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

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1. Introduction

Public assistance systems in Japan fundamentally decide whether applicants can receive benefits based largely 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), Kapteyn et al. (1988), Pradhan and Ravallion (2000), Garner and Short (2003), Stewart (2009), and Bishop et al. (2014), but studies of Japan are few. Only a fraction of research

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1) Refer to Watanabe (2013), pp.436-437.

such as Abe and Ueda (2014), Iwata and Iwanaga (2012), and Yamada et al. (2012, 2018) use estimates on a subjective scale. For example, Abe and Ueda (2014) analyzed what is the minimum standard of housing acceptable to general public of Japan using the Minimum Income Standard (MIS) methodology. As Ravallion (1994) 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 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, 2018) estimated subjective equivalence scale of people of 20-59, 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.

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, 2018) 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 for persons of 20-59) 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 Union Statistics on Income and Living Conditions (EU-SILC) (2004, 2007). They define adults as persons 15 years or older. 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, 2018), and regarding countries with high GDP per capita and high benefits in kind per

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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.).

unit of GDP (e.g., education and social security), such as the Netherlands, France, Germany, and Belgium, this trend is even further reinforced.

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 house-hold 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 house-hold type is the same. Furthermore, we confirm whether the differences support the results reported by Bishop et al. (2014) for the national level.

3. Empirical analysis

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

Table 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.

analysis were excluded from analysis. Consequently, the eventual sample size became 8,026 respondents.[3]

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[4]

Table 1 presents percentages of respective household types and the age distribution by household type (20s, 30s, 40s, and 50s).

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.

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3) Yamada (2018) also selected respondents based on age (20s-50s).

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

(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 level of income compared to the actual level.[5] 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)　$\ln(Y_{min}) = a_0 + a_1 \ln(Y) + a_2 z_2 + a_3 z_3 + \cdots + a_n z_n + \epsilon,$

In that equation, z_j $(j = 1, 2, \ldots, n)$ 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 $(j = 2, 3, \ldots, n)$ 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 $Y^*(z_2, z_3, \ldots, z_7)$ of each household type z_j $(j = 2, 3, \ldots, 7)$ is calculated from the following equation (2).

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

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

4. Estimation results

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

Table 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 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

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5)　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 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. ***, **, and * are statistically significant at 1%, 5% and 10% level.

a two person household; 1.73 in a three person household), which is often used for international comparison. The difference of equivalence scale 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 3 presents the results.

Reference to Table 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.[6] 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, little significant difference of equivalence scales between single

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6) 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 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 (11.65%)					
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	—	—	—	—
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 (4.29%)					
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	—	—	—	—
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 (35.07%)					
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 (15.03%)					
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	—	—	—	—
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 (18.96%)					
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	—	—	—	—
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 (7.77%)					
Single household (Male)	11	0.10	215.7	1.13	(0.87, 1.34)
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	—	—	—	—
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)

Table 3 *(Continued)*

	Share (%)	Coeff.	Subj. threshold	Equi. scale	95% CI
Kyushu/Okinawa (7.23%)					
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	—	—	—	—
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)

Note: We excluded the results of the case that the sample of single-parent household is below thirty.
Source: Author's calculations.

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 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. We can point out that no large differences were found in minimum required costs (subjective poverty lines) between couples without children and three-generation households in Hokuriku/Chubu. We omitted the detailed results, but similarly, even in other regions, same trends were confirmed.

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,

Table 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

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 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 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 6 reports the results the relationships between relative poverty rates and subjective poverty

Table 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		16.8	
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.

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."

5. Conclusion

This study estimated the subjective equivalence scale using a large sample of microdata (respondents of 20s, 30s, 40s, and 50s), for which studies are still few in Japan, particularly addressing the differences of

Table 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		23.2		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	—	—	—	—	—	—
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		21.8		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	—	—	—	—	—	—
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		15.1		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		21.3		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	—	—	—	—	—	—
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		22.1		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
Single-parent household	—	—	—	—	—	—
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

Table 6 *(Continued)*

	Relative pov. rate (Regional)	Relative pov. line (Regional)	Relative pov. rate (National)	Relative pov. line (National)	Subj. pov. rate	Subj. pov. line
Chugoku/Shikoku						
All	18.8		24.8		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	—	—	—	—	—	—
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		20.7		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	—	—	—	—	—	—
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 thirty.
Source: Author's calculations

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, 2018; 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).

We have to take into account that respondents older than 60 were excluded from analysis, but as main 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 people's 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.

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