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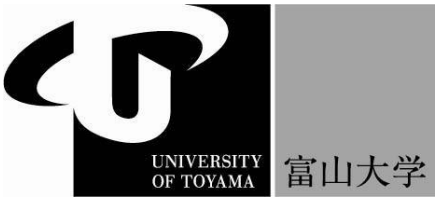

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Dynamics of Well-being in Japan from Capability-based Perspective

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Abstract

This study aims to analyze dynamics of multidimensional poverty in Japan in terms of the Capability Approach (CA) as a conceptual framework. Following Alkire and Foster (2011), an multidimensinal poverty index (MPI) for Japan is proposed. Similar to Suppa (2018), our MPI is also defined without income, which enables us to compare it with conventional income-based measures. Then, the adjusted headcount ratio M_0, which can be related to capability poverty, is contrasted to the usual headcount ratio. As a result, we have clarified the similarities and differences between poverty as measured by income and poverty as evaluated by the CA in the Japanese context. Using Japanese general social surveys for the years 2012, 2015, and 2017/18, the M_0 values for different subgroups as well as by year are computed and presented as an empirical analysis. The analysis reveals differences between income poverty and multidimensional poverty. Through comparisons of trends between the two over time, we find that multidimensional and income poverty measures differ regarding who is viewed as poor. Conversely, we also find similarities between the two. In the context of child poverty, both measures make common judgments for subgroups of variables on family's economic background in a respondent's childhood. That is, the more dire the household financial situation during childhood is, the higher the values of M_0 and income poverty rate are. This would be an interesting finding when considering intergenerational chains

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of poverty, which has also been observed in Japan through our M_0.

Keywords: Capability approach, Multidimensional well-being, Alkire-Foster method, Child poverty, Intergenerational chains of poverty, Japan

JEL Classification: I32, D63, H1

1 Introduction

Poverty is a universal problem in both developed and developing countries. For example, among the 17 Sustainable Development Goals (SDGs) adopted by the United Nations General Assembly in 2015, Goal 1 "No Poverty," in particular, has had a strong influence on formulations of relevant policies in all the UN countries. As a specific country, say Japan, the problem of child poverty has been paid attentions from the public since around early 2010s. Despite this growing public concern, the majority of government support is still centered on financial assistance to poor households. Academic research on well-being measurement, however, is critical of such an income-centered view as unaware of other equally important aspects of an individual's or household's well-being (Stigliz et al., 2009). Especially, according to Sen, an advocate of the Capability Approach (CA), he warns that uncritical acceptance of such a one-dimensional view, even as a simplification, ignores inherent diversities of human beings. He also argues that well-being itself must also be multidimensional. Sen himself seems reluctant to make a list of specific wellbeing, but in measurement practice it consists of multiple dimensions such as labor, education and health, etc.（Alkire and Foster, 2011). More importantly, child poverty is perceived as a multidimensional concept (Muinujin and Nandy, 2012). Following recent trends of related research, we propose adopting the CA as a framework for analyzing poverty issues.

In order to demonstrate potential of CA, the purpose of this paper is to answer the following questions: What are the similarities and differences between poverty measured by income and poverty evaluated by CA? This question constituted one of the main questions in Sen (1992, 1999), but has recently been empirically analyzed by Suppa (2018) using German data. It is still unknown in Japan, however. We will study using data from three waves of the Japanese general social surveys (JGSS) for the years 2012, 2015, and 2017/2018. Following Alkire and Foster (2011), we will construct an index that considers the diversities of human well-being, and dynamics of well-being in Japan in the 2010s is evaluated and compared with income-based index. We clarify the differences and similarities between the evaluations of the two indices in Japanese context.

The paper is organized as follows. Section 2 provides a brief review of CA and related literature. Section 3 explains a method we employ and proposes an MPI for Japan. Section 4 reports results. Section 5 is devoted to discussions on our main findings. Section 6 concludes the paper.

2 Capability Approach: conceptual framework for evaluating multidimensional well-being

It is necessary to evaluate the well-being of subjects, specifically individuals or households. Then, we adopt the capability approach as a conceptual framework for evaluating well-being, and we would like to see poverty in terms of capability deprivation or capability poverty. Roughly speaking, the CA has two components: functionings and capability. Functionings would be considered to be as essential components of human well-being. Capability corresponds to "the substantive freedoms he or she enjoys to lead the kind of life he or she has reason to value" (Sen 1999, p.87), which is formally defined feasible combinations of functionings to achieve. From such functionings-capability views, therefore, "poverty must be seen as the deprivation of basic capabilities rather than merely as lowness of income" (ibid, p.87).[1]

Moreover, CA focuses on difference in ability among individuals, referred to as "conversion factor." Consider often-used example to explain it as follows: a disable person needs a larger amount of resources to do the same thing than an abled-bodied one does. That is, even if both have the same amount of resources, what they are able to do could be different. In CA, this fact is captured as differences of to convert resources into functionings. According to CA literature, conversion factors can range from the micro level (e.g., disability, gender) to the meso level (e.g., family), and to the macro level (e.g., geography) (see Robeyns, 2005).

How do we measure capabilities to justify a view of CA? The practical requirements for measurement have given rise to many methods that take diversities of human well-being into account (e.g., Tsui (2002); Atkinson (2003); Bourguignon and Chakravarty (2003); Alkire and Foster (2011)).[2] In particular, the method employed is one proposed by Alkire and Foster (2011) (often called Alkire-Foster method, hereinafter abbreviated as AFM). The adjusted headcount ratio M_0 is one of the most powerful multidimensional poverty indexes (hereinafter abbreviated as MPI) since its advocacy, and has been used as a basis for poverty and policy evaluation. Of particular importance, under some normative conditions, M_0 can be associated with capability deprivation (see Alkire et al. 2015, ch. 6.1). In other words, the degree of poverty assessed by M_0 can be interpreted as a way of expressing deprivation of capabilities or as a measure of capability poverty.[3]

[1] Many studies on the measurement of well-being and poverty in terms of CA have been conducted (e.g., Robeyne (2006), Clark (2008), Chiappero-Martinetti and Roche (2009), Arndt and Volkert (2011), Van Ootengen and Verhofstadt (2012), Hick (2014), Suppa (2018), Qi and Wu (2019), and Chen and Lin (2020)).

[2] In addition, for handbook articles and books related to this field, see Aaberge and Brandolini (2015), Chakravarty and Lugo (2016), Villar (2017), and Chakravarty (2018).

[3] AFM has been used extensively in applied research. We try to classify these applied research according

Comparing our work to previous studies is useful for clarifying our findings. Suppa (2018) proposes an MPI for Germany based on AFM. More importantly, he seems to explore an MPI beyond conventional income-based poverty measures in the German context. Then, he proposes an MPI consisting of six dimensions: Education, Housing, Health, Material deprivation, Social participation, and Employment (see Suppa, 2018, p.664, Table2). It should be noted that his MPI does not include income dimension. Such construction of MPI allows us to contrast with conventional income poverty measure. In fact, differences between the two appear effectively by showing that income-poverty is largely captured by material deprivation indicators, for instance. As a result, he clarifies the similarities and differences between poverty measured by income and poverty evaluated through CA.

3 Method

3.1 Data

The data used in this study are the Japanese General Social Surveys (JGSS) for 2012, 2015, and 2017/18. The JGSS began in 2000, following the example of the GSS in the U.S., it covers various items ranging from basic household background (family composition, age, work, etc.) to current affairs. Panel (A) in Table 1 shows sample sizes and proportions (weighted) by year. The original sample size is given in the third row. Furthermore, we restrict working households to those who are employed. (i.e., self-employed, executives, etc. are excluded.) Here, target households here include unemployed households. In addition, records with at least one missing value for computing MPI among target households are omitted (i.e., pair wise deletion). Thus, the samples (na.omitted) used for analysis are 936 in 2012, 863 in 2015, and 1097 in 2017/18, which represents 41-42% of the original sample.[4]

Panel (B) shows a breakdown of sample (na.omitted) for each survey year and each variable. Variables used in the analysis are sex of respondents, region, youngest child age (abbr. cldage), the number of children under age 18 (abbr. numcld), and family income when a respondent was age 15 (abbr. fiage15). In terms of conversion factor mentioned

to the countries in which they are targeted. Research subjects are categorized as either country-by-country comparisons or single-country studies, and further categorized as either developed or developing countries. Therefore, from this point of view, applied research can be roughly divided into four categories: (a) country-by-country comparison of developing countries (e.g., Alkire and Santos (2014) etc.), (b) country-by-country comparison of developed countries (Notten and Roelen (2012), Peichi and Pestel (2013), Hick (2014), Alkire and Apablaza (2016), and Nozaki and Oshio (2016) etc.), (c) targeting single developing country (Alkire and Seth (2013), Levine et al. (2014) , Qi and Wu (2015), Chen and Alkire(2022) etc.), and (d) targeting single developed country (Wagle (2014), Suppa (2018), White (2020) etc.). According to this classification, our study is placed in category (d).

[4]In calculations below, sampling weights given to each record in JGSS are used.

above, sex of respondents could correspond to micro level, region to macro level, and others such as economic background in childhood to meso level.

[Insert Table 1]

3.2 Alkire-Foster Method

We employ a methodology proposed by Alkire and Foster (2011). Here, we briefly explain their method. The adjusted headcount ratio M_0 consists of a simple product of the following two indices. One is a headcount ratio in Alkire-Foster's sense, that is, $H(k) = p/N$, where $p = p(k)$ is the number of households identified as poor in terms of poverty cutoff k and N is the number of entire population. The other is a poverty gap ratio in their sense, denoted as, $A(k)$, which means the average of deprivation score among the poor for a given cutoff k. M_0 has some useful properties. For example, M_0 can be decomposed with respect to subgroups and dimensions. This property allows us to compute percentage contributions of subgroups and dimensions (see Alkire and Foster (2011) for the detailed formula).

3.3 MPI for Japan

After selecting dimension and indicators in our dataset, an MPI we propose is shown in Table 2. As shown in the first column of upper panel, it consists of five dimensions: Labor, Education, Health, Housing, and Relationships with family members and acquaintances, which are almost following Suppa (2018). In the first column of lower panel of Table 2, the item of target has a household head or respondent. This indicates that the corresponding person's information is used to measure its indicator. In this study, we follow equal weighting method for dimensional weights[5] (see the last column of lower panel of Table 2).

[Insert Table 2]

[5] As is common in related literature, there are various methods for weighting among dimensions (or indicators) in multidimensional indices including AFM, so there is no unique method (Decanq and Lugo 2013; Greco et al. 2019). Several studies on AFM usually adopt a weighting method, in which equal weight is assigned to each dimension, and then values obtained by dividing that given weight by the number of indicators that make up the corresponding dimension are used as weights of indicators. For an alternative weighting scheme in AFM, see Jones (2021).

4 Results

4.1 Comparisons of trends for income poverty rate and capability poverty

How similar and how different are income poverty and capability poverty measured by M_0? Here, we compare trends for the two indicators. Panel (A) of Table 3 shows M_0, standard errors, and 95% confidence intervals for cutoffs $k = 0.2, 0.3, 0.4$ and for each survey year. Clearly, for a given cutoff, M_0 takes different values in different survey years, but the corresponding 95% confidence intervals overlap each other, which means that changes in M_0 are not significant. In other words, it can be said that the M_0 across Japan did not change significantly between 2012 and 2018. On the other hand, based on equivalent household income[6], Panel (B) of Table 3 shows income poverty rates, standard errors, and 95% confidence intervals for two cutoffs (median income, i.e., $q = 0.5$ and the bottom 60% quantile, i.e., $q = 0.6$)[7]. We observe that poverty rates decrease monotonically from 2012 to 2018, regardless of cutoffs. Figure 1 compares trends for poverty rates with trends for M_0. As is clear from Fig.1, M_0 hardly changed. This indicates that the directions of changes in income poverty rate and M_0 are not necessarily the same.

[Insert Table 3 and Figure 1]

What are the percentages of those who are identified as poor in one dimensional measure or a multidimensional measure (or both)? For $q = 0.5, 0.6$ and $k = 0.2, 0.3, 0.4$, we compute such population shares for each cutoff combination. The first three rows of Panel (A) in Table 4 are the percentages of those who are identified as poor for both (both poor), for only income poverty (shortly inc.poor.only), for only multidimensional poverty (shortly md.poor.only), respectively. For example, if we look at $q = 0.5, k = 0.3$ (see also Figure. 2), 4.25% of the entire population is identified as poor for both measures. We also see 5.25% is inc.poor.only and 17.06% is md.poor.only. Next, we calculate the percentages of multidimensional poor among those who are income poor ((a)/(a)+(b)) and the percentages of income poor among those who are multidimensional poor ((a)/(a)+(c)), which are depicted

[6]As household annual income is just given as grouped data in JGSS, the median of an income group to which a household belongs is regarded as that household's income. Then, we obtain the equivalent income of this household by dividing the square root of household members. Poverty rates are calculated based on the equivalent household income. Note that income used in this study is pre-tax income.

[7]The median income ($q = 0.5$) and the bottom 60% quantile ($q = 0.6$) are 3 million yen and 4 million yen, respectively. Therefore, we use 1.5 million yen (when $q = 0.5$) and 2 million yen (when $q = 0.6$) as poverty lines. Here, in order to compare intertemporal poverty rates, consumer price index is often used to convert nominal household income into real terms, but it should be noted that this is not done. The reason for this is that prices in Japan did not change much from 2012 to 2018, and poverty lines used was the same throughout survey periods, which makes comparisons easier.

in Panels (A) and (B), respectively. Focusing on a cut-off combination $q = 0.5, k = 0.3$, the former value is approximately 45%, and the latter value is approximately 20%. That is, more than two out of five persons who are income poor are multidimensional poor, and one out of five persons who are multidimensional poor is income poor. As you can see above, two indicators do not match about who is poor. These findings have been also confirmed by Suppa (2018) in the German context, and different policy implications would be expected depending on which indicators are focused on.

[Insert Table 4 and Figure 2]

4.2 M_0 for different subgroups

We move to M_0 for different subgroups.[8] Figure 3 depicts M_0 values for each of the four subgroups (Far below average (shortly fb.a), Below average (b.a), Average (a), Above/Far above average (a/fa.a)) related to respondents' family economic backgrounds when he/she was 15 years old. $M_0^{fb.a}$ values for far below average group is the highest for any cutoff, followed by $M_0^{b.a}$ for below average group. Groups with the lowest M_0 values are subgroups for Average or Above/Far above average and no dominance relation is observed between the two. These findings mean that the worse economic situations in childhood are, the higher M_0 values are. It would be also suggested that economic situations in childhood are closely related to current vulnerabilities.

[Insert Figures 3]

4.3 Comparisons of trends for the two indicators for subgroups

Analogous to Section 4.1, we compare trends for income poverty rate and M_0 in the subgroups. The third and fifth columns in Table 6 are income poverty rates when $q = 0.5$ and M_0 values when $k = 0.3$, respectively. In addition, the values in the second column are population shares of each subgroup, and the fourth and sixth columns are percentage contributions by subgroups to income poverty and M_0, respectively.

First, note the values of the two indices by sex. Female income poverty rate (9.89) is higher than the counterpart (6.96). But, the order is reversed for M_0.That is, M_0^{male} (9.29) is higher than M_0^{female}(8.81). This means that income poverty rate and M_0 make different evaluations between male and female. It might be much easier to understand if we look at percentage contributions adjusted by the corresponding population share. They are given

[8]Table 5 (A1) in Appendix presents M_0values for subgroups of each variable on cutoff $k = 0.2, 0.3, 0.4$.

in the last two columns of Table 6 (i.e., (b)/(a), (c)/(a)). Intuitive meanings of figures are that given subgroups of a variable, a subgroup with greater (smaller) values is considered to be in worse (better). Additionally, the more (fewer) it is than 1, the worse (better) the corresponding subgroup. Moreover, as is clear from the constructions of these values, the evaluations that (b)/(a) (resp.(c)/(a)) imposes on subgroups of a variable are the same as ones by income poverty rate (resp. M_0). In fact, regarding sex in (b)/(a), we see that a value for female (1.18) is higher than male (0.83), and in (c)/(a), a value for female (0.97) is lower than male (1.03).

Second, we see the results by subgroups for household economic status when respondents were 15 years old. In this subgroup, the similarities between evaluations led by the two indices are salient. First, when focusing on income poverty rates, their value decrease in order of " far below average, " " below average, " " average, " and " above/far above average. " The difference between the maximum value (2.45) and the minimum value (0.54) of (b)/(a) is 1.91, which is the largest value among the differences between the maximum and minimum values in any subgroup. Next, looking at M_0, we do not observe monotonicity observed in income poverty rates between " average " and " above/far above average. " However, a monotonic decrease is observed in order " far below average, " " below average, " and two others. Consequently, it can be said that a moderate monotonic decrease in M_0 is also observed. Therefore, a monotonicity of both indices reflects economic situations during childhood.

Through the above analysis, we have made comparisons of trends for income poverty and M_0 for different subgroups of each variable. Of course, the values calculated in Table 6 are ones under a specific cutoff ($q = 0.5, k = 0.3$), so assertions based on the findings above may be limited. However, the differences and similarities between the two indices could have been effectively shown.

[Insert Table 6]

4.4 Dimensional percentage contributions to M_0

Panels (A) and (B) in Table 7 show the contributions of 5 dimensions and 13 indices to M_0 when $k = 0.3$, respectively. The values in the first two columns (resp. in the subsequent three columns) are contributions by sex (resp. fiage15). First, we can observe that the relative importance of each dimension differs between males and females. For example, dimensions in which males contribute more to M_0 than females are health (1.18=15.96-14.78) and relationships to family and friends (5.51=22.1-16.59). In particular, we see a

significant gender difference with respect to relationships with acquaintances.[9] In order to investigate a reason for this, we focus on the contributions of four indices consisting of this dimension: sports, meal preparation, meeting with friends, and housework. We find that the indicator with the largest gender difference of percentage contributions is housework among these four indicators. The contributions of males are more than four points higher than those of females (see the last row of Panel (B) of Table 7). Thus, a large gender difference with respect to relationships with family members and acquaintances can be mostly explained by a difference in contributions of housework between males and females. In addition, this could be interpreted as an evidence of unequal distribution of domestic work between a husband and wife.

Figure 4 (left) is a radar chart of percentage contributions of five dimensions for each subgroup of fiage15 when $k = 0.3$ based on Table 7.[10] Four panels in Figure 4 (right) show contributions of four chosen indicators for each subgroup: nowork, school, physical, and housing. These are also based on the corresponding figures of Table 7. First, when focusing on labor dimension, its contribution monotonously decreases in order of "far below average," "below average," "average," and "above/far above average" (see Panel (A) of Table 7). Further, if we look at two indicators emptype and wkhour, the contributions for both are stable across subgroups (these are in 4% to 5% range). On the other hand, as shown in the upper left panel of Figure 4, for nowork, we find a monotonicity similar to one observed in labor dimension. Especially, a contribution for "far below average" in this indicator are more than two times as that for "above/far above average" (see also Panel (B) of Table 7).

Regarding education dimension, we see that subgroup "far below average" has the highest contribution (23.89) and subgroup 'above/far above average" has the lowest (18.86), but a monotonicity among the subgroups is not observed. Of the three educational indicators, schooling is an interesting one, although its contribution has lower values compared to other two. The reason is that we also observe a monotonicity like that observed in labor (see the upper right panel of Figure 4). As also shown in Panel (B) of Table 7, the contributions of the four subgroups "far below average," "below average," "average," and "above/far above average" are 5.45, 2.22, 1.71, and 0.9, respectively. Surprisingly, a contribution for "far below average" in this indicator are nearly six times as "above/far above average."

Regarding relationships with family members and acquaintances, we again find contribution for "far below average" has the highest contribution value and "above/far above

[9] On the other hand, dimensions in which females contribute more to M_0 than males are labor (2.27), education (2.26), and housing (2.14) where the figures in parentheses are the differences in contributions of the two subgroups. In these three dimensions, the contributions of females are more than two points higher than those of males.

[10] Here, abbreviations "fb.a," "b.a," "a," and "a/fa.a" also refer subgroups of fiage15 with the same meanings as Table 7.

average" has the lowest, but a monotonicity among subgroups is not observed in the indicators, such as nowork and school. In particular, of the four indicators, we focus on meetings with friends. As shown in Panel (B) of Table 7, the contribution of this indicator for subgroup "far below average" is the highest (its value is 4.73), and for subgroup "above/far above average" is the lowest (its value is 1.73). Again, we observe that the former value is more than double the latter.

By analyzing the tendencies of dimensional contributions among the four subgroups, we find some indicators whose contributions (nearly) monotonously decreases in order of "far below average," "below average," "average," and "above/far above average." These indicators are nowork, school, and meetings with friends.[11] This indicates that those who experienced severe economic conditions in childhood have greater disadvantages in terms of these indicators.

[Insert Table 7 and Figure 4]

4.5 Subgroups by years

Is it possible that a dominance relation can be established among subgroups *regardless* of both years and cutoffs? This question relates to how robust observations are. Table 8 (A2) shows M_0 values over the three survey periods for different subgroups when cutoff $k = 0.2, 0.3, 0.4$. Surprisingly, orders of M_0 values across subgroups in fiage15 do not change at all in any significant way corresponding to those in Table 5 (A1). Current magnitudes of M_0 values depend largely on degrees of economical disadvantages in childhood.

[Insert Table 8 (A2)]

5 Discussion

Through calculations, we have found the similarities and differences between the two indicators. Our main findings are summarized as the following three implications.

[11] On the other hand, no salient differences among subgroups seem to be observed for the health dimension (see also bottom left panel of Figure 4). In contrast to observations seen in nowork and school, in housing dimension/indicator, the contribution for "far below average" has the lowest value and one for "above/far above average" has the highest. In this dimension/indicator, attention should be paid to the differences between subgroup "far below average" and the other three, which may require further considerations.

(a) identification of poor population

The main difference is that the income-based headcount ratio for the entire Japan has been on a downward trend from 2012 to 2018, while the M_0 value for it has not. That is, the M_0 for the entire Japan has neither decreased nor changed significantly. Moreover, through comparisons of trends over time, we find that multidimensional and income poverty measures differ regarding who is poor. This finding has been also confirmed by Suppa (2018) in the German context. In addition, as we have shown, disadvantage rankings can differ among subgroups. Evaluations between female and male are opposite for the two approaches, for instance. This implies that the understanding of the disadvantage of individual well-being is different. Thus, different policy implications would be expected depending on which indicators are focused on. Where the reliability of income data is questionable (see Deaton (2018, ch.1) for this issue), it can prompt a reconsideration of income based approach.

(b) intergenerational chains of poverty

On the other hand, there are also similarities between the two indicators. For instance, both make common judgments for each household's economic status when a respondent was 15 years old (see Table 6). That is, the direr the household financial situation during childhood is, the higher the values of M_0 and income poverty rate are. This would be an interesting finding when considering intergenerational chains of poverty. This problem is widely known in developed countries, but it is also confirmed in Japanese context. This finding has been confirmed previously. Using different approach and data from ours, Abe (2007) analyzed the intergenerational chain of poverty based on a retrospective survey of respondents' household income at the age of 15.[12] It reveals that poverty in childhood affects the real standard of living (basic needs and material deprivation) in adulthood. It can be said that this study also supports the findings of Abe (2007) from the viewpoint of M_0 with Japanese data in the 2010s. Furthermore, through analyzing the influence of each indicator on M0, we find that those who experienced severe economic conditions in childhood have greater disadvantages in indicators such as unemployment, schooling, and relationships with family members and acquaintances.

[12]In Europe and the United States, there are many detailed studies on intergenerational chains of poverty based on long-term, large-scale panel data. However, there is no such panel data in Japan. For this reason, in the analysis, research is conducted by substituting, for example, the self-evaluation of one's lifestyle at the age of 15 as a surrogate indicator.

(c) evidence on unequal distribution of domestic work

As a problem that cannot be found in the analysis of income poverty, we discover the problem of inequality in the distribution of household chores within the household. This issue seems to be rarely mentioned in multidimensional wellbeing literature, but forms one of the main topics in related fields such as gender inequality. For example, Cerrato and Cifre (2018) use data from Spain to determine whether unequal participation in household chores between female and male is associated with increased work-family conflict between them (expected easily, the results show unequal participation of women and men in household chores, higher in women than in men, and lower in women than men in perception of partner involvement). This study also confirms the same in the Japanese context, although it is not as serious as related studies. That is, the contributions of males are more than four points higher than those of females (see the last row of Panel (B) of Table 7). This could be interpreted as an evidence of unequal distribution of domestic work between a husband and wife. It would be interesting that our framework has applicability in these fields as well.

6 Conclusion

We evaluated and analyzed well-being dynamics in Japan in the 2010s using the capability approach. Here, we summarize the key policy recommendations for child poverty identified in the analysis so far and some limitations that should be addressed in future research.

As we mentioned at Introduction, the Children and Family Agency has launched to deal with children's problems related to poverty in 2023. In order to effectively promote poverty alleviation, we propose the adoption of CA. Our emphasis is that "poverty must be seen as the deprivation of basic capabilities rather than merely as lowness of income"(Sen 1999, p.87). Through our analysis, we have shown that looking at poverty in terms of capability deprivation can reveal specific combinations of indicators that households are deprived of. Once it becomes clear which indicator has such a disadvantage, limited resources aid can be used more effectively to help them reach the suitable level of capability.

We have performed a basic analysis based on AFM, and the quantitative analysis presented here is descriptive in nature. This is because the purpose of this study is to show a possibility of the analysis based on CA. In recent years, more advanced quantitative analysis based on CA or AFM has been demonstrated. Such an analysis is beyond the scope of this paper and will be the subject of future work. As a direction of future research, the CA to child poverty has undergone more significant theoretical changes. For instance, Biggeri and Cuesta (2021) argue that in order to fully understand child poverty, researchers must gather information on the opinions and experiences of the children themselves. By doing this, child

poverty studies can accomplish the CA's goal of fostering children's freedom and agency. This topic would be interesting to apply such quantitative analysis.

Compliance with Ethical Standards

Disclosure of potential conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Research involving Human Participants and/or Animals

The authors declare that this study has no relationship with human participants and/or animals.

Informed consent

The authors declare that this study is not applicable.

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Figures and Tables

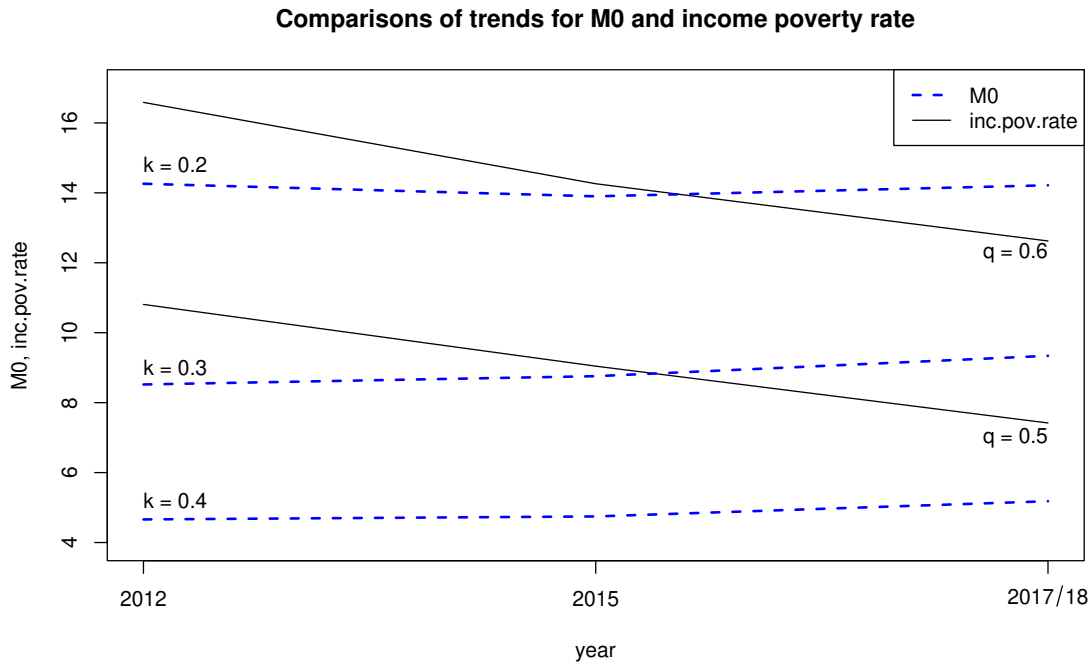

Figure 1: Comparisons of trends for M_0 and income poverty rate

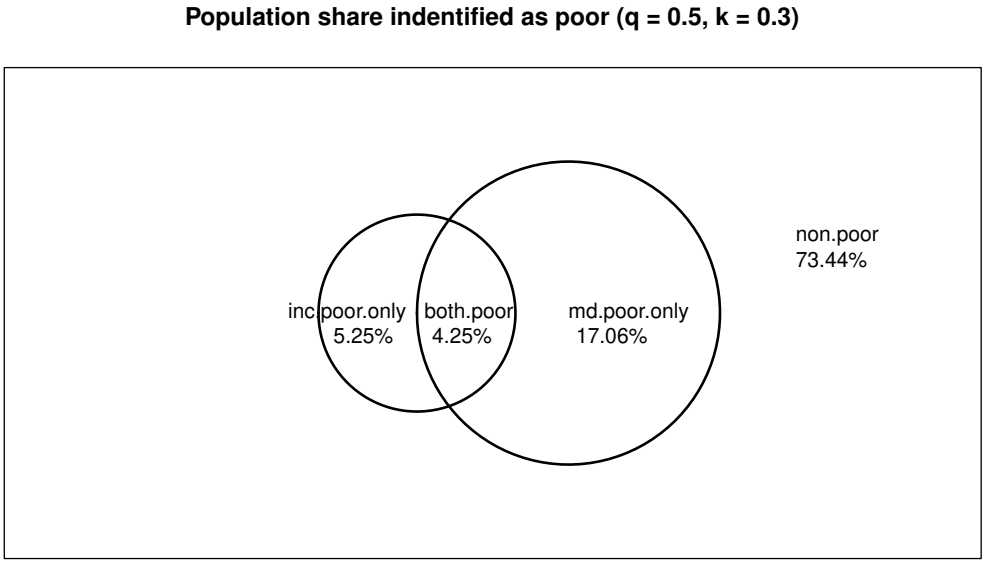

Figure 2: Population share indentified as poor ($q = 0.5, k = 0.3$)

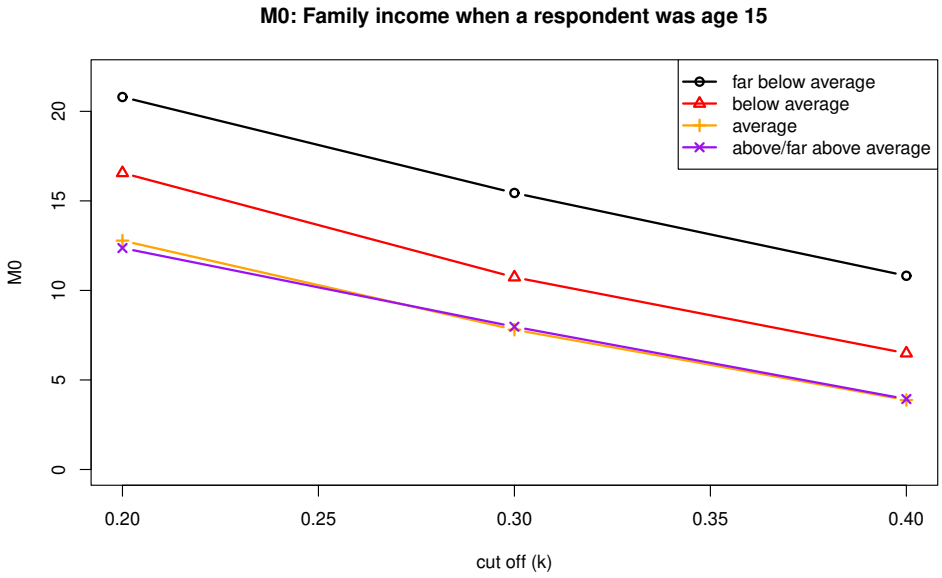

Figure 3: M_0: Family income when a respondent was aged 15

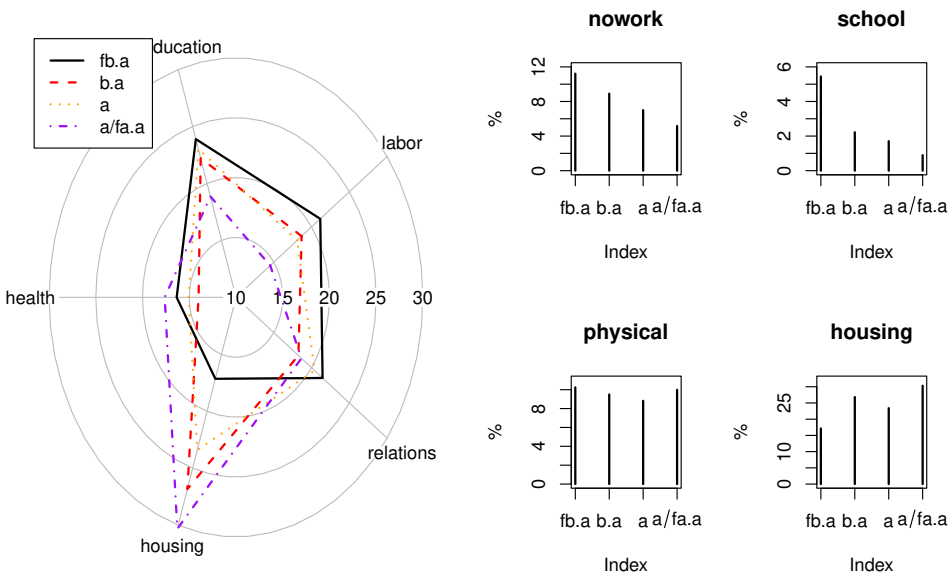

Figure 4: Percentage contributions to M_0 by subgroups for fiage15

Table 1: Sample size and variables

Panel (A)			
year	2012	2015	2017/18
original.sample.size	2332	2079	2660
%	100	100	100
employed	1308	1204	1516
% (weighted)	58	58	59
na.omitted	936	863	1097
% (weighted)	41	42	42
Panel (B): final sample size (na.omitted)			
year	2012	2015	2017/18
sex			
male	461	417	552
female	475	446	545
city size			
big city	238	224	293
cities with more than 200,000 (mt200t)	226	206	296
cities with less than 200,000 (lt200t)	376	345	429
towns and villages (town)	96	88	79
youngest child age (cldage)			
less than age 5 (ltage5)	159	141	188
between age 6-11 (bet.6-11)	106	105	122
between age 12-17 (bet.12-17)	110	102	135
age 18 or more (age18+)	320	268	357
no child (nocld)	241	247	295
the number of children less than age 18 (numcld)			
zero	561	515	652
one	159	149	173
two	167	147	197
three or more (three+)	49	52	75
family income when a respondent was age 15 (fiage15)			
far below average (fb.a)	69	66	74
below average (b.a)	238	226	252
average (a)	414	382	525
above/far above average (a/fa.a)	215	189	246

Note: Words in parentheses that follow variables or subgroups represent their abbreviations.

Table 2: Dimensions, indicators, cutoffs, and weights

	dimension	indicator	abbreviation	item
1	Labor	non-working	nowork	Reasons for non-working
2		employment type	emptype	Employment status
3		work hour	wkhour	Overwork
4	Education	schooling	school	Completion of school
5		reading books	book	Number of books read per month
6		reading newspaper	newsp	Frequency of reading newspapers
7	Health	physical helath	physical	Health status
8		mental health	mental	Feeling depressed
9	Housing	housing	housing	Do you want to continue living?
10	Relationships with family members	sports	sports	Frequency of sports
11	and acquaintances	dinner with family	dinner	Frequency of dinner with family
12		meeting with friends	friend	Frequency of dinner or meeting with friends
13		housework	housework	Frequency of housework

(Cont. from above)	target	deprivation cut-off	weight
1	household head	unemployed, physical/mental reasons	1/5
2	household head	part-time job, dispatch, contract, commission	1/10
3	household head	more than 60 hours per week	1/10
4	household head	junior high school	1/15
5	respondent	rarely read	1/15
6	respondent	don't read at all	1/15
7	respondent	bad/not really good	1/10
8	respondent	always/almost always	1/10
9	respondent	move if possible/immediately	1/5
10	respondent	several times a year/rarely	1/20
11	respondent	once a week or less	1/20
12	respondent	never	1/20
13	respondent	4 out of 5 tasks are once a month or less	1/20

Note 1: Housework consists of dinner preparation, washing, daily necessities shopping, cleaning the house, and garbage disposal.
Note 2: The weight for nowork and the weights for emptype and wkhour are alternative (see sec. 4.3.2 for details).

Table 3: Comparisons of M_0 using standard error

	M_0	Stand. err.	95% Confidence Interval	
			Lower bound	Upper bound
$k = 0.2$				
2012	14.26	0.56	13.15	15.37
2015	13.90	0.60	12.71	15.09
2017/18	14.22	0.55	13.14	15.29
$k = 0.3$				
2012	8.52	0.56	7.43	9.61
2015	8.76	0.59	7.59	9.92
2017/18	9.34	0.54	8.28	10.40
$k = 0.4$				
2012	4.66	0.47	3.73	5.59
2015	4.75	0.51	3.75	5.75
2017/18	5.18	0.47	4.26	6.11
	Pov.rate	Stand. err.	95% Confidence Interval	
			Lower bound	Upper bound
$q = 0.5$				
2012	10.81	1.02	8.82	12.80
2015	9.04	0.98	7.13	10.96
2017/18	7.42	0.79	5.87	8.97
$q = 0.6$				
2012	16.59	1.22	14.20	18.97
2015	14.26	1.19	11.93	16.60
2017/18	12.62	1.00	10.66	14.59

Table 4: Population share identified as poor

Panel (A)						
	$q = 0.5$			$q = 0.6$		
	$k = 0.2$	$k = 0.3$	$k = 0.4$	$k = 0.2$	$k = 0.3$	$k = 0.4$
(a) both.poor	6.91	4.25	2.59	9.77	5.94	3.49
(b) inc.poor.only	2.59	5.25	6.91	5.18	9.01	11.46
(c) md.poor.only	35.95	17.06	7.29	33.08	15.37	6.39
(a)/(a)+(b)	72.73	44.73	27.27	65.36	39.72	23.33
Panel (B): income poor over md poor						
	$k = 0.2$		$k = 0.3$		$k = 0.4$	
	$q = 0.5$	$q = 0.6$	$q = 0.5$	$q = 0.6$	$q = 0.5$	$q = 0.6$
(a)/(a)+(c)	16.12	22.80	19.94	27.88	26.22	35.31

Table 5: M_0 for different subgroups (Table A1)

	$k = 0.2$	$k = 0.3$	$k = 0.4$
sex			
male	13.91	9.29	4.94
female	14.38	8.81	5.04
city size			
big city	13.46	8.42	4.67
cities with more than 200,000	13.52	8.98	5.02
cities with less than 200,000	14.80	9.56	5.14
towns and villages	15.09	9.03	5.20
youngest child age			
less than age 5	11.91	5.71	2.66
between age 6-11	10.66	6.18	3.24
between age 12-17	11.42	7.01	3.73
age 18 or more	12.82	8.77	5.28
no child	19.32	13.43	7.35
the number of children less than age 18			
zero	16.07	11.11	6.32
one	10.68	5.95	2.96
two	12.41	6.50	3.92
three+	10.96	6.18	1.52
fiage15			
far below average	20.80	15.44	10.82
below average	16.56	10.74	6.49
average	12.78	7.81	3.88
above/far above average	12.37	7.97	3.93

Table 6: Income poverty rate ($q = 0.5$) and $M_0(k = 0.3)$ by subgroups

	(a)pop.share	inc.pov.rate	(b)perc.contrib.inc.pov.	M_0	(c)perc.contrib.M_0	(b)/(a)	(c)/(a)
entire population	1	8.35	1	9.06	1	1	1
sex							
male	0.53	6.96	0.44	9.29	0.54	0.83	1.03
female	0.47	9.89	0.56	8.81	0.46	1.18	0.97
city size							
big city	0.27	6.84	0.22	8.42	0.25	0.82	0.93
cities with more than 200,000	0.26	7.54	0.24	8.98	0.26	0.90	0.99
cities with less than 200,000	0.39	8.57	0.40	9.56	0.41	1.03	1.06
towns and villages	0.09	14.53	0.15	9.03	0.09	1.74	1.00
youngest child age							
less than age 5	0.18	4.91	0.11	5.71	0.12	0.59	0.63
between age 6-11	0.12	1.86	0.03	6.18	0.08	0.22	0.68
between age 12-17	0.12	5.50	0.08	7.01	0.09	0.66	0.77
age 18 or more	0.29	12.46	0.43	8.77	0.28	1.49	0.97
no child	0.29	10.15	0.36	13.43	0.43	1.22	1.48
the number of children less than age 18							
zero	0.58	11.30	0.79	11.11	0.71	1.35	1.23
one	0.18	2.58	0.06	5.95	0.12	0.31	0.66
two	0.17	5.52	0.11	6.50	0.12	0.66	0.72
three or more	0.06	5.57	0.04	6.18	0.04	0.67	0.68
fiage 15							
far below average	0.07	20.45	0.16	15.44	0.11	2.45	1.70
below average	0.24	10.70	0.31	10.74	0.28	1.28	1.18
average	0.47	7.25	0.40	7.81	0.40	0.87	0.86
above/far above average	0.23	4.54	0.12	7.97	0.20	0.54	0.88

Table 7: Dimensional percentage contribution to M_0 for different subgroups ($k = 0.3$)

Panel (A)						
	sex		fiage15			
	male	female	fb.a	b.a	a	a/fa.a
labor	16.86	19.13	21.15	18.69	18.10	14.53
education	21.03	23.29	23.89	22.22	23.04	18.86
health	15.96	14.78	16.35	14.00	15.05	17.63
housing	24.06	26.20	17.15	26.83	23.41	30.32
relations	22.10	16.59	21.46	18.26	20.40	18.66
Panel (B)						
	sex		fiage15			
	male	female	fb.a	b.a	a	a/fa.a
nowork	6.78	8.68	11.22	8.90	7.00	5.17
emptype	4.17	6.51	4.06	5.61	5.88	4.12
wkhour	5.91	3.94	5.88	4.18	5.22	5.24
school	1.78	2.52	5.45	2.22	1.71	0.90
book	11.64	12.38	11.17	12.36	12.31	11.25
newsp	7.60	8.39	7.27	7.64	9.02	6.71
physical	9.93	8.80	10.24	9.49	8.82	9.99
mental	6.03	5.98	6.10	4.51	6.23	7.64
housing	24.06	26.20	17.15	26.83	23.41	30.32
sports	8.36	9.77	9.15	9.23	9.03	8.57
dinner	5.40	3.30	4.01	3.14	5.06	5.28
friend	3.15	2.54	4.73	2.73	3.01	1.73
housework	5.19	0.98	3.57	3.15	3.31	3.09

Note: "Far below average," "below average," "average," and "above/far above average" abbriviate "fb.a," "b.a," "a," and "a/fa.a," respectively.

Table 8: M_0 for different subgroups and years (Table A2)

cutoff	$k = 0.2$			$k = 0.3$			$k = 0.4$		
year	2012	2015	2018	2012	2015	2018	2012	2015	2018
entire sample	14.29	13.90	14.23	8.56	8.76	9.34	4.70	4.75	5.18
sex									
male	15.34	14.35	13.34	9.48	9.40	9.19	5.23	4.88	4.89
female	13.05	13.39	15.17	7.43	8.02	9.51	4.02	4.59	5.50
city size									
big city	13.39	13.30	13.55	7.59	8.70	8.48	4.46	3.57	5.23
cities with more than 200,000	13.13	13.62	13.55	7.94	9.15	9.13	4.67	5.85	4.73
cities with less than 200,000	15.05	14.40	14.95	9.46	8.69	10.03	4.64	5.15	5.26
towns and villages	15.99	14.17	15.40	8.48	8.20	9.76	5.22	3.53	6.29
youngest child age									
less than age 5	12.35	10.99	12.22	5.60	5.11	6.01	2.32	2.83	2.67
between age 6-11	9.47	10.13	11.26	4.36	5.50	7.03	2.68	1.35	4.47
between age 12-17	11.19	12.90	10.79	5.47	6.82	7.45	2.58	2.30	4.66
age 18 or more	15.83	12.56	12.19	11.21	8.51	8.29	6.60	5.58	4.81
no child	16.99	18.73	20.18	10.44	13.16	14.28	5.76	7.43	7.69
the number of children less than age 18									
zero	16.39	15.80	16.13	10.84	10.96	11.24	6.19	6.55	6.23
one	9.27	12.90	9.96	3.02	7.26	6.03	1.05	2.79	3.50
two	13.30	10.08	13.38	7.48	4.81	7.12	4.21	1.99	4.83
three or more	11.38	9.78	11.43	5.55	3.70	7.46	1.86	1.30	1.55
fiage15									
far below average	22.52	20.75	20.37	15.37	13.42	16.63	8.88	10.03	11.80
below average	14.98	17.28	16.58	8.46	11.55	10.88	4.07	6.78	6.97
average	13.81	12.25	12.79	8.38	7.38	7.88	4.85	3.09	4.02
above/far above average	11.85	10.96	13.17	6.78	6.70	8.88	3.66	3.91	4.01