to conduct widely various analyses of poverty. Earlier studies, such as that by Tachibanaki and Urakawa (2006), have implemented analyses with cross-sectional data. These studies have demonstrated that less-educated people, non-regular workers, and fatherless households are likely to fall into poverty. Nevertheless, few examinations have assessed whether longer poverty spells make movements out of poverty more difficult, or not.

Iwata (1999), Ishii (2010), and Kureishi and Wakabayashi (2017) examined poverty exit, entry, and persistence. Ishii particularly investigated the determinants of movements into and out of poverty using logistic analysis. Kureishi and Wakabayashi studied poverty persistence of households with children through the estimation of logistic models. However, these studies included no consideration of the following two aspects. The first is spell duration in and out of poverty. For example, a lengthy poverty spell might lower the probability of ending poverty. The second is that some individuals experience spells both in and out of poverty. In general, exit from and entry into poverty depend on the numbers of spells in and out of poverty during the sample period. Each event does not simply occur independently. To estimate econometric models allowing for these dependencies, we must include an individual's unobserved heterogeneity.

This chapter is intended to examine poverty exit and entry, with consideration of the aspects presented above. To do so, we conducted two analyses. First, a life table approach (Tutz and Schmid 2016, pp. 15-20) was applied to ascertain how the probabilities of event occurrence changed as spell durations lengthened. Second, we investigated factors affecting the probabilities of poverty exit and entry, which include the order and durations of spells.

To conduct the second analysis, we adopted a discrete-time hazard rate approach as a method of survival analysis. Willett and Singer (1995) revealed that the discrete hazard rate model is equal to a standard logistic model that was estimated straightforwardly. As described earlier, adding unobserved heterogeneity to models is necessary to measure the effects of covariates on exit and entry rates. Consequently, this chapter estimated both the pooled logistic model and a random effects model. Additionally, a left-censoring problem must be addressed. This issue is that correct spell durations are unknown because individuals who have spent a spell in or out of poverty at the beginning of the survey might have already been poor or non-poor before the survey was taken. In the chapter, to address this difficulty, both models that include left-censored spells and the models that drop them were estimated.

This chapter is organized as follows. Section 4.2 outlines earlier studies and confirms the chapter features. In Section 4.3, we explain a dataset and variables. Section 4.4 presents results. Section 4.5 explains our conclusion.

4.1 Earlier studies and features of this chapter

4.1.1 Earlier studies

Iwata (1999) estimated the proportion of women in their twenties and thirties who experienced exit from and entry into poverty using a dataset from the Japanese Panel Survey of Consumers for 1994–1997. In that estimation, she defined a poverty-exit group and a poverty-entry group. The former is a class that ended poverty between 1995 and 1997. Subsequently, those who were poor in 1994 did not fall back into poverty. The latter is a class of those who were not poor in 1994 who nonetheless entered poverty between 1995 and 1997, and thereafter remained poor during the remainder of the sample period. She found that 5.5% of women were classified into the poverty-exit group, and that 4.6% were classified into the poverty-entry group.

Ishii (2010) conducted a logistic analysis of movements into and out of poverty using data from the Keio Household Panel Survey for 2004–2009. In an exit analysis, a dependent variable is a binary variable that takes a value of 1 when an individual is poor in time $t-1$ and is not poor in time t, and 0 otherwise. In an entry analysis, an outcome is a dummy variable that takes a value of 1 when an individual is not poor in time $t-1$ and is poor in time t, and 0 otherwise. Results revealed that, for households headed by a person younger than 60 years old, non-regular workers are more likely to fall into poverty and are less likely to leave poverty than regular workers. In addition, that study revealed that fewer employed members in a household is associated with higher probability of entering poverty.

Kureishi and Wakabayashi (2017) used data from the Longitudinal Survey of Newborns in the 21st Century in 2001, 2004, 2007, 2010, and 2013 to ascertain the determinants of poverty persistence. The persistence of poverty is defined as households that spent below the poverty line at three or more points of time. The analysis is limited to households with children. A logistic model is used. The results demonstrated that fatherless households have a higher chance of persistent poverty than other households have.

In studies conducted abroad, two methods have been applied to exit from and entry into poverty. The first method treats persistent poverty as a condition of an individual's average income over time being below the poverty line. The second method uses a discrete-time hazard rate approach. This strategy specifically examines estimation of the effects of independent variables on movements into and out of poverty, allowing for the inclusion of the order and durations of poverty and non-poverty spells.

Rodgers and Rodgers (1993) adopted the first method. They submitted an additively decomposable index permitting the measurement of chronic poverty and transitory poverty. Using this measure, they showed for 1977–1986 that 36% of the overall poverty level in the United States was attributable to chronic poverty.

For Canada, Germany, Britain, and the United States, Valletta (2006) calculated exit and entry rates[1] and the rate of people falling into chronic poverty. The results demonstrated that exit rates were higher than entry rates by 30–50 percentage points. Valletta also used logistic analysis to examine the determinants of movement into and out of poverty and of chronic poverty, revealing that changes in the number of employed workers in a household had a significant effect on the dynamics and persistence of poverty for all four countries.

Bane and Ellwood (1986) measured the probability of ending poverty (the hazard rate) for a sample of people younger than 65 years old in the United States for 1970–1982. Their results suggest that people spending below the poverty line escaped poverty within a year with probability of 44.5%, whereas those who remained in poverty for seven years had an eight-year exit rate of less than 10%.[2] Additionally, the study examined events leading to transitions, which revealed that changes in household head income account for more than 50% of exits and 38% of entries.

Stevens (1999), Devicienti (2011), and Arranz and Cantó (2012) used discrete hazard rate approaches to assess factors affecting exit from and entry into poverty. These studies assumed that unobserved heterogeneity had a discrete distribution, and estimated a model using a method provided by Heckman and Singer (1984). Devicienti (2011) and Arranz and Cantó (2012) increased the number of values that a discrete distribution can take until a maximum likelihood function is fully optimized. Stevens conducted an analysis with two possible values. Smoothing the distribution step-by-step leads to more elaborate estimates than when one assumes a normal distribution for unobserved heterogeneity.

4.1.2 Features of this chapter

This chapter describes analyses conducted on the basis of a discrete-time hazard rate model according to Stevens (1999), Devicienti (2011), and Arranz and Canto (2012), although we use a model presented by Willett and Singer (1995), which differs from earlier studies' models. Therefore, the assumption that individual-specific effects have a discrete distribution does not hold. Willett and Singer's model, however, is straightforward for estimation. It allows for the inclusion of variables that represent whether second

[1] Exit and entry rates that Valletta calculates are different from hazard rates. He measured the exit and entry rates as the following: for exit rates, (i) calculate the rate of people that ended poverty in time $t+1$, out of those who have been poor in time t, and (ii) repeat the computation in (i) for all combinations of t and $t+1$, and average the results obtained. Entry rates are given in a similar fashion.

[2] Şeker and Dayıoğlu (2015) conducted almost the same analysis as that of Bane and Ellwood (1986) with a Turkish dataset, the Survey on Income and Living Conditions. Results demonstrated that although exit rates are around 50%, the probabilities of falling back into poverty after exit exceed 30%.

or third spells are examined. As described in Section 4.1, the model in this chapter coincides with a pooled logistic model, which is the same as Ishii's (2010) model. Unlike her work, we consider multiple spells and their durations.

4.2 Data and variables

4.2.1 Data

The dataset we use is the Japan Household Panel Survey (JHPS) for 2009–2014 administered by the Keio University Panel Data Research Center. The JHPS is a survey of around 4,000 individuals aged 20 and older, including information related to the respondents, their spouses, and households they live in.

The JHPS includes a question of who is the household head. Based on this question, we restructured the dataset so that its demographic and economic variables would provide information related to a household head. Additionally, we restricted our sample to cases in which the respondent or the spouse is a household head. Observations in which another member is a household head are excluded because that other person's educational attainment is unknown. Furthermore, it is noteworthy that, for some subjects, a household head changes from the respondents to their spouses, and vice versa, in the middle of the survey. This is true, probably because a household head is defined as the main earner, with that status possibly changing by, for example, changed employment status. In those cases, we excluded the subjects from our analysis.

Before our estimation, we must ascertain the time spent in spells in and out of poverty. However, if observations in some years are dropped because of missing values, then it is unclear whether individuals were poor in that year, resulting in unknown spell duration. For this reason, observations including missing values must be eliminated along with observations that appear before or after the dropped observations for the continuity of observed years. Table 4.1 presents processes that are applied when subjects have missing values for four cases. In Case 1, an observation in 2009 is missing. In this case, the exclusion of the 2009 observation is not problematic for the continuity of the observed years. Case 2 includes a missing value in 2010. Dropping this value alone results in disconnection of observed years. In this case, we excluded the 2009 observation as well as the 2010 one. For Case 3, observations in 2013 and 2014 are eliminated. Finally, Case 4 includes missing values in 2009 and 2012 observations. In this case, exclusion of the two observations leaves two sets of two-consecutive-year data. It does not enable us to ascertain which set of observations should be deleted. Therefore, all 221 observations categorized into Case 4, which account for around 2.4% of the sample, were dropped.

In addition to the operations described above, single-person households with a head who is a student were also excluded. As a result of the deletion of observations, the whole sample size became 9,067. The size of our sample when left-censored spells were dropped became 1,135, which is very small because approximately 76.5% of the sample

Table 4.1 Treatment in the case of the split of observed years by missing values

	2009	2010	2011	2012	2013	2014
(a) Before deletion of observations						
Case 1	Missing	✓	✓	✓	✓	✓
Case 2	✓	Missing	✓	✓	✓	✓
Case 3	✓	✓	✓	✓	Missing	✓
Case 4	Missing	✓	✓	Missing	✓	✓
(b) After deletion of observations						
Case 1	✗	✓	✓	✓	✓	✓
Case 2	✗	✗	✓	✓	✓	✓
Case 3	✓	✓	✓	✓	✗	✗
Case 4	✗	✗	✗	✗	✗	✗

Notes: ✓, does not include missing values; Missing, does include missing values; ✗, dropped from the sample.

Source: Author's preparation.

consisted of individuals who had never entered poverty for 2009–2014 and who were excluded as left-censored spells.

The income and the poverty line were defined as follows. Income is an equivalized disposable income, which is the household disposable income divided by the square root of the number of household members. Income is adjusted by the consumer price index (2010=100) of the Statistical Bureau of Japan. The poverty line is half of the median of the income distribution, of which the average is 1.426 million yen. The same threshold is used for the sample that eliminates left-censored spells.

4.2.2 Variables

The dependent variable is a binary one that takes a value of 1 when movements into or out of poverty occur; otherwise it is 0. The model in this chapter does not distinguish exit from and entry into poverty with two dummies, which means that only one outcome variable represents both events.

Independent variables used in this chapter include several dummies (durations, poverty, and second or third spells) and two interaction terms (the poverty dummy and the logarithm of durations, and the second spell dummy and the logarithm of durations[3]). The duration dummies comprise a binary variable that takes a value of 1 when people are in the first year of a spell, a dummy variable that takes a value of 1 when people are in the second year of a spell, and so on. For the sixth year of a spell, we used a more-than-five-year (more-than-four-year) dummy instead of a sixth-year (fifth-year) dummy because no event occurred at the end of the survey. Using these variables enables us to estimate variations of each probability of exit from and entry into poverty when the events persist over many years.

[3] We use no interaction term between the third spell dummy and the logarithm of durations because inclusion of this term leads to complete separation problems (Hosmer et al. 2013, pp. 147–149).

The poverty dummy takes a value of 1 when an individual is poor; otherwise it is 0. This dummy is included to examine the difference in the probabilities of the two events. For example, the positive coefficient of the variable means that poverty exits are more likely to occur than entries.

The second spell dummy is a variable that takes a value of 1 when people spend time in the second poverty or non-poverty spells; otherwise it is 0. Similarly, we use the third spell dummy. These two variables enable us to investigate which event is likely to occur, depending on whether individuals spend the first or since-the-second spells.

We include the interaction term between the poverty dummy and the logarithm of durations in our model because the poverty dummy enables us to ascertain which of exits and entries is more likely to occur, but not to ascertain variations of the difference that depends on spell duration. According to Willett and Singer (1995), the logarithm of durations is used rather than the durations themselves. Similarly, the interaction term between the second spell dummy and the logarithm of durations is used to interpret the coefficient estimate of the second spell dummy, taking account of the spell duration.

In addition to the variables described above, variables that characterize households and a household head are used. For attributes of a household head, we include the female dummy, age group (less than 30, 30–39, 40–49, 50–64, and 65 and over), education level (secondary school, high school, specialized school or junior college, and university or graduate school), and employment status (regular, non-regular, self-employed, unemployed, non-employed, and other). Regarding the employment status, the difference between "unemployed" and "non-employed" is the following: Unemployed persons are those who did not work at all during the month before the response time, and searched for a job. Non-employed persons are those who did not work at all during the month before the response time, mainly because of school attendance, housework duties, or retirement. Those who did not work at all because of absence from work are classified into the category to which they belonged before the absence. The "other" category includes professional workers such as doctors, lawyers and accountants, and those who work independently such as side job workers. Variables that characterize households in which the respondents reside are household types (single person younger than 65, single person aged 65 and over, only couple, couple with one child, couple with two or more children, and others).[4] Other variables, which are increases in the number of children and changes in the number of workers in a household, can affect poverty exit and entry. Therefore, we estimate the model including three dummy variables: increases in children, increases in workers, and decreases in workers. Averages of the independent variables are presented in Table 4.2.

[4] Household types do not include single parent households for the reason described in footnote 3.

Table 4.2 Transitions of variable means

	2009	2010	2011	2012	2013	2014
Duration (years)						
1	1.00	0.20	0.16	0.13	0.11	0.10
2	0	0.80	0.12	0.11	0.09	0.06
3	0	0	0.73	0.09	0.09	0.07
4	0	0	0	0.66	0.09	0.08
5 or more	0	0	0	0	0.62	0.69
Second spell	0	0	0.04	0.08	0.11	0.13
Third spell	0	0	0	0	0.004	0.01
Poverty	0.09	0.12	0.09	0.10	0.10	0.10
Female	0.08	0.07	0.07	0.07	0.07	0.07
Age						
Less than 29	0.04	0.03	0.02	0.01	0.01	0.003
30–39	0.18	0.16	0.15	0.14	0.12	0.10
40–49	0.21	0.22	0.23	0.23	0.24	0.25
50–64	0.33	0.33	0.34	0.34	0.33	0.33
65 and over	0.25	0.26	0.27	0.28	0.30	0.32
Household type						
Single under 65	0.10	0.10	0.09	0.09	0.08	0.07
Single aged 65 and over	0.04	0.04	0.04	0.05	0.05	0.05
Only couple	0.41	0.41	0.43	0.42	0.44	0.47
Couple with one child	0.13	0.12	0.11	0.11	0.11	0.10
Couple with two or more children	0.18	0.19	0.21	0.21	0.20	0.21
Others	0.13	0.13	0.12	0.12	0.11	0.10
Education						
Secondary	0.09	0.08	0.08	0.07	0.07	0.06
High	0.42	0.43	0.42	0.41	0.41	0.40
Specialized school or junior college	0.11	0.11	0.11	0.12	0.12	0.12
University or graduate school	0.38	0.38	0.40	0.40	0.41	0.42
Employment status						
Regular	0.55	0.54	0.54	0.54	0.54	0.53
Non-regular	0.11	0.11	0.12	0.12	0.13	0.13
Self-employed	0.13	0.14	0.14	0.13	0.13	0.13
Unemployed	0.02	0.02	0.02	0.01	0.02	0.02
Non-employed	0.17	0.17	0.17	0.17	0.17	0.18
Others	0.02	0.02	0.02	0.02	0.02	0.02
Change in a household						
Increase in children	0.02	0.03	0.02	0.01	0.02	0
Increase in workers	0.11	0.12	0.11	0.12	0.12	0
Decrease in workers	0.11	0.12	0.10	0.11	0.11	0

Note: Averages of respective years are calculated with the sample including left-censored spells.
Source: Author's calculations using the JHPS.

4.2 Results

4.2.3 Descriptive analysis with life tables

Tables 4.3 and 4.4 show life tables (Tutz and Schmid 2016, pp. 15–20) with particular note of transitions into and out of poverty. The purpose of the life table is to capture the probability changes of both events as their durations lengthen.

Column 1 headed by "interval (year)" shows the poverty or non-poverty duration. Interval [0, 1) in the second row shows the first year of a spell. Similarly, interval [3, 4) signifies a spell persisting for three years. In general, whether individuals have income below the poverty line is determined by the annual income, but the life table analysis assumes that the events occur during the interval. Columns 5–8 show survival functions, hazard rates, and their standard errors. The survival function is the probability of staying a spell beyond each interval. The hazard rate is the probability of ending and entering poverty within each interval.

We first confirm life tables of poverty exits (Table 4.3). Although survival functions decrease as poverty persists, they are also high in later intervals. For cases in which left-censored spells are included, poverty lasts for one or more year at a probability of 50.7%; it reduces to around a half, 25.2%, in interval [2, 3). Thereafter the decrease slows, but the probability of remaining in a poverty spell for five or more years is somewhat high: 18.4%. In case the left-censored spells are dropped, survival functions are lower than those of Table 4.3(a), although poverty persists for four or more years at a probability of 12.2%. Exit rates decrease as the spell duration lengthens, which means that longer durations engender difficulty in escaping poverty. For example, Table 4.3(a) shows that an exit rate within a year is 49.3%, but it declines to 24.7% in interval [2, 3). In Table 4.3(b), although exit rates have a reduction tendency, the magnitude is higher by about 10% points than those of Table 4.3(a).

Next, we ascertain life tables of poverty entries (Table 4.4). Survival functions in Table 4.4(a) demonstrate a probability of 80.2% by which spells out of poverty last for five or more years. From this result, it is apparent that individuals undergo poverty spells at least once between the first and fifth years at a probability of 19.8%. In Table 4.4(b), survival functions are 0.591 (=59.1%) during interval [3, 4), which means that the probability of entering poverty at least once between the first and fourth years is 40.9%. In Table 4.4(a), an entry rate in interval [0, 1) is the highest at 8.0%. It reduces to 2.7% in interval [4, 5). In Table 4.4(b), entry rates in intervals [0, 1) and [1, 2) are 19.6% and 12.5%, respectively, but they are less than 10% from the third year, just as in Table 4.4(a).

4.2.4 Results obtained using a discrete-time hazard rate approach

Table 4.5 presents results of the discrete-time hazard rate approach. As described in Section 4.1, Willett and Singer (1995) revealed that this approach corresponded to a pooled logistic analysis. Furthermore, we estimated models that included left-censored spells and models that excluded them. If left-censored spells are eliminated, the since-the-

Table 4.3 Life tables (exits from poverty)

Interval (years)	No. of spells	No. of exits	No. of right-censored spells	Survival function	Std. err.	Exit rates	Std. err.
(a) Include left-censored spells							
[0, 1)	575	246	152	0.507	0.022	0.493	0.022
[1, 2)	177	53	42	0.335	0.024	0.340	0.038
[2, 3)	82	18	18	0.252	0.025	0.247	0.050
[3, 4)	46	8	11	0.202	0.025	0.198	0.063
[4, 5)	27	2	11	0.184	0.026	0.093	0.063
[5, 6)	14	0	14	0.184	0.026	0.000	0.000
(b) Exclude left-censored spells							
[0, 1)	335	152	96	0.470	0.029	0.530	0.029
[1, 2)	87	31	28	0.271	0.032	0.425	0.058
[2, 3)	28	9	7	0.171	0.033	0.367	0.097
[3, 4)	12	3	3	0.122	0.034	0.286	0.139
[4, 5)	6	0	6	0.122	0.034	0.000	0.000

Source: Author's calculations using the JHPS.

Table 4.4 Life tables (entries into poverty)

Interval (years)	No. of spells	No. of exits	No. of right-censored spells	Survival function	Std. err.	Entry rates	Std. err.
(a) Include left-censored spells							
[0, 1)	2,363	172	442	0.920	0.006	0.080	0.006
[1, 2)	1,749	66	243	0.882	0.007	0.041	0.005
[2, 3)	1,440	40	306	0.855	0.008	0.031	0.005
[3, 4)	1,094	36	202	0.824	0.009	0.036	0.006
[4, 5)	856	21	169	0.802	0.010	0.027	0.006
[5, 6)	666	0	666	0.802	0.010	0.000	0.000
(b) Exclude left-censored spells							
[0, 1)	327	54	103	0.804	0.024	0.196	0.024
[1, 2)	170	18	53	0.703	0.031	0.125	0.028
[2, 3)	99	7	37	0.642	0.036	0.087	0.031
[3, 4)	55	3	34	0.591	0.043	0.079	0.044
[4, 5)	18	0	18	0.591	0.043	0.000	0.000

Source: Author's calculations using the JHPS.

fourth-year and third spell dummies are not employed for the estimations because these variables can take on 1 only in the final year of the sample period. However, during that year, all values of the dependent variable are 0. In addition, coefficient estimates are identical to two decimal places in both the pooled logistic and random effect models, providing the result of the pooled logistic model alone.

Table 4.5 Results of the discrete hazard rate model

	Include left-censored spells				Exclude left-censored spells	
	Pooled logit		Random effects		Pooled logit	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Constant	−2.89***	(0.19)	−3.54***	(0.28)	−1.85***	(0.35)
Duration (ref. first year)						
2	−0.62***	(0.13)	−0.56***	(0.14)	−0.54**	(0.25)
3	−0.90***	(0.17)	−0.74***	(0.18)	−0.86**	(0.37)
4	−0.74***	(0.18)	−0.46**	(0.20)	—	—
4 or more	—	—	—	—	−1.39***	(0.53)
5 or more	−1.58***	(0.23)	−1.23***	(0.25)	—	—
Poverty	2.22***	(0.12)	2.07***	(0.14)	1.54***	(0.19)
Second spell	0.07	(0.19)	−0.97***	(0.26)	−0.70**	(0.34)
Third spell	−0.48	(0.69)	−2.39***	(0.79)	—	—
Poverty× log(duration)	−0.29	(0.19)	0.14	(0.23)	0.07	(0.38)
Second spell× log(duration)	0.38	(0.42)	0.21	(0.45)	1.25	(1.00)
Female	0.38*	(0.20)	0.48*	(0.27)	0.40	(0.37)
Age (ref. 30–39)						
Less than 29	−0.38	(0.32)	−0.52	(0.39)	0.45	(0.80)
40–49	−0.24*	(0.15)	−0.37**	(0.18)	−0.22	(0.24)
50–64	−0.12	(0.16)	−0.25	(0.21)	0.11	(0.28)
65 and over	−0.41*	(0.21)	−0.58**	(0.27)	−0.52	(0.37)
Household type (ref. only couple)						
Single under 65	0.04	(0.20)	0.08	(0.25)	−0.05	(0.37)
Single aged 65 and over	−0.43*	(0.26)	−0.29	(0.33)	−0.57	(0.46)
Couple with one child	0.09	(0.18)	0.12	(0.23)	−0.20	(0.36)
Couple with two or more children	0.60***	(0.16)	0.75***	(0.21)	0.56*	(0.30)
Others	0.11	(0.15)	0.16	(0.19)	−0.03	(0.29)
Education (ref. high)						
Secondary	0.14	(0.15)	0.24	(0.21)	0.11	(0.26)
Specialized school or junior college	−0.09	(0.14)	−0.14	(0.19)	0.19	(0.23)
University or graduate school	−0.36***	(0.11)	−0.49***	(0.15)	−0.39*	(0.20)
Employment status (ref. regular)						
Non-regular	0.56***	(0.15)	0.76***	(0.18)	0.02	(0.25)
Self-employed	0.64***	(0.13)	0.87***	(0.17)	0.07	(0.22)
Unemployed	0.51*	(0.28)	0.79**	(0.34)	−0.01	(0.46)
Non-employed	0.38**	(0.18)	0.55**	(0.22)	0.13	(0.32)
Others	−0.48	(0.54)	−0.77	(0.69)	−0.14	(0.89)
Change in a household						
Increase in children	1.09***	(0.26)	1.29***	(0.29)	0.02	(0.72)
Increase in workers	0.65***	(0.13)	0.80***	(0.15)	1.07***	(0.24)
Decrease in workers	0.65***	(0.14)	0.76***	(0.15)	1.00***	(0.25)
σ	—	—	1.21***	(0.14)	—	—

Table 4.5 (*Continued*)

	Include left-censored spells		Exclude left-censored spells
	Pooled logit	Random effects	Pooled logit
Log likelihood	−1850.1	−1830.4	−520.5
Sample size	9,067	9,067	1,135

Notes: We use household heads' information for female dummy, age, education, and employment status. σ is the standard deviation of the random effect. ***, **, and * respectively denote estimates significant at 1%, 5%, and 10%.

Source: Author's calculations using the JHPS.

We first confirm results of the pooled logistic analysis. All duration dummies are significant and negative, which means that the longer poverty and non-poverty spells last, the less likely exits and entries are to occur. The coefficient of the poverty dummy is significant and positive, revealing that exits are more likely to occur than entries. This result is consistent with that of the life tables, which shows exit rates exceeding entry rates. Results demonstrate that the interaction term between the poverty dummy and the logarithm of durations is not significant, which demonstrates that the difference in exit and entry rates does not necessarily change, even though durations lengthen. For household types, "couple with two or more children" has a coefficient that is significant and positive. Regarding schooling levels, the coefficient of "university or graduate school" is significant and negative. For the employment status, "non-regular," "self-employed," and "non-employed" have coefficients that are significantly positive, demonstrating that individuals belonging to these groups have a high chance of moving into and out of poverty compared with "regular," which is a baseline group. Finally, for variables related to variations in a household, all coefficients are significant and positive, which demonstrates that childbirth and changes in workers engender a high probability of transition between spells in and out of poverty.

The random effects model incorporating unobserved heterogeneity has additional significant variables aside from the variables that were significant in the pooled logistic model. The second and third spell dummies are significant and negative, showing that spells after the first have a lower probability of event occurrence. For the attributes of households and their heads, "40–49," "65 and over," and "unemployed" have coefficients that are significant at the 5% level.

An analysis that dropped left-censored spells revealed that the significance of the main variables is equivalent to the random effect model described above. For the attributes of households and their heads, "increases in workers" and "decreases in workers" have coefficients that are significant and positive at the 1% level, but the other variables' coefficients are non-significant (or significant at the 10% level).

4.3 Conclusion

This chapter explained our analyses related to movement into and out of poverty using the dataset from the Japan Household Panel Survey (JHPS) for 2009–2014. Specifically, life tables were used to assess variations of exit and entry rates when spell durations change. Additionally, using the discrete hazard rate approach, controlling for attributes of households and their heads, we studied the probabilities of event occurrence to ascertain whether they become lower as spells in and out of poverty persist, and whether experiences in the first spells or since-the-second spells cause exit and entry rates to vary considerably.

Results of life table analyses demonstrated that exit rates exceeded entry rates and that exit rates decreased sharply as poverty durations lengthened. By contrast, entry rates declined slowly as spells out of poverty lengthened. Values of survival functions demonstrated that individuals became poor at least once during the survey period at probabilities of around 20–40%.

Results of the hazard rate model showed that exit was more likely to occur than entry, irrespective of the treatment of left-censored spells. This observation coincides with the life table analysis results. For attributes of households and their heads, results revealed that changes in workers in a household led to a high probability of transition between spells in and out of poverty.

A challenge that must be confronted in future research is examination of the effects of duration dummies and variables that characterize households and a household head on each of exit and entry. For our analysis, we used a single dependent variable to incorporate consideration of multiple spells and their durations. Therefore, we failed to estimate the separate effects of the independent variables, although this distinction is important. Particularly, it is crucially important for anti-poverty policies to address the issue of whether exit from poverty becomes increasingly difficult as poverty persists. Therefore, it is necessary to investigate how the effects of variables on exit and entry mutually differ in comparison to methods used in earlier studies.

Chapter 5

Subjective Poverty Equivalence Scales in Japan: Empirical Analysis by Regional Area and Household Type

5.1 Introduction

Public assistance systems in Japan fundamentally decide whether applicants can receive benefits based on their household income. Therefore, that number representing household income has extremely important meaning to assess well-being. Nevertheless, a single household income figure does not imply distribution of the same well-being to each household member. If the number of household members and household structure (household members' ages, with or without children, etc.) differ, then the level of economic welfare also differs, even assuming equal household income. Actually, the standard for payment in public assistance systems in Japan incorporates differences of the number of household members and household members' ages in the calculation of the livelihood aid.

An equivalent scale is a scale that adjusts the degree of economic efficiency of household size, and compares welfare levels for each household receiving from income in the same standard. For example, if one regards a single household as the standard household and the equivalence scale of couple without children is judged as 1.20, then a couple without children who has 1.2 times the household income of single household are regarded as having the same welfare level as a single household.[1]

Two main methods are used for concrete measure equivalent scales: a method using data of household consumption expenditures (consumption scale); and a method that uses subjective evaluation of people for their own or particular income level (subjective scale) (Buhmann et al. 1988; Atkinson et al. 1995; Watanabe 2013). In research of equivalent scales in Japan, equivalent scales based on a consumption scale that uses data of household consumption expenditure have mainly been estimated (Suruga 1991, 1995; Yagi and Tachibanaki 1996; Nagase 2001; Oyama 2004; Watanabe 2013).

In foreign countries, methods using subjective scales have been accumulated, as exemplified by studies conducted by Kapteyn and van Praag (1978), Pradhan and Ravallion (2000), Stewart (2009), and Bishop et al. (2014), but studies of Japan are few. Only a fraction of research such as Yamada et al. (2012) uses estimates on a subjective scale. However, as Van Praag et al. (1980) pointed out, the evaluation of a living standard or the evaluation of whether a household falls into poverty or not is fundamentally decided by a person's own subjective view. That is actually a very important viewpoint that particularly addresses subjective well-being of how people feel when their family life and

[1] Refer to Watanabe (2013), pp.436–437.

household income level are used to compare welfare levels between different households, particularly when residing in different regions.

Even in economically developed countries, many regional differences of life environments arise from various perspectives such as education, security, social welfare, and housing. One can consider that an income level that is necessary to maintain a minimum standard of wholesome and cultured living differs by region. Yamada et al. (2012) estimated subjective equivalence scale, particularly addressing the differences of numbers of household members and households with or without children, but regarding measurements of subjective equivalence scale considering regional differences as well as household type differences, insufficient studies have been conducted in Japan.

For this study, we estimate equivalence scales based on a subjective scale by household type using responses that include people's subjective evaluations of their minimum required income obtained from a large internet survey. Responses are compared with values of the OECD standard equivalence scale, with equivalent elasticity set always to 0.5. Additionally, we compare poverty rates estimated from a subjective equivalence scale with relative poverty rates of OECD standard. Results confirm which households' poverty rates are different by application of different equivalence scales. Furthermore, we confirm significant differences in minimum required income and equivalence scale responses for regional areas and household types. Finally, we offer new perspectives for considering regional poverty.

The outline of this study is the following. Section 2 surveys representative earlier studies that estimated equivalence scales in Japan and overseas. Section 3 presents an outline of the measurement method of subjective equivalence scale and data used for this study. Section 4 presents interpretation of the characteristics of the equivalence scales and poverty rates by household type and regional block based on the estimated results. Section 5 explains conclusions and future research tasks based on our results.

5.2 Earlier research

In Japan, the measurement of an equivalence scale based on a consumption scale that used responses to a Family Income and Expenditure Survey was conducted to estimate child expenditures. The most common approach is to set a couple without children as a standard household, with estimates of how much additional income is needed by other household types (e.g., couples with one child) to achieve the same utility level compared to the standard household. Then we regard the amount as the expected cost of having one child (Oyama 2004). For example, Suruga (1995) estimated consumption equivalence scales using data related to the food budget share and expenditure for goods and services that adults consume, as based on aggregate data from the National Survey of

Family Income and Expenditure of 1984 by the Ministry of Internal Affairs and Communications (MIC)[2]. From the estimated results of the food budget share method, a child cost amounts to about 35–40% of a standard household (couple without children).

In addition, not a few studies in Japan have estimated equivalence scales, particularly addressing child cost, such as Nagase (2001), who used the Family Income and Expenditure Survey by MIC, and Oyama (2004), who used the Panel Survey on Consumer's Affairs by the Research Institute on Household Economy.

Watanabe (2013) estimated equivalence scales by household type and specifically examined time series trends of them using four year data of the National Survey of Family Income and Expenditure (1989, 1994, 1999, and 2004). This study yielded several important results: (1) The equivalence scales of household with children decreased during 15 years, irrespective of child's age class and of whether their household type is double parent or single parent. (2) The equivalence scale of elderly couple without children was 1.3 times as high as the case of single-parent household (one child). (3) The values of the consumption scale tend to be lower than those of OECD scale (equivalence elasticity is always 0.5) for cases of a single-parent household and single elderly household. Therefore, it is possible that poverty rates of these household categories calculated from the consumption scale tend to be lower

As described earlier, Yamada et al. (2012) estimated the equivalence scale based on a subjective scale. This study investigated the subjective minimum cost of living using the answer results on minimum required cost of living from internet surveys (two surveys were conducted) to assess the relations between minimum cost of living that an ordinary person evaluates and the current minimum cost of living calculated from current public assistance in Japan. As an estimation result, they found that (1) the current base amount of public assistance falls below the subjective minimum required cost for a single household; (2) even if household income increases by 1%, the subjective minimum required cost only increases about 0.2%; (3) the equivalence scale based on the subjective scale is extremely small. The economic efficiency of household size is largely evaluated for people.

Furthermore, as a recent representative research abroad, we can present work by Bishop et al. (2014), who estimated the subjective equivalence scales of Euro 15 countries using individual data of the European Income and Living Conditions (SILC) (2004, 2007). As main conclusions, they demonstrated that the subjective equivalence scales largely evaluate the economic efficiency of household size compared to the OECD equivalence scale, as reported by Yamada et al. (2012), and regarding countries with high GDP per capita and high benefits in kind per unit of GDP (e.g., education and social security), such as the Netherlands, France, Germany, and Belgium, this trend is even further reinforced.

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[2] Estimation based on the food budget share assumes that the level of household welfare can be approximately represented by the household food budget share (Watanabe 2013, p. 444.).

Additionally, they pointed out that the additional cost of having a child becomes greater as the number of children increases, and that subjective poverty rates are consistently lower in all Euro-zone 15 countries than OECD standard poverty rates, although the ranks of the 15 countries themselves do not change.

Bishop et al. (2014) obtained important evidence demonstrating that the economic efficiency of household size works better in countries that are more economically developed and more developed particularly in the field of social policy. This point offers an important perspective when comparing the welfare levels of different regional areas within a country. Our study estimates the equivalence scales based on a subjective scale and verifies whether the levels are significantly different among regional areas, even when the household hold type is the same. Furthermore, we confirm whether the differences support the results reported by Bishop et al. (2014) for the national level.

5.3 Empirical analysis

5.3.1 Data

Individual data used for our empirical analyses in this study were obtained from A Survey of Regional Life Environment and Happiness, funded by MEXT and the Japan Society for the Promotion of Science. The nationwide internet survey was administered in Japan in February 2011. Its sample size is 11,556; its collection rate was 68.3%. This questionnaire asked respondents to report details of their subjective well-being (sense of happiness, life satisfaction, etc.) and social and economic factors such as income, educational background, occupation, and the regional area. The survey also included the Minimum Income Question (MINQ), which enables derivation of the Subjective Poverty Line (SPL).

Data collected from this internet survey were influenced by three important biases. First, the gender proportion was skewed somewhat toward men, who accounted for 55.4% of respondents. Second, the respondents were more educated than the actual population. Actually, approximately 51% had graduated from college or had some higher education, which was well above the 28% of the actual population aged 20–69 years (Employment Status Survey 2012). Third, 35% of respondents lived in the Tokyo metropolitan area, which is higher than the 28% of the population of Japan who actually live there (according to the Comprehensive Survey of Living Conditions of the People on Health and Welfare 2011). Because of these biases, caution is necessary when interpreting the estimated results. However, the distributions of age and household income did not differ significantly from the actual distributions.

For these analyses, this study specifically examines the working generation (20s–50s). Considering the educational level of respondents older than 60, this study selected respondents based on age (20s, 30s, 40s and 50s). In addition, data of students and those who did not respond to questions that were important for analysis were excluded from analysis. Consequently, the eventual sample size became 8,026 respondents.

Table 5.1 Rates of respective household types and age distribution

	n	Share (%)	20s	30s	40s	50s
All	(8,026)		22	28	23	27
Single household (Male)	(899)	11	34	26	21	19
Single household (Female)	(626)	8	54	19	15	13
Couple without children	(1,185)	15	15	30	19	35
Couple with children	(2,959)	37	9	30	31	31
Single-parent household	(148)	2	9	17	27	47
Three-generation household	(503)	6	4	20	31	45
Other household	(1,706)	21	38	29	16	17

Source: Author's calculations.

We set the following seven household types for analysis.

(1) Single household (Male)
(2) Single household (Female)
(3) Couple without children
(4) Couple with children
(5) Single-parent household
(6) Three-generation household
(7) Other household[3]

Table 5.1 presents percentages of respective household types and the age distribution by household type (20s, 30s, 40s, and 50s).

5.3.2 Setting of the poverty line

Next, we explain the measurement method of equivalence scale based on the subjective scale. In our survey, we asked "In your opinion, what is the very lowest annual disposable income that your household would need to make ends meet?" Then we examined the minimum required income Y_{min} for each respondent, based on the answer results. Additionally, we asked about personal income and the spouse's income in the survey. Therefore, we can regard the sum of each income as household income Y. According to the intersection method used by Bishop et al. (2014), we can set an econometric model for estimating the predicted minimum required income from information related to household income and household type. Bishop et al. (2014) pointed out that, generally speaking, high-income earners tend to report a higher level of income compared to the actual minimum required income; low-income earners (poverty group) tend to report lower

[3] "Other household" includes households that consist of single-parent household and children aged over 20 and households for which the household type is unknown.

level of income compared to the actual level.[4] Intersection method is a method that considers that trend and provides an estimate of the levels of minimum required income by household type.

The econometric model is presented as the following equation (1).

$$(1)\quad \ln(Y_{min}) = a_0 + a_1 \ln(Y) + a_2 z_2 + a_3 z_3 + \cdots + a_n z_n + \epsilon,$$

In that equation, z_j $(j = 1, 2, \dots, n)$ is a dummy variable representing the household type to which a respondent belongs. The coefficient of logarithm of household income a_1 reflects the income elasticity of minimum required income; a_0 shows the logarithm of minimum required income which the standard household (single household or couple without children is set in the study) requires in the case the actual household income level is zero. Parameters from a_2 to a_n $(j = 2, 3, \dots, n)$ show how much additional household income (logarithm) should be increased or decreased to achieve the same level of the utility of the standard household when household type is j. ϵ shows an error term that satisfies classical assumptions of independent identically distributed (i.i.d.).

In the analysis, based on the OLS parameters obtained from equation (1), each minimum required income $Y^*(z_2, z_3, \dots, z_7)$ of each household type z_j $(j = 2, 3, \dots, 7)$ is calculated from the following equation (2).

$$(2)\quad Y^*(z_2, z_3, \dots, z_n) = \exp\left(\frac{a_0 + a_2 z_2 + \cdots + a_n z_n}{1 - a_1}\right).$$

For our study, we designated the estimated minimum required income obtained through the procedure described above as the subjective poverty line.

5.4 Estimation results

5.4.1 Subjective poverty lines and equivalence scale by household type and regional area

Table 5.2 presents estimation results of subjective poverty lines by household type, based on equations (1) and (2), which set a female single household as the standard household. Table 5.2 demonstrates that the minimum required income of other household types is significantly higher than the base category (single female household). Furthermore, the subjective poverty line that regards household income level below the line as poverty is high. However, no large difference of the values of subjective poverty line between household type is found, as a result, the values of equivalence scales are much lower than the OECD scale (1.41 in a two person household; 1.73 in a three person household), which is often used for international comparison. The difference of equivalence scale

[4] Bishop et al. (2014) pointed out that through the adaptation process, people tend to answer the level of minimum required income for making ends meet as lower than ordinary people if their poverty status continues in the long run.

Table 5.2 Subjective poverty line and equivalence scale (National level)

	Share (%)	Coeff.	Subj. threshold	Equiv. scale	95% CI
Single household (Male)	11	0.10***	225.7	1.13	(1.05, 1.17)
Single household (Female) [Base]	8	—	199.2	1.00	—
Couple without children	15	0.07**	216.6	1.09	(1.01, 1.13)
Couple with children	37	0.16***	243.9	1.22	(1.12, 1.24)
Single-parent household	2	0.09*	223.8	1.12	(0.99, 1.20)
Three-generation household	6	0.13***	235.2	1.18	(1.07, 1.22)
Other household	21	0.16***	244.8	1.23	(1.12, 1.24)

Note: The subjective poverty line is based on annual income. The monetary unit is 10,000 yen.
Source: Author's calculations.

against a single female household stays only 23% even for some other household type, which marks the largest values, as a category for comparison. This result occurs because the level of subjective poverty line of single household became high compared to the relative poverty line calculated in the OECD standard as Yamada et al. (2012) and Bishop et al. (2014) pointed out.

To elucidate regional differences among the gaps of subjective poverty line caused from the difference of household type, if any exist, we set seven regional blocks based on information related to respondents' residential areas: (1) Hokkaido/Tohoku; (2) Northern Kanto; (3) Southern Kanto; (4) Hokuriku/Chubu; (5) Kinki; (6) Chugoku/Shikoku; and (7) Kyushu/Okinawa. Subsequently, we estimated their subjective poverty lines and equivalence scales by household type, setting a single female household as the base category. Table 5.3 presents the results.

Reference to Table 5.3 reveals several interesting trends. First, the equivalence scales between the single female household and couple with children significantly differ in four out of seven regional blocks. Therefore, results show that child costs increase the minimum required income that people consider (subjective poverty line). As a result, it enhances the equivalence scale, even in regional analysis.[5] Second, we found significant differences of equivalence scales between single female household and other many household types in Hokkaido/Tohoku and southern Kanto areas. The economic efficiency of household size is limited in these areas when the number of family members increases because of marriage and childbirth; many people consider that the minimum required income will become high compared to other regional blocks. More detailed verification for the results should be done in future studies, but it can be considered that regarding southern Kanto including the metropolitan area, a high level of housing/educational cost is a main reason. Third, in Chugoku/Shikoku and Kyushu/Okinawa,

[5] However, in the three regional blocks of northern Kanto, Chugoku/Shikoku and Kyushu/Okinawa, no significant difference was found between "single female" and "couple with children". It was attributable to the high level of subjective poverty line of single female household, whose levels are about 1.3 times as high as the level of OECD standard relative poverty line.

Table 5.3 Subjective poverty rate and equivalence scale by regional area and household type (Base: single female household)

	Share (%)	Coeff.	Subj. threshold	Equi. scale	95% CI
Hokkaido/Tohoku					
Single household (Male)	10	0.11*	199.6	1.15	(0.95, 1.29)
Single household (Female) [Base]	11	—	173.5	1.00	
Couple without children	14	0.12*	202.2	1.17	(0.97, 1.30)
Couple with children	32	0.22***	229.4	1.32	(1.10, 1.41)
Single-parent household	2	0.24**	236.6	1.36	(0.95, 1.63)
Three-generation household	9	0.25***	239.9	1.38	(1.09, 1.51)
Other household	22	0.19***	220.5	1.27	(1.06, 1.37)
Northern Kanto					
Single household (Male)	12	0.09	234.2	1.13	(0.75, 1.46)
Single household (Female) [Base]	4	—	207.5	1.00	
Couple without children	13	0.17	257.2	1.24	(0.81, 1.57)
Couple with children	34	0.14	246.8	1.19	(0.80, 1.50)
Single-parent household	2	0.10	235.4	1.13	(0.55, 1.67)
Three-generation household	13	0.04	218.7	1.05	(0.70, 1.39)
Other household	22	0.18	262.7	1.27	(0.85, 1.57)
Southern Kanto					
Single household (Male)	13	0.09**	233.9	1.11	(1.00, 1.19)
Single household (Female) [Base]	8	—	210.2	1.00	
Couple without children	15	0.13***	247.7	1.18	(1.04, 1.25)
Couple with children	39	0.21***	271.2	1.29	(1.14, 1.34)
Single-parent household	2	0.16**	255.5	1.22	(0.98, 1.37)
Three-generation household	4	0.23***	280.4	1.33	(1.12, 1.42)
Other household	19	0.18***	261.8	1.25	(1.10, 1.30)
Hokuriku/Chubu					
Single household (Male)	8	0.12	235.5	1.16	(0.94, 1.32)
Single household (Female) [Base]	5	—	202.9	1.00	
Couple without children	13	−0.02	197.7	0.98	(0.82, 1.14)
Couple with children	38	0.14**	241.9	1.19	(0.98, 1.32)
Single-parent household	2	0.01	204.9	1.01	(0.73, 1.28)
Three-generation household	10	0.07	222.1	1.10	(0.90, 1.26)
Other household	24	0.11*	232.9	1.15	(0.96, 1.28)
Kinki					
Single household (Male)	11	0.09*	236.5	1.12	(0.96, 1.23)
Single household (Female) [Base]	9	—	211.2	1.00	
Couple without children	16	0.02	215.8	1.02	(0.90, 1.14)
Couple with children	37	0.12**	246.2	1.17	(1.01, 1.25)
Single-parent household	2	−0.05	199.0	0.94	(0.77, 1.13)
Three-generation household	4	0.11	243.8	1.15	(0.94, 1.30)
Other household	21	0.13***	249.5	1.18	(1.02, 1.27)
Chugoku/Shikoku					
Single household (Male)	11	0.10	215.7	1.13	(0.87, 1.34)

Table 5.3 (*Continued*)

	Share (%)	Coeff.	Subj. threshold	Equi. scale	95% CI
Single household (Female) [Base]	6	—	191.0	1.00	
Couple without children	16	0.05	202.5	1.06	(0.83, 1.27)
Couple with children	36	0.11	219.1	1.15	(0.90, 1.33)
Single-parent household	1	0.07	208.8	1.09	(0.66, 1.49)
Three-generation household	6	0.13	226.3	1.19	(0.87, 1.43)
Other household	23	0.18**	241.0	1.26	(0.98, 1.44)
Kyushu/Okinawa					
Single household (Male)	10	0.06	192.4	1.09	(0.84, 1.29)
Single household (Female) [Base]	7	—	176.7	1.00	
Couple without children	15	−0.03	170.3	0.96	(0.77, 1.17)
Couple with children	37	0.08	198.1	1.12	(0.89, 1.30)
Single-parent household	2	0.13	210.9	1.19	(0.72, 1.57)
Three-generation household	7	0.02	180.7	1.02	(0.77, 1.26)
Other household	22	0.18**	226.7	1.28	(0.98, 1.43)

Source: Author's calculations.

little significant difference of equivalence scales between single female and other household types. In other words, in these areas, the impact of the household size enlargement on living standards is not so much emphasized as in other regions.

For this study, we estimated subjective poverty lines and equivalence scales in the case of setting a couple without children as the base category instead of a single female household. Thereby, we ascertained whether people tend to increase the subjective minimum required income because of child rearing, or not, and whether there are significant differences of equivalence scales between regional areas even in the case of same household type, or not. The results are presented in Table 5.4 in comparison to the case of a couple without children living in Hokuriku/Chubu. Results show that the equivalence scales of couple without children living in northern Kanto and southern Kanto were significantly high. In the Kanto area, the economic efficiency of household size did not work well compared to that in the Hokuriku/Chubu area.

In addition, compared to the case of couples without children living in Hokuriku/Chubu areas, the subjective poverty line and equivalence scale for couple with children in the same region were found to have significantly high values. This trend was confirmed in many regional blocks, but excluding Chugoku/Shikoku and Kyushu/Okinawa. Therefore, results show that the minimum required costs of couple with children surpass those of couple without children in almost all areas. Particularly, as for southern Kanto which covers metropolitan area, the equivalence scales of a couple with children was very high. Remarkably, no large differences were found in minimum required costs (subjective poverty lines) between couples without children and three-generation households.

Table 5.4 Subjective poverty line by regional area and household type (Base: Couple without children (Hokuriku/Chubu))

	Subjective threshold	Equivalence scale	95% CI
Couple without children			
Hokkaido/Tohoku	175.09	1.03	(0.89, 1.15)
Northern Kanto	236.79	1.39**	(1.04, 1.50)
Southern Kanto	207.81	1.22**	(1.04, 1.27)
Hokuriku/Chubu [Base]	170.50	1.00	
Kinki	189.15	1.11	(0.96, 1.20)
Chugoku/Shikoku	173.42	1.02	(0.88, 1.15)
Kyushu/Okinawa	160.90	0.94	(0.82, 1.09)
Couple with children			
Hokkaido/Tohoku	202.78	1.19**	(1.02, 1.25)
Northern Kanto	220.19	1.29**	(1.05, 1.36)
Southern Kanto	228.21	1.34**	(1.12, 1.35)
Hokuriku/Chubu	211.13	1.24**	(1.05, 1.28)
Kinki	215.73	1.27**	(1.07, 1.30)
Chugoku/Shikoku	189.41	1.11	(0.96, 1.20)
Kyushu/Okinawa	187.59	1.10	(0.95, 1.19)
Three-generation			
Hokkaido/Tohoku	213.63	1.25**	(1.01, 1.35)
Northern Kanto	188.59	1.11	(0.88, 1.27)
Southern Kanto	236.22	1.39**	(1.10, 1.43)
Hokuriku/Chubu	193.37	1.13	(0.96, 1.24)
Kinki	215.87	1.27**	(1.00, 1.37)
Chugoku/Shikoku	197.50	1.16	(0.90, 1.33)
Kyushu/Okinawa	171.05	1.00	(0.81, 1.20)

Source: Author's calculations

5.4.2 Comparison of poverty rates by equivalence scales

Many researches, as represented by Atkinson et al. (1995), De Vos and Zaidi (1997), and Bishop et al. (2014) have been analyzing the degree of the change in inequality and poverty indexes in the case of using different equivalence scales. For the study, we follow the measurement method of previous research, estimate poverty rates based on the subjective scales obtained from the econometric model set in the previous section, and compares them with the OECD standard equivalence scale, with equivalent elasticity set always to 0.5. Furthermore, we confirm significant differences in poverty identification from responses for regional areas and household types.

Table 5.5 presents the results comparing relative poverty rates and subjective poverty rates by household type. The OECD standard relative poverty rate is 19.7% in all of Japan, and surpasses about three percentage point compared to subjective poverty rate, 16.8%. However, referring to the case of each household type, subjective poverty lines

Table 5.5 Relative poverty rate and subjective poverty rate by household type (Base: Single household (Female))

	Relative poverty rate (National)	Relative poverty line (National)	Subjective poverty rate	Subjective poverty line
All	19.7	150.0	16.8	233.5
Single household (Male)	12.9	150.0	28.8	225.7
Single household (Female)	14.5	150.0	32.9	199.2
Couple without children	5.2	212.1	5.2	216.6
Couple with children	6.8	288.3	2.5	243.9
Single-parent household	29.7	243.2	29.7	223.8
Three-generation household	13.1	345.9	5.6	235.2
Other household	62.2	273.2	39.4	244.8

Note: The subjective poverty line is based on annual income. The monetary unit is 10,000 yen. Relative poverty lines (the OECD standard) present the values of 1.5 million yen, based on single household, multiplied the average numbers of household size of each household type.

Source: Author's calculations.

of "single household (male and female)" are greatly higher than the cases of relative poverty lines, so the subjective poverty rates mark more than double as much as the relative poverty rates. In the cases of "Couple with children," "three-generation," and "Other household," subjective poverty rates are lower than the values of relative poverty rates. These points coincides with the results of previous research.

Next, Table 5.6 reports the results the relationships between relative poverty rates and subjective poverty rates by household type and regional area. Regarding relative poverty rates, we calculated them using two poverty standards; national level and regional level. Relative poverty rates of national level are estimated by setting 50% of median of equivalent disposable income (equivalent elasticity is 0.5) of all samples as poverty line. In those of regional level, 50% of median of equivalent disposable income (equivalent elasticity is 0.5) by each regional area are used for the estimation.

We found several trends from the results by regional area. First, regarding Southern Kanto and Kyushu/Okinawa areas, subjective poverty rates surpass relative poverty rates (national level) in many cases. Particularly for Southern Kanto area, we confirmed the significant differences between relative poverty rates and subjective poverty rates in the cases of "Single household (Male and Female)," and "Single-parent household."

Secondly, referring to the relative poverty rate calculated by regional area, the relative poverty rate of Southern Kanto area amounted to about 20% in total, and almost coincides with the subjective poverty rate in the same region. It can be said that relative poverty rates of regional level tend to more reflect the sense of poverty for residents in urban areas.

Thirdly, regarding "three-generation," subjective poverty rates are all below relative poverty rates (both national level and regional level) in all regional blocks. Therefore, we can consider that economic efficiency of household size are exerted in the case of "three-generation."

Table 5.6 Comparison of poverty rate by regional block

	Relative pov. rate (Regional)	Relative pov. line (Regional)	Relative pov. rate (National)	Relative pov. line (National)	Subj. pov. rate	Subj. pov. line
Hokkaido/Tohoku						
All	18.2	125.0	23.2	150.0	20.6	215.6
Single household (Male)	15.2	125.0	15.2	150.0	34.8	199.6
Single household (Female)	12.5	125.0	12.5	150.0	32.7	173.5
Couple without children	0.8	176.8	3.8	212.1	3.8	202.2
Couple with children	3.7	239.4	9.7	288.3	3.7	229.4
Single-parent household	—	199.8	—	243.2	—	236.6
Three-generation household	10.0	290.1	17.5	345.9	2.5	239.9
Other household	48.8	232.8	64.1	273.2	48.8	220.5
Northern Kanto						
All	17.2	135.8	21.8	150.0	21.5	244.7
Single household (Male)	17.1	135.8	17.1	150.0	31.7	234.2
Single household (Female)	21.4	135.8	21.4	150.0	28.6	207.5
Couple without children	4.4	192.1	6.7	212.1	13.3	257.2
Couple with children	11.0	261.1	11.9	288.3	5.1	246.8
Single-parent household	—	228.6	—	243.2	—	235.4
Three-generation household	4.5	311.9	4.5	345.9	2.3	218.7
Other household	36.8	248.8	52.6	273.2	55.3	262.7
Southern Kanto						
All	19.6	175.0	15.1	150.0	19.9	256.2
Single household (Male)	25.3	175.0	8.9	150.0	25.5	233.9
Single household (Female)	28.8	175.0	12.2	150.0	28.8	210.2
Couple without children	3.8	247.5	3.8	212.1	3.8	247.7
Couple with children	5.5	334.3	3.9	288.3	3.8	271.2
Single-parent household	50.0	286.9	37.5	243.2	50.0	255.5
Three-generation household	10.3	399.9	7.7	345.9	5.1	280.4
Other household	59.4	312.1	52.5	273.2	58.9	261.8
Hokuriku/Chubu						
All	18.3	144.3	21.3	150.0	13.6	228.8
Single household (Male)	15.7	144.3	15.7	150.0	24.5	235.5
Single household (Female)	12.9	144.3	12.9	150.0	30.6	202.9
Couple without children	5.1	204.1	5.1	212.1	2.5	197.7
Couple with children	7.1	279.0	7.5	288.3	1.8	241.9
Single-parent household	47.4	227.0	52.6	243.2	47.4	204.9
Three-generation household	12.5	334.1	14.2	345.9	5.0	222.1
Other household	58.7	270.9	56.0	273.2	31.7	232.9
Kinki						
All	18.1	137.5	22.1	150.0	18.6	236.8
Single household (Male)	15.2	137.5	15.2	150.0	31.1	236.5
Single household (Female)	22.1	137.5	22.1	150.0	37.5	211.2
Couple without children	5.9	194.5	8.1	212.1	8.1	215.8
Couple with children	8.3	266.5	8.8	288.3	2.9	246.2

Table 5.6 (*Continued*)

	Relative pov. rate (Regional)	Relative pov. line (Regional)	Relative pov. rate (National)	Relative pov. line (National)	Subj. pov. rate	Subj. pov. line
Single-parent household	31.6	224.2	44.7	243.2	28.9	199.0
Three-generation household	13.6	309.8	15.2	345.9	9.1	243.8
Other household	62.8	250.9	57.2	273.2	39.7	249.5
Chugoku/Shikoku						
All	18.8	129.9	24.8	150.0	17.8	217.6
Single household (Male)	18.8	129.9	18.8	150.0	31.9	215.7
Single household (Female)	13.2	129.9	13.2	150.0	31.6	191.0
Couple without children	2.9	183.7	6.9	212.1	6.9	202.5
Couple with children	11.1	250.5	11.1	288.3	3.6	219.1
Single-parent household	—	212.1	—	243.2	—	208.8
Three-generation household	26.3	307.6	23.7	345.9	7.9	226.3
Other household	39.9	236.5	62.9	273.2	39.9	241.0
Kyushu/Okinawa						
All	17.4	125.0	20.7	150.0	20.9	197.2
Single household (Male)	13.6	125.0	13.6	150.0	35.6	192.4
Single household (Female)	9.3	125.0	9.3	150.0	46.5	176.7
Couple without children	3.4	176.8	4.5	212.1	3.4	170.3
Couple with children	4.2	240.1	7.5	288.3	2.4	198.1
Single-parent household	—	197.6	—	243.2	—	210.9
Three-generation household	15.8	293.2	21.1	345.9	13.2	180.7
Other household	50.8	221.2	60.0	273.2	50.8	226.7

Note: We excluded the results of the case that the sample of single-parent household is below twenty.

Source: Author's calculations.

5.5 Conclusion

This study estimated the subjective equivalence scale using a large sample of microdata, for which studies are still few in Japan, particularly addressing the differences of minimum required income (subjective poverty line) by each household type and the presence of regional differences among the same household type. From estimation results obtained using the intersection method by Bishop et al. (2014), we found the following points.

First, as reported from earlier studies (Yamada et al. 2012; Bishop et al. 2014) that estimated the equivalence scale based on the subjective scale that directly asked respondents about minimum required household income, the values of subjective equivalence scale were almost all small. Economic efficiency of household size was highly evaluated. Results demonstrate that subjective poverty rates in households with many household members are low. However, the subjective poverty rate in single households tends to be high.

Secondly, when particularly addressing differences of household type, regarding the regional block of southern Kanto area including metropolitan area, many households" equivalence scales such as "couple with children" and "three generation" are significantly higher than single female households. The level of equivalence scale itself suggests a situation which does not work with economies of scale well. A high level of housing and/or educational expenses might affect the subjective evaluation for minimum required income particularly for residents in urban areas.

Thirdly, according to the analysis by regional area, in the cases of "single household (male and female)" and "single-parent household," in southern Kanto, the levels of subjective poverty rate based on the subjective equivalence scale largely surpass relative poverty rates (national standard). Additionally, a trend was found by which, in the areas of southern Kanto and Kinki, including representative large cities, relative poverty rates (regional standards) showed more similar values to subjective poverty rates than in cases of the relative poverty rate (national standard).

As estimation results show, differences between subjective equivalence scale and OECD standard equivalence scale differ greatly among household types. Japan has a historical background by which livelihood assistance in the public assistance system has been revised while considering balance for consumption levels of general low-income households (Watanabe 2013). The public assistance system in Japan has been setting levels of minimum cost of living, to some degree, by considering the equivalence scale based on a consumption scale. Nevertheless, the equivalence scale based on consumption scale which only specifically examines the consumption expenditure of low income households insufficiently might reflect the minimum required income that low-income households truly need. For example, Bishop et al. (2014) reports that low-income households have already greatly cut living expenditures and that they tend to become involuntarily adapted to poverty life. Based on that concern, it is worthwhile to conduct a study investigating whether consistency prevails, or not, between a consumption scale and a subjective scale that reflects the actual peoples" perspective for poverty. Additionally, verification of equivalence scales must be conducted from various points of views so that social policy enhances people's subjective well-being, and decreases their sense of disparity and poverty to the greatest degree possible.

Chapter 6

Summary and Policy Implications

This dissertation has presented a study of poverty in Japan. Chapter 2, using data from the CSLC for 2001, 2004, 2007, and 2010 provided by the MHLW, examined the determinants of poverty measure changes during the 2000s. For those analyses, we decomposed changes in poverty measures, which are the poverty rate and the squared poverty gap ratio, into mean income change, income inequality change, share change of household members who belong to each household type, and poverty line change, measuring the respective effects by household type. Results demonstrated that while a mean income decrease and a share increase of elderly households are associated with an increase in poverty rates, poverty line reduction offsets these effects, resulting in little change in the poverty rate. Moreover, the change in the squared poverty gap ratio was found to be significant and negative, which is induced by an inequality decrease among poor people. Each-household-type effects demonstrated that the poverty line decline strongly affected couples with children, households including two or more elderly people, and three-generation households, revealing that many poor people subsist near the poverty line. Households that are categorized as "others" and for which the head is older than 65 years old significantly and positively affected the two poverty measure changes.

Chapter 3 presented an investigation of poverty by examination of income and liquid assets. Using a dataset from the Japan Household Panel Survey (JHPS) for 2009–2014, we measured income poverty rates, income-plus-asset poverty rates, and asset poverty rates, which are computed only for non-income poor people, for demographic and socioeconomic subgroups. Furthermore, logistic regression models were applied to assess the effects of variables such as household types and education on poverty incidence. Results of calculations of income-plus-asset poverty rates showed decreasing poverty headcounts for household subgroups: those headed by a woman, an elderly person, a less-educated person, and a non-employee. Measuring income poverty alone can engender overestimation of the poverty rate magnitude. Results of logistic regression analysis revealed that addition of wealth to income does not necessarily reduce poverty risks compared with reference groups in the analyses. Asset poverty rates, which are calculated only for non-income poor persons, had high values for many subgroups, revealing that, when people become income poor because of shocks such as economic crises, many might be unable to escape poverty even if they reduce assets to compensate for a low income.

Chapter 4 explained our study of poverty exit and entry using JHPS data for 2009–2014. Specifically, we examined variations of exit and entry rates as poverty or non-poverty durations persist, by making use of the life table. Additionally, a discrete-time hazard rate approach was applied to elucidate factors affecting movement into and out of poverty. Results of life table analysis showed that exit rates were higher than entry rates, and that they declined sharply as the poverty duration lengthened. The results also demonstrated that people fell into poverty at least once within four or five years, at a probability of 20% (when left-censored spells were included) or of 40% (when they were dropped). From discrete-time hazard models, we were able to infer that movements out of poverty were more likely to occur than those into poverty even if attributes of households and household heads were controlled for. This result coincides with those obtained from life table analysis. For attributes of households and household heads, results showed that changes in the number of workers in a family were associated with transitions between the two events.

Chapter 5 estimated subjective poverty lines and equivalence scales by household type and region, with calculation of subjective poverty rates with thresholds obtained for comparison with relative poverty rates, using a nationwide internet survey in Japan. Results elucidated that when the subjective equivalence scale for single female households is set to one, equivalence scales of many household types had almost unity, which demonstrates large economies of scale by an increase in the number of household members. Furthermore, subjective poverty rates were less than relative poverty rates for households with many members; opposite results were obtained for single-person households. Results of analyses conducted by region showed that household types such as couples with children and three-generation households had subjective equivalence scales that were significantly higher than that of single female households, which is constant at one, in Minami-Kanto including metropolitan areas. This result might be attributable to higher costs of dwellings and childcare affecting subjective poverty thresholds. Moreover, in Minami-Kanto and Kinki, relative poverty rates with poverty lines that vary from region to region were close to subjective poverty rates more than those based on a nationwide single threshold were, revealing that the former reflect residents' ideas of poverty better.

The previously described results lead to three salient policy implications. The first is that the government should publish poverty rates with a fixed threshold and asset-based poverty rates as well as income-based headcounts. As might be readily apparent from the results included in Chapter 2, even though relative poverty rates have little change, one must not be optimistic about Japan's poverty issue. In addition, the analysis of Chapter 3 demonstrates that income-based poverty rates might be overestimated without addition of assets. To overcome the former problem, fixed-threshold poverty rates must be announced. If their values tend to increase, then probably all or part of mean income decreases, income inequality increases, and share change occurs. Consequently, examination of these changes enables us to ascertain precisely that the determinants of poverty rate increase. For the latter issue, the government should publish poverty rates calculated from the sum of income and assets. Moreover, wherever possible, measurements of poverty rates with and without conversion of assets into flow must be mutually compared to those results.

The second is to decrease poverty risks confronted by people who have insufficient assets by prolonging the benefit receipt period of employment insurance. As Chapter 3 emphasizes, many people are less likely to escape poverty even by reducing assets when they enter income poverty, for example, by unemployment. Employment insurance helps to decrease this risk, but as Shikata and Komamura (2011) and Sakai (2012) emphasize, benefit receipt rates of insurance are low in Japan because of a short period of benefit receipt, which fails to prevent long-term unemployment. Therefore, the government role should be to prolong benefit receipt periods to reduce risks that asset-poor people must confront.

The third is to address poverty persistence by raising the take-up rate of public assistance. As shown in Chapter 4, the persistence of poverty makes exit difficult. To avoid long periods spent in poverty, it is necessary to find poor people earlier and to render the necessary support immediately. One effective means of accomplishing this is to increase the take-up rate of public assistance. As described in Chapter 1, some studies have estimated the take-up rate as around 20%, and at about 30% in an estimation by the MHLW. These estimates and the results presented in Chapter 4 show that poor people who do not receive benefits have an increasingly lower chance of ending poverty as the period of poverty persists. Consequently, the government should increase the take-up rate of public assistance to find poor persons earlier and to address poverty persistence.

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