Measuring Poverty in Japan from a Multidimensional Perspective

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Abstract

In this paper, following a methodology developed by Alkire and Foster (2011), we define a multidimensional poverty index (MPI) consisted of three dimensions such as consumption, wealth, and dwelling environment. By using household data from the National Survey of Family Income and Expenditures, we compute the MPI at national level. Using the decomposable property of the index, we also estimate the MPI by four sub-groups such as single parent, two parents, three generation, and childless households. We analyze intertemporal changes in multidimensional poverty in Japan.

Keywords: the capability approach, poverty, multidimensional, the adjusted headcount

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1 Introduction

A few years ago, the Health, Labor and Welfare Ministry in Japan reported new calculations on poverty rates since the mid-1980s. The report clarifies that both overall and child poverty rate have been continuously increasing over the past 30 years. Especially, child poverty rate in 2012 (16.3%) seemed to be recognized as shocking news among people in Japan. Since a publication of the official report, government makes related laws and launches various policies in order to alleviate the situations.

Among almost all poverty related issues including the case mentioned above, a focal variable is just an economic dimension such as income or consumption. Although an economic dimension is practically essential, one's well-being might not be appropriately evaluated from a unidimensional point of view. In this context, some thinkers pay attention to a multidimensionality of a person's well-being. For example, according to the capability approach (Sen 1985a, 1992), a person's well-being should be multidimensional in nature. From such a multidimensional perspective, several approaches to poverty measurement have been proposed so far (Tsui 2002, Atkinson 2003, Bourguignon and Chakravarty 2003).

We employ a methodology developed by Alkire and Foster (2011) to compute a multidimensional poverty index (MPI) in Japan. They specify a class of multidimensional poverty measures, which is an extension of a class of the mono-dimensional poverty measure by Foster, Greer, and Thorbecke (1984). Especially, we will use the so-called M_0 measures of this class, namely, the censored headcount H, the intensity of poverty among poor A, and the adjusted headcount M_0. As we will explain in detail in the next section, roughly speaking, the former two indices focus on a breadth of poverty and an intensity of poverty in a multidimensional framework, respectively. The M_0 is an index combined the H with the A through the relation: $M_0 = H \times A$. By using this relation, for example, we can analyze that intertemporal changes in M_0 is a result of an increase (or a decrease) in H and/or in A. The M_0 also satisfies useful properties such as decomposability. This property allows us to analyze that the M_0 is decomposed by any subgroup of household type.

The paper will try to capture poverty profiles for Japan from a multidimensional perspective. In order to do so, the paper has two tasks. First, we will focus on intertemporal changes in multidimensional poverty in Japan. Based on the National Survey of Family Income and Expenditure, we compute the nationwide MPI for the 1989, 1994, 1999, and 2004 survey. Second, when households are classified as four categories such as single parent, two parents, three generation and childless households, we calculate the MPI by household types by way of using decomposability of the M_0.

Through the preliminary exercises, two findings are obtained. First, the M_0 value for the entire Japan decreases, but the degree of intertemporal changes in the value have become smaller through time. This is mainly due to reductions of the censored headcount H. On the other hand, the intensity of poverty among poor A became stable around mid-1990s. Second, through a decomposition of the MPI values into sub-groups, the MPI values for single parent and two parents households are higher than the national level for every survey year, indicating that the two types of households are always the most vulnerable ones.

The paper is organized as follows: Section 2 elaborates a method employed in detail. Section 3 explains dataset used, dimensions/indicators, cutoffs/weights, and treatment of missing values. Section 4 reports main results. Section 5 concludes.

2 Method

In this section, we explain the methodology developed by Alkire and Foster (2011).[1] We consider a n-person society. Let $N := \{1, 2, \ldots, n\}$ be a set of persons. Similar to the capability approach, the method employs a multidimensional informational base to assess a person's well-being. A person's well-being is represented by an achievement vector in the d-dimensional nonnegative real space $\mathbb{R}^d_+$, which is called a functioning vector in Sen's terminology. A matrix $\mathbf{Y} \in \mathbb{R}^{n\times d}_+$ is called an achievement matrix. In order to determine whether each entry of a person's achievement vector is short or not compared to a given threshold for each dimension, let us introduce a vector $\mathbf{z}$ in the d-dimensional positive real space $\mathbb{R}^d_{++}$. This vector $\mathbf{z}$ is called a deprivation cutoff vector. Using a deprivation cutoff, an achievement matrix is transformed a matrix with a 0-1 entry, denoted as $\mathbf{D}$, by the following rule: $d_{ij} = 1$ if $y_{ij} < z_j$; $d_{ij} = 0$ otherwise. We call $\mathbf{D}$ a deprivation matrix. Here, a word "deprived" is introduced for each dimension as follows. Letting dimension j be consumption for instance, if consumption for person i is lower than a given threshold z_j, we say he or she is deprived in consumption.

Now, in order to consider a relative importance among dimensions, we introduce a weight vector $\mathbf{w} \in \mathbb{R}^d_+$ so that the sum of each entry across dimensions is unity. From a deprivation matrix $\mathbf{D}$ and a weight vector $\mathbf{w}$, we build a weighted deprivation matrix $\bar{\mathbf{D}}$ where $\bar{d}_{ij} = w_j \cdot d_{ij}$. Let us introduce a counting vector $\mathbf{c}$, which is a row-sum vector of $\bar{\mathbf{D}}$, that is, $c_i := \sum_{j=1}^d w_j d_{ij},\ i = 1, 2, \ldots, n$. An entry c_i of $\mathbf{c}$ can be interpreted as a deprivation score for person i. A c_i takes a value between zero and unity: $c_i = 0$ if a person i is not deprived at all; $c_i = 1$ if deprived in all dimensions.

Let us introduce a parameter $k \in (0, 1]$ called a poverty cutoff. Then, when a deprivation score for i, c_i, is greater or equal to a given poverty cutoff k, person i is identified to be a

[1] We just give an explanation regarding the M_0 measures. The measures M_1, M_2 and M_α ($\alpha \geq 3$) will not be explained because we do not use them in the following analysis.

multidimensional poor in terms of k. Here, two spacial cases should be noticed. If a poverty cutoff k is set as $\frac{1}{d}$, then a person is judged as poor if deprived at least one dimension, which is called the union approach; Letting k be unity, called the intersection approach, a person is judged as poor if deprived in all dimensions.

Let $P(k)$ be a set of a multidimensional poor in terms of k. The censored headcount ratio is defined as

$$H(k) = \frac{|P(k)|}{n}.$$

The H says the population share of the multidimensional poor.[2] For clear understanging, consider a simple example. Let the number of dimension be 4 ($d = 4$). When $H(0.3) = \frac{3}{5}$, the figure means 60% of the population is multidimensional poor deprived in 1 or more dimensions. Similar to the usual headcount ratio in a unidimensional framework, the censored headcount ratio focuses on a breadth of poverty, that is, how many persons are multidimensional poor in a society at hand. Although the H is easy to calculate and provides us a clear interpretation, it cannot capture a depth of poverty. That is to say, the censored headcount ratio does not satisfy a property of the dimensional monotonicity: when an achievement for a person to be identified as multidimensional poor worsen more, the censored headcount remains unchanged.

As explained below, the intensity of poverty A is an index to satisfy this property. For each $i \in N \setminus P$ by replacing a $1 \times d$ vector $\bar{\mathbf{d}}_i$ for a zero vector, build a censored matrix $\bar{\mathbf{D}}$, which is a deprivation matrix $\mathbf{D}$ obtained by dropping all information on the non-poor. The intensity of poverty A is defined as the average deprivation score among the poor. Formaly, the A is defined as

$$A = \frac{\sum_{i \in P} c_i}{|P| \cdot d}.$$

For example, when $A = \frac{13}{20}$ for example, the figure means the poor in this society experience 65% of the total possible deprivations the poor could experience. We can easily understand that the A satisfies the dimension monotonicity. This is because a deprivation score c_i increases and accordingly the A does when an achievement for the poor worsen.

When the H is adjusted through taking the intensity of poverty A, the adjusted headcount ratio is defined as the average deprivation score among persons in a society at hand. Formaly,

[2]In the following, a povety cutoff k will be omitted for a simple description unless a confusion occurs. For example, the $H(k)$ will be shortly described as H.

the M_0 is defined as

$$M_0 = \frac{\sum_{i \in N} c_i}{n \cdot d}.$$

For example, when $M_0 = \frac{9}{20}$ for example, the figure means the poor in this society experience 45% of the total possible deprivations the society could experience. A simple calculation[3] leads to the following relation:

$$M_0 = H \times A.$$

This equation means that the adjusted headcount is a simple product of the two indices. Accordingly, the M_0 also satisfies the dimension monotonicity since the A satisfies this property.

As we said earlier, the adjusted headcount ratio M_0 has useful properties. First, the M_0 can be break-down across dimensions as follows, which will be used in the following to calculate percentage contributions to M_0.

$$M_0 = \sum_{j=1}^{d} \frac{w_j}{d} H_j \tag{1}$$

, where H_j is the uncensored headcount ratio for dimension j.[4] Second, the M_0 can be decomposed by subgroups as follows:

$$M_0 = \sum_{i=1}^{l} \frac{n^i}{n} M_0^i, \tag{2}$$

where $\frac{n^i}{n},\ i = 1, 2, \ldots, l$ is a population share for subgroup i and M_0^i is a adjusted headcount for subgroup i. [5]

[3] $\sum_{i \in N} c_i = \sum_{i \in P} c_i + \underbrace{\sum_{i \in N \setminus P} c_i}_{=0} = \sum_{i \in P} c_i.$

[4] Let $\bar{\mathbf{d}}^j$, $\mathbf{d}^j$ be $n \times 1$ vectors of matrices $\bar{\mathbf{D}}$, $\mathbf{D}$, respectively. Then, $M_0 = \frac{\sum_{i \in N} c_i(k)}{nd} = \frac{\sum_{i \in N} \sum_{j=1}^{d} \bar{d}_{ij}}{nd} = \frac{1}{d} \sum_{j=1}^{d} \frac{\mathbf{e}\bar{\mathbf{d}}^j}{n} = \frac{1}{d} \sum_{j=1}^{d} \frac{w_j \mathbf{e}\mathbf{d}^j}{n} = \frac{1}{d} \sum_{j=1}^{d} w_j H_j$, where $\mathbf{e} := \underbrace{(1, \ldots, 1)}_{n \text{ times}}$ and $H_j := \frac{\mathbf{e}\mathbf{d}^j}{n}$.

[5] $M_0 = \frac{1}{nd} \left[\sum_{i \in N^1} c_i + \sum_{i \in N^2} c_i + \cdots + \sum_{i \in N^l} c_i\right] = \left[\frac{n^1}{n} \frac{\sum_{i \in N^1} c_i}{n^1 d} + \frac{n^2}{n} \frac{\sum_{i \in N^2} c_i}{n^2 d} + \cdots + \frac{n^l}{n} \frac{\sum_{i \in N^l} c_i}{n^l d}\right] = \sum_{i=1}^{l} \frac{n^i}{n} M_0^i.$

3 Set up

3.1 Data

We use as dataset the National Survey of Family Income and Expenditures (the NSFIE) conducted by the Ministry of Internal Affairs and Communications by every five years. The unit of the survey is households in the whole area of Japan. The households are classified by two groups, namely, single-person household and two-or-more persons household. The collection of data takes place on autumn season and the investigation periods differ by the household types; 3 months (September, October, and November) for two-or-more persons household; 2 months (September and October) for single-person household. The survey collects a lot of items including household income and expenditure, savings and liabilities, and amenities including house and residential land, etc. In the following, we employ the 1989, 1994, 1999 and 2004 surveys for two-or-more persons household. The whole samples for each survey are 44,537, 44,687, 44,540 and 43,861 households, respectively.

3.2 Dimensions and Indicators

In designing a multidimensional poverty index, first of all we have to choose dimensions and indicators. We will choose as dimensions consumption, wealth, and dwelling environment. In the following, we briefly explain indicators for measuring each dimension and their definitions.

Consumption

First, to consume something is indispensable for our daily economic activities and closely related to our wellbeing. Although income can be one of candidates for evaluating our wellbeing, in an affluent society, consumption is often considered to be an appropriate proxy for a person's wellbeing compared to income (Movshuk, 2015; Peichl and Pestel, 2013). In addition, a reason of this is that in focusing on relatively long periods (i.e., 15 years between 1989 and 2004 in our case) a disposable income, which is considered as a standard measure of household income, is largely affected by changes in a taxation. As an alternative, we will focus on a nondurable consumption and employ an equivalent nondurable consumption as an indicator for consumption. The definitions of nondurable consumption and an equivalent nondurable consumption are given in Appendix.

Wealth

Our wealth dimension consists of amenities and savings. First, amenities are a very simple measure for evaluating household wealth and focus on how many amenities the household have. The list of amenities and their diffusions rates for non-durable goods, car and house are reported in Table 4.

Second, we will explain savings for household as the second indicator for wealth dimension. According to the NSFIE, savings are defined as total amount of ordinary and time deposits for banks, life insurance, stocks, bonds and deposits for non-banking institutions. Household savings are evaluated at the end of November of the corresponding survey year based on the questionnaire on annual income and savings. The amounts of savings for each household are provided with a top coding where a threshold is uniformly set as ninety five million yen across the survey employed. We can also calculate net savings defined as savings minus liabilities. However, we will not use this as an alternative indicator. Since a housing loan makes up a large fraction of household liabilities, net savings for households that own a house tend to be negative. Intuitively, we would be hard to consider these households as be deprived because getting a mortgage shows a long-term solvency.

Here, we have a notice on the two indicators of wealth dimension. Compared to indicators for other dimensions, a lot of missing values exist. For example, in the 2004 survey, 3,825 households out of 43,861 are identified as providing unreliable saving data. We will go back to this point in section 3.4.

Dwelling environment

As the last dimension, we consider dwelling environment. Although dwelling environment can be evaluated from several aspects such as sick house issues for instance, it is simply assumed to be an increasing function of living spaces, that is, the larger living spaces are, the better our housing environment is. Living space mentioned is defined as total floor space minus floor space for business use.

In order to use as a cutoff point, we calculate minimum living spaces with taking family member compositions into consideration. Minimum living spaces are proposed by Ministry of Land, Infrastructure, Transport and Tourism and the formula is given in Appendix. Although we employ the official formula in calculating minimum living space, the settings for child coefficient need to be modified because our dataset does not contain the age of children. Here, we will count a 0.75 person per child (see Appendix A.2 in detail).

3.3 Cutoffs and Weights

In a poverty measurement, it is important to set a poverty line to determine who is poor. There are several ways to set a poverty line such as relative or absolute. An adjective "relative" means here that a cutoff point can be different by survey year or by household, for instance. The so-called one half of median criteria would be typical relative poverty line because the median number of a focal variable would be different by survey year. For non-durable consumption, we will use the one half of median criteria. Namely, a household is deprived in non-durable consumption if it is less than the one half of median equivalent non-durable consumption. For living spaces, relative poverty cutoffs are also employed and set as the minimum living space which is different from compositions of household members. On the other hand, an adjective “absolute” means that a cutoff is uniformly fixed across any survey year or any subgroup, for example. For the two indicators of wealth dimension, we will use absolute cutoffs. Regarding amenities, cutoffs are set as 10 amenities, which is determined by the number of amenities that their diffution rates are more than 70%. One million yen is used as a cutoff point for savings.

Defining weights among dimensions is essential for computing the MPI. Similar to the issue of defining cutoffs, there are various procedures to assign weights to dimensions (Decancq and Logo, 2012). Here, we employ nested weights as a weighting structure (Alkire and Foster, 2011). In our case, the nested weights assigns one third to each dimension. Next, the weight assigned is divided by the number of indicators for each dimension. Since wealth dimension has two indicators, each indicator for this dimension is assigned one sixth. The last column of Table 1 shows and weights assigned to each indicator.

Dimensions	Indicators	Deprived if	Weights
Consumption			0.33
	non-durable consumption	the half of median non-durable consumption	(0.33)
Wealth			0.33
	amenities	10 items	(0.167)
	savings	one million yen	(0.167)
Dwelling environment			0.33
	living space	minimum living space	(0.33)

Table 1:

3.4 Data Cleaning

In this subsection, we explain how we treat unreliable information. Second through fifth rows of Table 2 reports the number of unreliable information for each indicator. As we said above, the two indicators of wealth dimension have much unreliable information. On the other hand, there are no unreliable information concerning non-durable consumption and living space. In order to compute the MPI, we have done data cleaning by dropping all unreliable information for related indicators. Seventh and last rows of Table 2 report unreliable information dropped and sample size employed in the following analysis.

# of unreliable information	1989	1994	1999	2004
non-durable consumption	0	0	0	0
amenities	1,384	1,544	2,307	3,033
savings	2,030	1,830	1,362	3,825
living space	0	0	0	0
whole sample size	44,537	44,687	44,540	43,861
unreliable information dropped	3,386	3,345	3,616	4,737
remaining sample size	41,151	41,342	40,924	39,124

Table 2:

4 Results

We present multidimensional poverty profiles for Japan. First, levels and changes in the MPI indicators are discussed. Second, we report the multidimensional poverty indices for the entire Japan and the four sub-groups mentioned above. Third, results for decomposition the MPI into contributions by sub-groups and dimensions are reported.

4.1 Levels and changes in indicators

In this subsection, we report levels and changes in the MPI indicators except for these for living space. Regarding non-durable consumption, Table 3 shows that the median equivalent non-durable consumption per month. As a general feature, we see that across all the household types including nationwide the median non-durable consumption increase radically during the first five years, and during the subsequent 10 years it decreases gradually.

	1989	1994	1999	2004
the entire nation	127,767	146,766	145,008	142,911
childless	142,071	160,188	157,209	153,515
single parent	84,389	111,711	101,720	101,539
two parents	115,008	132,689	129,749	127,480
three generation	123,928	149,050	147,381	143,390

Table 3: the median equivalent nondurable consumption per month (JPY)

Next, the lists of amenities and their diffusion rates are reported in Table 4. Blanks in table mean that the corresponding diffusion rates are not collected. Although the lists of goods little bit change by the survey year, we can observe that diffusion rates for almost all items increase through time.[6] For example, the numbers of items whose diffusion rates are more than 70% are 10 items for 1989, 11 items for 1994, and 13 items for 1999 and 2004.

[6]There are several notices concerning Table 4. First, the diffusion rate for piano was dropped suddenly between 1999 and 2004. This is a result of a change in the questionnaire on piano. Namely, the first three survey collected data on piano including electric organs while in the 2004 survey electric organs were excluded. Second, the diffusion rate for stereo goes up over 30% between the last two surveys, which is also the same reason for piano. In the 2004 survey, the two items on stereo and cd/md were combined. Lastly, in 1989, the diffusion rate for house seems to be little bit high. This is a reason that the 1989 rate for house is computed from the item on a relationship of the ownership of house while other three are calculated from the item on whether a respondent own a house or not.

	1989	1994	1999	2004
system kitchen	18.6%	28.0%	43.0%	57.0%
water heater	46.2%	51.6%	55.6%	61.1%
wash stand		34.3%	45.8%	63.4%
combined toilets		23.5%	42.0%	59.2%
refrigerator	98.1%	98.7%	99.2%	99.1%
wash machine	98.9%	99.4%	99.3%	99.2%
air conditioner	65.0%	79.3%	84.3%	87.1%
piano	38.2%	42.0%	41.4%	27.5%
video recorder	68.7%	68.8%	78.9%	82.0%
color tv	98.3%	99.2%	99.3%	97.3%
video camera	17.4%	33.9%	39.8%	41.9%
camera	86.8%	89.7%	87.5%	81.0%
computer	12.5%	16.4%	37.8%	69.7%
word processor	25.0%	43.7%	45.3%	
vacuum cleaner	97.6%	98.9%	99.2%	99.4%
rice cooker		78.1%	81.7%	85.6%
microwave	73.0%	89.4%	95.3%	97.6%
dish washer	4.5%	5.2%		19.3%
sawing machine	68.7%	73.5%	70.7%	67.7%
desk		62.3%	64.9%	64.8%
stereo	60.1%	54.9%	50.0%	81.0%
radio-cas/cd/md	76.3%	68.0%	78.1%	
fax		9.5%	33.1%	51.3%
golf equipment	33.8%	41.1%	42.2%	38.7%
mobile phone		43.7%	64.7%	85.0%
phone	81.4%			
car	79.3%	81.4%	85.2%	86.6%
house	(75.5%)	72.8%	76.5%	80.4%

Table 4: List of amenities and diffusion rates for the entire nation

Last, Table 5 reports that the median and 25 percentile in parenthesis of equivalent household savings for each household category. For all the household types including the entire Japan, both the median and 25 percentile went up during the first five years. During the subsequent 10 years, the median and 25 percentile for the entire Japan and childless household still continued increasing while the degree of increases in the median for two parents and three generation households became slowly; a hundred thousand yen up for two parents household; two hundred thousand yen up for three generation household. On the other hand, both the median and 25 percentile for single parent household, and 25 percentile for two parents and three generation households decreased during the same period. From this observation, it is fair to say that one half of single parent household and one quarter of both parents household (which are usually considered as the most vulnerable households) were worse off while others were well off.

median (25 percentile)	1989	1994	1999	2004
entire Japan	310 (144)	428 (200)	470 (203)	517 (227)
childless	445 (202)	640 (297)	707 (308)	762 (333)
single parent	135 (32)	238 (92)	197 (53)	201 (55)
two parents	204 (101)	279 (141)	277 (130)	289 (135)
three generation	270 (138)	375 (196)	387 (189)	396 (188)

Table 5: Equivalent savings for household: median and 25 percentile (ten thousand yen)

4.2 The MPI for Japan

Table 6 reports figures, standard deviations and confidence intervals for M_0, H, and A for $k = 0.3$. In 2004, the censored headcount ratio H was 9.19%, which means that 9.19% of the population were deprived in one or more indicators. When the H is adjusted through taking depth of poverty A into consideration, the adjusted headcount is calculated as 3.84%. This is lower than the M_0 value for 1999, which was 4.52%. The decrease in the M_0 value in 2004 is a consequence of reduction in the H while the intensity of poverty A seems to remain unchanged. We can also observe that the M_0 value decreases between 1994 and 1999 due to the same reason as in 2004, that is, a relatively large reduction in the H. During the first five years, a decrease in the M_0 value can be observed. This is a result of a reduction of both the H and the A values.

A decomposition of the MPI results by sub-groups are reported in Table 7. Several features can be observed. First, all the MPI figures for single parent household are highest across every survey year. Two parents household have the second highest MPI values among sub-groups except for the A in 1989 ranked as third. It is not the case for both three generation and childless household. Second, across every survey year, the MPI results for single and two parents household are always higher than for the entire Japan, whereas regarding three generation and childless households the converse relationship holds. Third, across all sub-groups, there is a general tendency of decreasing the M_0 values through time due to mainly reductions in the censored headcount.

To check whether intertemporal changes in the estimated values are statistically significant, we perform a simple statistical test under the null hypothesis that there are no differences in the values between adjoint two periods (i.e. $\Delta MPI_{t,t-1} := MPI_t - MPI_{t-1} = 0$)

		1989	
Estimate	Value	Standard Error	Confidence Interval (95%)
M_0	7.25%	0.085%	(7.08%, 7.41%)
H	16.55%	0.18%	(16.2%, 16.9%)
A	43.8%	0.18%	(43.5%, 44.1%)
		1994	
Estimate	Value	Standard Error	Confidence Interval (95%)
M_0	5.91%	0.076%	(5.77%, 6.06%)
H	14.23%	0.17%	(13.9%, 14.6%)
A	41.57%	0.18%	(41.2%, 41.9%)
		1999	
Estimate	Value	Standard Error	Confidence Interval (95%)
M_0	4.52%	0.068%	(4.39%, 4.65%)
H	10.82%	0.15%	(10.5%, 11.1%)
A	41.77%	0.20%	(41.4%, 42.6%)
		2004	
Estimate	Value	Standard Error	Confidence Interval (95%)
M_0	3.84%	0.064%	(3.72%, 3.97%)
H	9.19%	0.15%	(8.9%, 9.5%)
A	41.82%	0.21%	(41.4%, 42.2%)

Table 6: The MPI for the entire nation ($k = 0.3$)

against the alternative $\Delta MPI_{t,t-1} \neq 0$. The results are reported in Table 8. During the periods of 1989-94, the estimated values M_0, H and A have declined statistically significant at the national level and across all four sub-groups except for a change in A for single parent household. During the subsequent periods from 1994 to 1999, decreases in M_0 as well as in H are statistically significant at the entire Japan and three sub-groups excluding single parent household. Changes in intensity of poverty A are not statistically significant for all groups except for three generation household. In the third period of 1999-2004, we find a sharp contrast between changes in H and in A. Namely, all changes in H are statistically significant whereas these in A are not. From the statistical test, almost all changes in both M_0 and H are statistically significant and decreases in M_0 are mainly due to decreases in H. On the other hand, we also find that almost all changes in A are not statistically significant during the periods between 1994 and 2004 while these are significant during the first five years. This might suggest that seriousness of poverty among the poor became stable around mid-1990s.

	1989			1994			1999			2004		
	M_0	H	A	M_0	H	A	M_0	H	A	M_0	H	A
Single parent	22.35	44.79	49.91	13.11	27.52	47.66	13.38	27.43	48.77	11.15	21.74	51.3
Two parents	10.22	23.23	43.99	7.61	18.11	42.0	6.01	14.24	42.24	4.47	11.04	42.3
Three generation	5.94	14.3	41.54	4.83	12.40	38.94	3.91	9.80	39.93	3.53	8.63	40.94
Childless	5.99	13.52	44.34	5.03	12.05	41.75	3.69	8.92	41.39	3.37	8.19	41.13
Entire Japan	7.25	16.55	43.8	5.91	14.23	41.57	4.52	10.82	41.77	3.84	9.19	41.82

Table 7: The measures M_0, H and A by sub-groups ($k = 0.3$)

Difference	94-89			99-94			04-99		
	ΔM_0	ΔH	ΔA	ΔM_0	ΔH	ΔA	ΔM_0	ΔH	ΔA
Single parent	-9.24***	-17.27***	-2.25	0.26	-0.09	1.11	-2.22	-5.69**	2.53
Two parents	-2.61***	-5.12***	-1.99***	-1.59***	-3.87***	0.24	-1.35***	-3.20***	0.06
Three generation	-1.11***	-1.90***	-2.59***	-0.92***	-2.60***	0.98*	-0.38	-1.17**	1.01
Childless	-0.96***	-1.47***	-2.59***	-1.34***	-3.13***	-0.36	-0.32***	-0.72***	-0.26
Entire Japan	-1.33***	-2.32***	-2.23***	-1.39***	-3.41***	0.20	-0.68***	-1.63***	0.05

Table 8: Subgroup decomposition of intertemporal changes in the mpi values

*** statistically significant at $\omega = 0.01$, ** statistically significant at $\omega = 0.05$, * statistically significant at $\omega = 0.10$.

4.3 Decomposition of the M_0 values

By using equation (2), we compute the percentage contributions to the M_0 values by subgroups, which is shown in Figure 1. The contributions to the M_0 for child bearing households is relatively higher than the corresponding population share among the four surveys, where child bearing households refer to single, two parents, and three generation households. However, the contributions have declined through time. This reflects a smaller share of child bearing households in the population. In other words, childless households have had relatively larger effects on the M_0 value.

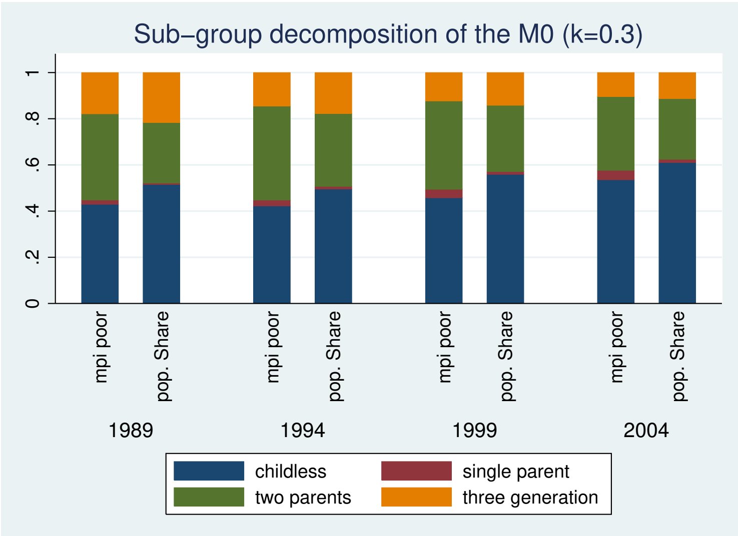

Figure 1: the contributions to the M_0 values by sub-groups

Figure 2 shows the contributions to the M_0 values by dimensions, which are computed by using equation (1). We can find that the dwelling environment dimension is the largest contributor to the M_0 in 1989, whereas it becomes the least in 2004. Conversely, we also observe that the dimension on consumption makes the largest contribution to the M_0 value in 2004, which was the least in 1989. Further, regarding the wealth dimension, after the percentage contribution decreased between 1989 and 1994, it remains stable during the 1994 through 2004. Why the consumption dimension dominate in 2004? The primary reason is that the degree of deprivation in non-durable consumption worsened during 1989-2004. In fact, the usual headcount on this indicator is shown in the upper right panel of Figure 3, where the poverty line is set as one half of the median equivalent non-durable consumption for each survey. It is increased 0.7 points from 5.5% in 1989 to 6.2% in 2004. The secondary reason is that situations on dwelling environment improved. This is supported by the lower left panel of Figure 3. This is the usual headcount on living space where the cutoff is set as the minimum living space calculated by each household. The headcount monotonously decreased during the 15 years. Due to continuous increases in percentage contributions, the M_0 value has become more sensitive to changes in non-durable consumption.

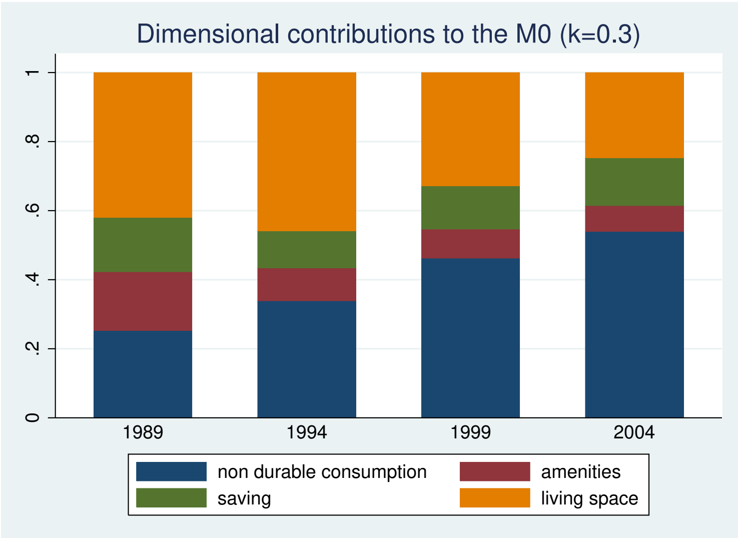

Figure 2: the contributions to the M_0 values by dimensions

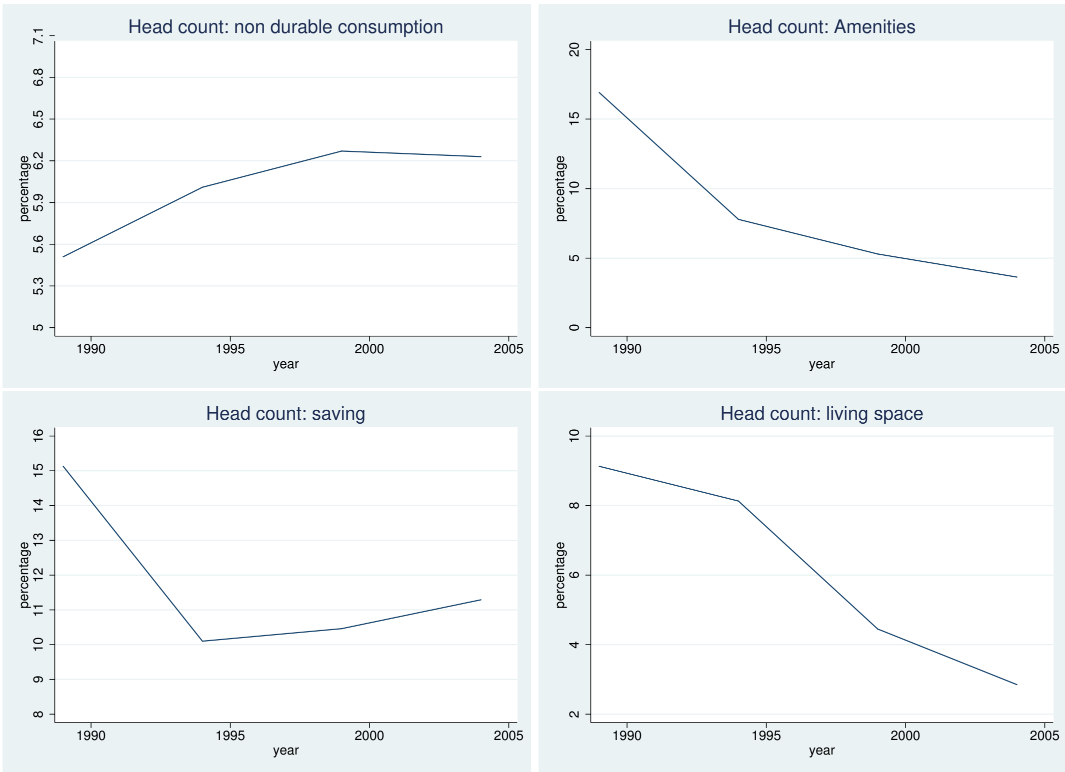

Figure 3: the headcount ratios by indicators

5 Concluding remarks

In this paper, we have tried to capture poverty profiles for Japan from a multidimensional perspective. Following the methodology developed by Alkire and Foster (2011), we compute the MPI for the entire nation and four sub-groups based on the NSFIE. In the following, we will sum up several results.

First, we find that the M_0 value for the entire Japan decreases, but the degree of intertemporal changes in the value have become smaller through time. This is mainly due to reductions of the censored headcount. It seems that this finding perhaps contradict the result of the government official reports where the monetary headcount goes up over the past-30 years. However, as shown the upper left panel of Figure 3, intertemporal changes in the headcount on non-durable consumption are consistent with that in the officially-reported monetary headcount. It would be natural that such differences occur because informational bases are not same.

Second, through a decomposition of the MPI values into sub-groups, the MPI values for single and two parents household are higher than the national level for every survey year. Although this would be a standard result, the finding suggests that the two types of households are always the most vulnerable ones from a multidimensional perspective.

Third, as shown in Figure 1, child bearing households in the population decrease over time. This makes the corresponding contributions to M_0 small, which indicating that compare to the past the M_0 value becomes relatively insensitive to changes in child bearing households. Given the all parameters such as poverty cutoff and cutoff vector etc., non-durable consumption in 2004 have become the largest contributor to the M_0 value (see Fig.2). This means that movements in M_0 become approximated to changes in the indicator.

Lastly, during 1999 through 2004, we find a sharp contrast between changes in H and in A. Namely, all changes in H are statistically significant whereas these in A are not. From the statistical test, almost all changes in both M_0 and H are statistically significant and decreases in M_0 are mainly due to decreases in H. On the other hand, we also find that almost all changes in A are not statistically significant during the periods between 1994 and 2004 while these are significant during the first five years. This might suggest that seriousness of poverty among the poor became stable around mid-1990s.

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Appendix

A.1 Non-durable consumption

Following Movshuk (2015), a non-durable consumption for household is defined as follows:

> Non-durable consumption =
> Food + (Housing - Rents for dwelling and land) + Fuel, lights and water charges + (Furniture and household utensils - Household durables - Interior furnishings - Bedding) + Clothing and footwear + Medical care + (Transportation and communication - Purchase of car and bicycles) + Education + (Culture and recreation - Recreational durable goods) + Other consumption expenditure - Remittances

A equivalent non-durable consumption is defined as

> Equivalent non-durable consumption =

$$\frac{\text{non-durable consumption}}{\text{square root of the number of household}}.$$

A.2 Minimum living space

According to Ministry of Land, Infrastructure, Transport and Tourism (2016), the minimum living space is set as

$$\begin{cases} 25m^2 \text{ for single household} \\ 10m^2 \times (\text{\# of household members}) + 10m^2 \text{ for two-or-more household} \end{cases}$$

Secondly, when one calculates the number of household members, a child is counted as

$$\begin{cases} 0.25 \text{ person for under age 3} \\ 0.5 \text{ person for between age 3 and a age 6} \\ 0.75 \text{ person for between age 6 and age 10} \\ 1 \text{ person for over age 10} \end{cases}$$

Our dataset has no information on how old children are since we only obtain the number of children less than age 17. Here we will modify the child counting rule as follows. That is, this paper counts any child less than age 17 as 0.75 person.

	official	this paper
under 3	0.25	0.75
bet. 3-6	0.5	0.75
bet. 6-10	0.75	0.75
over 10	1	0.75

Table 9: Child counting rules

Lastly, in the case that total number of household is greater than 4, the minimum living space is 5% deduction. For example, consider a household consisted of two adults and three children, the minimum living space is $49.875m^2 = (10 \times (2 + 0.75 * 3) + 10) \times 0.95$. On the other hand, when we consider a household consisted of two adults and two children, the number of household members is 3.5 (=2+0.75*2) according to our child counting rule. In this case, the 5% deduction rule does not apply and accordingly the minimum living space is $45m^2$.