Multidimensional Poverty Measurement and Poverty Reduction Effect Analysis — Based on the Survey Data of H County in Southern Shaanxi

Yangchenhao WU

School of Economics and Management, Northwest University, Xi'an, China; 13669237903@163.com

Abstract: This paper takes Southern Shaanxi, a national demonstration area of relocation for poverty alleviation, as the research object, uses the survey data of relocated farmers for poverty alleviation in southern Shaanxi, and uses the double boundary model (A-F model) to measure the Multidimensional Poverty Situation of local farmers before and after relocation, and analyzes the poverty reduction effect of relocation for poverty alleviation on relocated farmers. The study found that, on the whole, the relocation policy for poverty alleviation can effectively block the connection between farmers and the bad geographical capital of the relocation place, realize the spatial reconstruction, increase the disposable income of farmers, improve the accessibility of medical, educational and social entertainment activities, and realize the growth of the living capital and the enhancement of the livelihood ability of relocated farmers. Thus, it can effectively improve the Multidimensional Poverty Situation of relocated farmers, and has a significant poverty reduction effect. However, for different dimensions of poverty, the poverty reduction effects of relocation are quite different.

Key words: relocation for poverty alleviation; multidimensional poverty; poverty measurement; poverty reduction effect

JEL Classification: Q01; Q10; R10

1. Introduction

Poverty has always been an unavoidable major issue in human history. Similarly, poverty is also a major issue that hinders China's development and people's happy life. Shaanxi Province is a key province for poverty alleviation in China, with a large number of poor people, wide distribution and deep poverty degree. Especially in Hanzhong, Ankang and Shangluo cities in southern Shaanxi, because they are located in Qinba mountain area, they are invaded by natural disasters all year round, and the problem of poverty is particularly serious. The perennial natural disasters make the local ecology more fragile, and the safety of people's lives and property is threatened. The post disaster reconstruction also puts a heavy burden on families and the government, "it is difficult for one country to feed the people there". The harsh natural environment is accompanied by the poverty of the local people, and the accumulation cycle. The traditional way of poverty alleviation has encountered a bottleneck here. Relocation has become a historical and realistic necessity.

In the context of targeted poverty alleviation, Shaanxi, as a national demonstration site for relocation of relocation for poverty alleviation, officially started the relocation project of relocation for poverty alleviation in southern Shaanxi in May 2011. Now, the large-scale poverty alleviation and relocation work in southern Shaanxi has come to an end. At this time node, this paper first uses the first-hand research data in southern Shaanxi and uses the A-F double boundary method to measure the multidimensional situation of relocated farmers; Secondly, according to the measurement results, the multi-dimensional poverty changes of relocated farmers before and after relocation are obtained, which intuitively shows the poverty reduction effect of relocation of poverty alleviation in southern Shaanxi on relocated farmers, so as to provide an objective basis for the benefit evaluation of relocation of poverty alleviation and even targeted poverty alleviation; Finally, based on a deep understanding of the relocation difficulties faced by the relocated people in the first two steps, we put forward targeted countermeasures and suggestions to find a more reasonable and sustainable relocation plan. It is conducive to the relocated farmers with dual identities of farmers and immigrants, deal with the uncertainty caused by the change of living environment after relocation and resettlement, and further optimize the long-term benefits of relocation policies for poverty alleviation.

2. Literature Review

At present, the methods of poverty measurement are mainly divided into fuzzy set method (Cheli & Lemmi, 1995), axiomatic method (Bourguignon & Chakravarty, 2003), input-output efficiency method (Ramos & Silber, 2005), principal component analysis, multivariate correspondence analysis and other statistical methods. The fuzzy set method mainly includes three poverty fuzzy measurement methods, namely TFA complete fuzzy method, TFR complete fuzzy relative method avoiding the use of arbitrary threshold, and IFR comprehensive fuzzy relative method combining income cumulative distribution function with income Lorentz curve (Betti et al., 2006); Axiomatic method mainly measures multidimensional poverty by constructing indexes, which is the mainstream method of multidimensional poverty measurement at present, mainly including watts index (Chakravarty & Silber, 2008), FGT index (Foster et al., 2010), H-M index (Hagenaars, 1987), HDI human development index and HPI human poverty index (UNDP, 1997) Multidimensional Poverty Index MPI (UNDP, 2010), Ch-m index (Chakravarty et al., 1998, 2003; Tsui, 2002), F-M index (Chakravarty et al., 1998, 2003; Tsui, 2002), W-M index (Deutsch & Silber, 2005), multidimensional poverty assessment tool MPAT (Alasdair, 2010), A-F "double boundary" method (Alkire & Foster, 2011), etc. Among them, the Multidimensional Poverty Index MPI is a widely used multidimensional poverty measurement index system. A-F multidimensional poverty measurement method is also widely used because its measurement results are intuitive, easy to empirical analysis and insensitive to weight selection.

Some scholars in China are also constantly trying to explore and optimize the multidimensional poverty measurement method and index system. In terms of measurement methods, Li & Xu (2019) believe that the existing literature generally does not consider the impact of time factors on poverty characteristics, the subjective randomness of threshold setting

and unreasonable weight setting. In view of these three problems, the author improves the A-F method and complete fuzzy set method, and adjusts the weight coefficient at the same time. This makes it possible to highlight the impact of a certain dimension. In terms of index system, domestic scholars have expanded the HDI and MPI index system and added the dimensions of income, consumption and medical insurance on the basis of health, education and living standards (Long & Xie, 2018). Other scholars have paid attention to social capital (Liu & Xu, 2015) and subjective welfare, future confidence, life satisfaction and other dimensions (Xie, 2017).

3. Multidimensional Poverty Measurement and Poverty Reduction Effect Analysis of Relocated Farmers in Southern Shaanxi

By combing the literature, it can be found that the existing research mainly focuses on the qualitative research in the macro aspect, and the quantitative research in the micro aspect is relatively few. Based on this, this paper intends to take the relocated farmers for poverty alleviation in southern Shaanxi as the research object, measure and decompose their multidimensional poverty status by using the A-F method, compare the specific changes of farmers' Multidimensional Poverty Index before and after relocation by using the basic statistical analysis method, and analyze the actual poverty reduction effect of relocation on relocated farmers.

3.1. Data Sources

The data used in this paper comes from the farmers' relocation data obtained by the research group during the investigation of H county in southern Shaanxi in 2019. The investigation is conducted in the form of household questionnaire. A total of 167 questionnaires are distributed, 167 are recovered, 18 invalid questionnaires are excluded, and 149 valid questionnaires are left. The questionnaire contains 83 questions, mainly related to the basic situation of relocated farmers' families, annual income, personal development and social integration after relocation. The questions are mainly multiple-choice questions, and the options are "yes" or "no" and "very satisfied", "satisfied", "uncertain", "dissatisfied" and "very dissatisfied". Strive to fully reflect the changes in the production and life of relocated farmers before and after the relocation, so as to reflect the implementation status and existing problems of the relocation policy for poverty alleviation, and provide guidance for the next step.

3.2. Measurement of Multidimensional Poverty Index of Farmers

1. Introduction to the measurement method of A-F

The A-F method is proposed by Alkire and foster. The method is divided into three steps: first, identify the poverty object. In the process of identification, first set the poverty dimension and boundary. This boundary is divided into two layers: the inner boundary of the dimension and the outer limit of the dimension. The first boundary considers whether the identified object is deprived in each dimension. The second boundary determines whether they fall into multi-dimensional poverty by combining the deprivation results of each dimension. For this reason, this method is also called "double boundary method". Second, sum up the identification status

of multidimensional poverty. When summing up, first set the weight between each dimension in combination with the research purpose and data characteristics, so as to reflect the relative importance between different dimensions. Generally, the A-F method generally adopts the equal weight method in terms of indicators and dimensions, so as to calculate the poverty index on this basis. Third, decompose the poverty index and consider the contribution rate of each dimension to poverty. A-F method overcomes the insensitivity of FGT method to different

Table 1. Framework and critical value of multidimensional poverty index in rural areas

Dimension	Index	Indicator interpretation	Critical value (1 is assigned below the critical value)
Income (1/4)	Per capita net income (1/4)	Per capita net income is divided by the total household income by the number of households, and the specific value is adjusted to 2011 according to the price index.	Adopt the latest poverty line 2300 yuan (constant price in 2010) established by the government. If it is lower than this standard, it will be regarded as income poverty, and it will be assigned as 1, otherwise it will be assigned as 0.
Health (1/4)	Medical insurance (1/16)	Whether to join the new agricultural cooperative medical insurance.	Qualitative variables, "No" is assigned to 1, and "Yes" is assigned to 0.
	Pension insurance (1/16)	Whether to join the new agricultural cooperative endowment insurance.	Qualitative variables, "No" is assigned to 1, and "Yes" is assigned to 0.
	Nursing home/elderly service center (1/16)	Is there a nursing home or elderly service center in the new residence?	Qualitative variables, "No" is assigned to 1, and "Yes" is assigned to 0.
	Health status (1/16)	Self-evaluation of health status.	Qualitative variables, very unhealthy, unhealthy are assigned 1, and healthy, very healthy are assigned 0.
Education (1/4)	Years of education (1/8)	The highest years of education among family members.	If the highest educational years of family members are lower than the national legal compulsory education years (9 years), the value is 1; otherwise, the value is 0.
	Children attend school (1/8).	Have children aged 6-16 dropped out of school?	There are dropouts assigned as 1, and no dropouts assigned as 0.
life （1/4）	Domestic water (1/16)	Domestic water source: tap water, well water or others.	Qualitative variables, others are assigned as 1, and "tap water, bottled water, purified water and filtered water" is assigned as 0.
	Power-on condition (1/16)	Power-on condition: whether there is power-on or frequent power-off.	Qualitative variables, "no power" and "frequent power failure" are assigned as 1, while "occasional power failure" and "almost no power failure" are assigned as 0.
	Sanitation facilities (1/16)	Types of toilets: flush toilets, dry toilets and no toilets.	Qualitative variables, "dry toilet or no toilet" is assigned as 1, and "flushing toilet with water" is assigned as 0.
	Cooking fuel (1/16)	Main cooking fuels: firewood, coal, gas, natural gas, solar energy, biogas, electricity, etc.	Qualitative variables, "use firewood" is assigned as 1, and others are assigned as 0.

deprivation degrees among various dimensions of Multidimensional Poverty, and realizes the decomposability of Multidimensional Poverty aggregate index, which has very good quality.

2. Definition of dimensions and indicators

This paper refers to the structure of MPI in the Millennium Development Goals and human development report proposed by the United Nations, and describes Multidimensional Poverty from four dimensions of income, health, education and life, including 11 indicators, combined with the characteristics of the survey data (see Table 1 for details).

3. Identification of one-dimensional poverty

One dimensional poverty identification refers to determining whether an individual I is poor in a single dimension. Let I represent the sample individual, n represents the total number of samples, J represents a specific dimension of the study, and K represents the total dimension of poverty in the study design. If a critical value is set for each dimension, it can be used to judge whether individual I exceeds the critical value in dimension J. If it exceeds the critical value, it can be judged that individual I is poor in dimension J, which is recorded as 1. If it does not exceed the critical value, it is determined that individual I is non poor in dimension J, which is recorded as 0. In this way, n individuals can be determined.

This paper describes the Multidimensional Poverty Situation of relocated farmers for poverty alleviation in southern Shaanxi from the four dimensions of income, health, education and life. Therefore, the value of k is 4. Taking the family as the unit, the relocation data of 149 households are investigated, so the value of n is 149. When the element value is 1, it indicates that the household is poor in this dimension. When the element value is 0, It indicates that the household is non poor under this dimension.

Let q represent the number of individuals judged to be poor in dimension j, then the incidence of poverty in this dimension is H = q/n.

Table 2. Incidence of one-dimensional poverty in H county in southern Shaanxi

Poverty dimension		Income	Health	Education	Life
Incidence of poverty	Before relocation	11.24%	9.14%	8.98%	14.43%
	After relocation.	0.84%	7.42%	8.98%	2.01%

According to the above calculation method, we can calculate the poverty incidence rate of relocated farmers for poverty alleviation in southern Shaanxi in various dimensions. Specifically, the proportion of living poverty before relocation is the highest, followed by income poverty, and the incidence of health poverty and education poverty is basically the same, ranking third. After the relocation, the income poverty and living poverty decreased significantly, indicating that the relocation of poverty alleviation plays a significant role in alleviating the income poverty and living poverty of farmers, but the improvement of health poverty and education poverty is not obvious.

4. Identification and summation of multidimensional poverty

Multidimensional Poverty identification refers to determining whether an individual i is poor when multiple dimensions are investigated at the same time. Suppose d is the number of poverty dimensions examined at the same time. When studying Multidimensional Poverty, $d = 2, 3, 4,..., k$. Let c_i be the dimension number of Multidimensional Poverty of individual i. If $c_i \geq d$, it is determined that individual i is d-dimensional poverty, which is recorded as 1. If $c_i < d$, it is determined that individual i is non-poverty in d dimensions, which is recorded as 0.

On the basis of multidimensional identification, we can calculate how many individuals are in poverty under a certain dimension d. this process is called poverty aggregation.

On the basis of Multidimensional Poverty identification and aggregation, in order to enhance the sensitivity of the calculation results to the increase of poverty dimension, A-F method introduces a new parameter – average deprivation share A, which is used to express the average deprivation degree of individual i.

$$A_k = |c_i(k)|/(dq) \tag{1}$$

In formula (1), $c_i(k)$ represents the sum of the highest number of dimensions deprived of all individuals n under a specific number of dimensions k. It is easy to see that equation (1) averages $c_i(k)$ twice. The first time, that is, divide by d, averages all poverty dimensions faced by each individual i, and the obtained result represents the average deprivation degree of the individual in each dimension. The second time, i.e. dividing by q, is to average the poverty dimension level faced by all poor individuals, and the result represents the overall average deprivation degree of all individuals falling into poverty.

The Multidimensional Poverty Index M_0, $M_0 = AH$ can be obtained by combining the average deprivation share a with the incidence of poverty H.

Table 3. Multidimensional poverty index table of H county in southern Shaanxi

d		Number of poor households q	Degree of poverty dimension $c_i(d)$	Incidence of poverty H	Average share of deprivation A	Multidimensional poverty index M_0
1	Before relocation	149	453	1.000	0.760	0.760
	After relocation	143	245	0.960	0.428	0.411
2	Before relocation	145	449	0.973	0.774	0.753
	After relocation	95	197	0.638	0.518	0.331
3	Before relocation	116	391	0.779	0.843	0.656
	After relocation	4	15	0.027	0.938	0.025
4	Before relocation	43	172	0.289	1.000	0.289
	After relocation	3	12	0.020	1.000	0.020

Through the above methods, combined with the survey data, we can calculate the Multidimensional Poverty Index Table of H county in southern Shaanxi (Table 3), which comprehensively reflects the poverty incidence, average deprivation share and

Multidimensional Poverty Index of relocated farmers in different dimensions, as well as the changes of these variables before and after relocation. Specifically, when d = 2, the incidence of poverty H in the relocation area before relocation is 0.973, that is, 97.3% of families are deprived in two or more dimensions, with an average deprivation share of 0.774, belonging to the multi-dimensional poor population, and the multi-dimensional poverty index M_0 is 0.753. When d = 3, the incidence of poverty H in the relocated area is 0.027, the share of poverty deprivation is 0.938, and the Multidimensional Poverty Index M_0 is 0.025. It can be seen that with the implementation of the relocation policy, the Multidimensional Poverty Index under different dimensions decreased significantly before and after relocation.

5. Decomposition of Multidimensional Poverty

The A-F Multidimensional Poverty Index has the excellent property of decomposability. Through decomposition, the contribution rates of different dimensions to the index can be calculated, so as to further analyze the specific impact of each dimension on poverty.

If the contribution of different dimensions to the Multidimensional Poverty Index is M, there is:

$$M = \sum_{i=1}^{n} \frac{c_i(k)}{nd} \tag{2}$$

Where $c_i(k)$ represents the sum of the highest dimension number of all individuals n deprived under a specific dimension number k, n is the total number of individuals, and d is the number of poverty dimensions investigated at the same time. According to equation (2), the contribution rate of each dimension to the Multidimensional Poverty Index under different d values is calculated as follows (Table 4).

Table 4. Contribution rate of each dimension to multidimensional poverty index under different D values (%)

d		M_0	Income	Health	Education	Life
1	Before relocation	0.760	14.79	32.89	23.62	28.70
	After relocation.	0.411	2.04	53.06	43.67	1.22
2	Before relocation	0.753	14.92	32.29	23.83	28.95
	After relocation.	0.331	2.54	48.22	47.72	1.52
3	Before relocation	0.656	16.11	29.67	26.09	28.13
	After relocation.	0.025	26.67	26.67	26.67	20.00

According to the decomposition results of Multidimensional Poverty Index, the Multidimensional Poverty of relocated poverty alleviation farmers in southern Shaanxi has the following characteristics:

a) Before the relocation, the internal contribution rate to poverty in each dimension showed a stable trend, and this trend remained stable in different dimensions. For example, in the income dimension, when d = 1 before relocation, the contribution rate of this dimension is 14.79%, when d = 2, the contribution rate of this dimension is

14.92%, and when d = 3, the contribution rate of this dimension is 16.11%, showing a fairly stable trend, which also exists in the other three dimensions;

b) Before relocation, the contribution rate of each dimension to the Multidimensional Poverty Index was relatively average. For example, when d = 1, the contribution rate of income dimension is 14.79%, the contribution rate of health dimension is 32.89%, the contribution rate of education dimension is 23.62%, and the contribution rate of life dimension is 28.70%. The contribution level is basically maintained at around 25%, and there is no significant change with the increase of poverty dimension;

c) After the relocation, the internal contribution rate of each dimension changed significantly. When d = 1 and d = 2, the change of income dimension and life dimension is the most significant. When d = 1, the contribution rate of income dimension decreased from 14.79% to 2.04%, a decrease of more than 85%, and the contribution rate of life dimension decreased from 28.70% to 1.22%, a decrease of more than 95%, indicating that the relocation of poverty alleviation plays a significant role in reducing the income poverty and living poverty of relocated farmers; This law is also applicable when d = 2;

d) After the relocation, the contribution rate of each dimension to the multidimensional poverty index changed significantly. Take d = 1 as an example. When d = 1, the contribution rate of income dimension is 2.04%, the contribution rate of health dimension is 53.06%, the contribution rate of education dimension is 43.67%, and the contribution rate of life dimension is 28.70%. This law also appears when d = 2;

e) Among all dimensions, the contribution rate of health dimension and education dimension is the most prominent, and the contribution rate increases slightly after relocation. It can be seen that the contribution rate of health and education dimensions is basically maintained at about 30%, sometimes even 50%. The comprehensive contribution of health and education dimensions to poverty basically accounts for more than half of the total poverty index. The reason is that the relocation policy can only improve the availability of medical resources for relocated farmers in a short time, but cannot improve the health status of farmers in a short time, which has a lag effect. At the same time, the respondents in this survey are generally over 40 years old, and their education level is generally low, resulting in a large contribution rate of educational poverty to the Multidimensional Poverty Index, which cannot be changed in the short term by the relocation policy of local poverty alleviation;

f) The contribution rate of health dimension and life dimension to poverty before relocation is large, and the contribution rate of health dimension and education dimension to poverty after relocation is large, indicating that relocation can effectively reduce the living poverty of relocated farmers, but has no significant effect on reducing health poverty. At the same time, it can be seen that relocation for poverty alleviation also plays a significant role in reducing farmers' income poverty.

4. Conclusion and Policy Recommendations

4.1. Research Conclusion

Based on the field survey data of H county in southern Shaanxi, this paper uses the A-F multi-dimensional poverty measurement method to measure the multi-dimensional poverty status of relocated farmers before and after relocation, and obtains the multi-dimensional poverty index, which intuitively explains the impact of the relocation policy of poverty alleviation on the multi-dimensional poverty status of relocated farmers. On this basis, the Multidimensional Poverty Index is decomposed to obtain the impact proportion of different dimensions on Multidimensional Poverty, and effectively identify the impact of relocation of relocation for poverty alleviation on each dimension of poverty. The main conclusions are as follows:

1. On the whole, the relocation policy has a significant impact on Farmers' multidimensional poverty. The relocation policy of poverty alleviation can effectively block the connection between farmers and the bad geographical capital of the relocation place, realize spatial remodeling, significantly improve the overall livelihood capital level of relocated farmers, enhance the sustainable livelihood ability of relocated farmers, and have a significant effect on poverty reduction;

2. However, for different dimensions of poverty, the poverty reduction effects of relocation are quite different. Specifically, relocation for poverty alleviation has a significant positive effect on reducing poverty in income dimension and life dimension, but it has no significant impact on poverty in health dimension and education dimension;

3. Different from the "intervention" poverty of relocated farmers caused by relocation due to large-scale projects, relocation for poverty alleviation can significantly improve the Multidimensional Poverty of farmers by increasing their disposable income, improving the accessibility of medical, educational and social entertainment activities, as well as housing and quality of life.

Overall, the relocation of poverty alleviation in southern Shaanxi in the past decade has achieved remarkable results, successfully achieved the goal of poverty reduction, and the situation of relocated farmers has been greatly improved. We explored a relocation path of poverty alleviation combined with the actual situation, and found a sustainable relocation way of poverty alleviation.

4.2. Policy Recommendations

The implementation of the relocation policy can be roughly divided into two stages: one is how to make poor farmers willing to move and how to move, so as to "move and live stably". The second is how to help farmers get rid of poverty and integrate into the resettlement site after relocation, so as to "get rich and integrate well". At present, the task of the first phase of the relocation project has been basically completed. The implementation of targeted Poverty Alleviation Policies, policy performance evaluation and policy optimization should focus on the second stage, that is, helping poor farmers achieve stable poverty alleviation and social

integration after relocation, and doing a good job in the "second half of the article" of poverty alleviation and relocation in other places. Based on this, combined with the effect of poverty reduction, the relocation policy for poverty alleviation should be optimized in the following three aspects:

a) In the post poverty alleviation era, we should continue to strengthen relocation poverty alleviation, strengthen sustained policy support, give full play to the leading role of the government, take employment and income increase as the core, enhance the endogenous development ability of farmers, build a long-term mechanism for poverty reduction and development, reduce the risk of returning to poverty of vulnerable farmers, and completely solve the situation of "people poor" due to "land poverty";

b) In view of the fact that relocation has no significant impact on health and education poverty, in the process of poverty alleviation in the future, we should launch corresponding targeted measures to improve the accessibility of medical and educational resources of the relocated people in the relocated areas, and connect the basic social security such as the new rural cooperative medical system, the new rural social security system and the minimum living security system for the relocated farmers, Ensure that the basic social security of relocated farmers is not lower than the level of resettlement sites, and build high-quality and reliable schools in the centralized resettlement areas to further eliminate poverty caused by education and health;

c) We should actively integrate the relocation project for poverty alleviation with the Rural Revitalization Strategy, consolidate and improve the results of targeted poverty alleviation of the relocation project, and realize the stable lifting of relocated farmers out of poverty.

Conflict of interest: none

References

Alasdair, C. (2010). The Multidimensional Poverty Assessment Tool: a new framework for measuring rural poverty. *Development in Practice*, *20*(7), 887-897. https://doi.org/10.1080/09614524.2010.508111

Alkire, S., & Foster, J. (2011). Counting and Multidimensional Poverty Measurement. *Journal of Public Economics*, *95*(7), 476-487. https://doi.org/10.1016/j.jpubeco.2010.11.006

Betti G., Cheli, B., Lemmi, A., & Verma, V. (2006) Multidimensional and Longitudinal Poverty: an Integrated Fuzzy Approach. In A. Lemmi, & G. Betti (Eds.), *Fuzzy Set Approach to Multidimensional Poverty Measurement. Economic Studies in Inequality, Social Exclusion and Well-Being* (Vol. 3, pp. 111-137). Springer. https://doi.org/10.1007/978-0-387-34251-1_7

Bourguignon, F., & Chakravarty, S. R. (2003). The Measurement of Multidimensional Poverty. *The Journal of Economic Inequality*, *1*(1), 25-49. https://doi.org/10.1023/A:1023913831342

Chakravarty, S. R., Mukherjee, D., & Ranade, R. R. (1998). On the family of subgroup and factor decomposable measures of multidimensional poverty. *Research on Economic Inequality*, 8, 175-194.

Chakravarty, S. R., & Silber, J. (2008). Measuring Multidimensional Poverty: The Axiomatic Approach. In N. Kakwani, & J. Silber (Eds.), *Quantitative Approaches to Multidimensional Poverty Measurement* (pp 192-209). Palgrave Macmillan. https://doi.org/10.1057/9780230582354_11

Cheli, B., & Lemmi, A. (1995). A "totally" fuzzy and relative approach to the multidimensional analysis of poverty. *Economic Notes*, *24*(1), 115-134.

Deutsch, J., & Silber, J. (2005). Measuring multidimensional poverty: An empirical comparison of various approaches. *Review of Income and Wealth*, *51*(1), 145-174. https://doi.org/10.1111/j.1475-4991.2005.00148.x

Foster, J., Greer, J., & Thorbecke, E. (2010). The Foster-Greer-Thorbecke (FGT) Poverty Measures: Twenty-Five Years Later. *The Journal of Economic Inequality*, 8, 491-524. https://doi.org/10.1007/s10888-010-9136-1

Hagenaars, A. (1987). A Class of Poverty Indices. *International Economic Review*, *28*(3), 583-607. https://doi.org/10.2307/2526568

Li, Q. F., & Xu, W. X. (2019). Construct and Decompose of Multidimensional Deep Poverty Index. *Statistics and Decision*, *35*(18), 72-75. https://doi.org/10.13546/j.cnki.tjyjc.2019.18.015

Liu, Y. H., & Xu, Y. (2015). Geographical identification and classification of multi-dimensional poverty in rural China. *Acta Geographica Sinica*, *70*(6), 993-1007. https://doi.org/10.11821/dlxb201506012

Long, Y., & Xie, H. (2018). Calculation and Dynamic Decomposition of Poverty Index in China: Perspective of Multidimensional Poverty. *Finance and Trade Research*, *29*(11), 43-50. https://doi.org/10.19337/j.cnki.34-1093/f.2018.11.004

Ramos, X., & Silber, J. (2005). On the application of efficiency analysis to the study of the dimensions of human development. *Review of Income and Wealth*, *51*(2), 285-310. https://doi.org/10.1111/j.1475-4991.2005.00155.x

Tsui, K. (2002). Multidimensional poverty indices. *Social Choice and Welfare*, *19*(1), 69-93. https://doi.org/10.1007/s355-002-8326-3.

UNDP.（1997). *Human Development Report 1997: Human Development to Eradicate Poverty*. Oxford University Press.

UNDP. (2010). *Human Development Report 2010: The Real Wealth of Nations - Pathways to Human Development*. New York.

Xie, E. (2017). Pensions and Multidimensional Elderly Poverty and Inequality: A Comparative Perspective on Urban and Rural Non-compulsory Pension Insurance. *Chinese Journal of Population Science*, (5), 62-73.