Chapter 3
Absolute and Relative Changes in Rural Poverty

The issue of poverty has traditionally been of interest to development economists. Scholars usually tend to classify poverty as absolute poverty and relative poverty. At present, China is still moving from a low-income country to the ranks of middle-income countries. In the past development process, rural poverty has been characterized by the coexistence of absolute and relative poverty. This chapter will study the phenomenon of absolute and relative poverty in China.

1 Long-Term Changes in Absolute and Relative Poverty in Rural China

Since the reform and opening up, China's economic growth has been relatively effective, but it has not achieved the performance agreed upon by the academic community in terms of income distribution. According to the household survey data of the NBS of China, the Gini coefficient of China's national resident income rose from 0.31 to 0.45 between the early 1980s and the early 2000s, and correspondingly, the Gini coefficient of rural resident income rose from 0.25 to 0.36. With micro-survey data of China adopted, some domestic and foreign scholars have measured and assessed the Gini coefficient of resident income of China in other years (Xie and Zhou 2014; Li et al. 2017; Luo et al. 2020). For example, Benjamin et al. (2005) found that the Gini coefficient of national resident income rose from 0.37 in 1991 to 0.44 in 2000 using China Health and Nutrition Survey (CHNS) data. Luo et al. (2021) found, based on CHIP data, that the Gini coefficient of China's resident income rose from 0.381 in 1988 to 0.49 in 2007. In 2019, the NBS of China published the Gini coefficient of national resident income since 2003.[1] The data showed that the Gini coefficient was as high as 0.491 in 2008, and after this peak, the Gini coefficient of

[1] See: Publication of Office of Household Survey, National Bureau of Statistics of China, *China Household Survey Yearbook 2019*, Beijing: China Statistics Press, 2019, p 451.

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China's resident income showed a continuous downward trend. However, there was no consensus among the academia as to whether China has experienced the "inverted U-shape" inflection point in 2008 and started to show a decreasing trend of income inequality. For example, Chen et al. (2018) and Chen and Zhang (2021) suggested that the changes in China's resident income inequality after the reform and opening up have roughly followed an inverted U-shape trajectory through their estimation of the changes in China's long-term income inequality; however, Luo et al. (2021) had different opinions.

Looking back on the establishment process of poverty lines, China has implemented three rural poverty lines, namely the "1978 poverty line", the "1998 poverty line" and the "2010 poverty line", which are commonly characterized by being absolute poverty-oriented to ensure that the minimum needs of rural residents in different development periods are guaranteed. For example, the "1978 poverty line" is a minimum subsistence line, the "1998 poverty line" aims to reach the level of subsistence for rural residents, and the "2010 poverty line" is the standard bottom line for moderate prosperity.[2]

To put this in context, Fig. 1 shows the changes in the relative income levels of China's rural poor people, based on the absolute poverty line. At the beginning stage of reform and opening up, China's distribution model featured a relatively fair but low per-capita income level, at which time the poverty headcount ratio measured by the current official absolute poverty line in rural areas (RMB2300, based on the 2010 price) was significantly higher than the relative poverty headcount ratio, in other words, the major issue facing China's rural areas in the early stages was absolute poverty. Along with the development of national economy, the per capita income level of rural residents has increased significantly, with gradually widened income inequality. At the meantime, the relative poverty headcount ratio in rural areas continued to rise, while the absolute poverty headcount ratio had been falling.

In the twenty-first century, it can be seen that the rural poverty headcount ratio measured by the two poverty lines began to approach or even cross. Figure 1 shows that around 1998, the poverty headcount ratio measured by 60% of the median of the rural residents' per capita disposable income (hereinafter referred to as the "median income") as the relative poverty line was close to that measured by the World Bank's "USD 1.9" standard as the absolute poverty line. Around 2004, the poverty headcount ratio measured by 50% of the median income as the relative poverty line was close to that measured by the official absolute poverty line of rural China (RMB2300, based on the 2010 price). Around 2009, the poverty headcount ratio measured by 40% of the median income as the relative poverty line was close to that measured by the World Bank's "USD 3.2" as the absolute poverty line. From then on, the rural

[2] In 2011, the State Council set the rural poverty line for 2011–2020 as "RMB2,300 per person per year at the 2010 price level". According to the calculation of the National Bureau of statistics, with respect to nutrition, the food expenditure in the new poverty line in 2010 could not only satisfy the basic needs of survival, i.e., 2100 cal needed for every person per day, but also adapt to the moderately prosperous society and meet the basic needs of healthy survival. This poverty line, equivalent to USD1.60 per person per day, indicated that the actual living standard of rural residents was significantly higher than the international poverty line of USD1.9 per person per day.

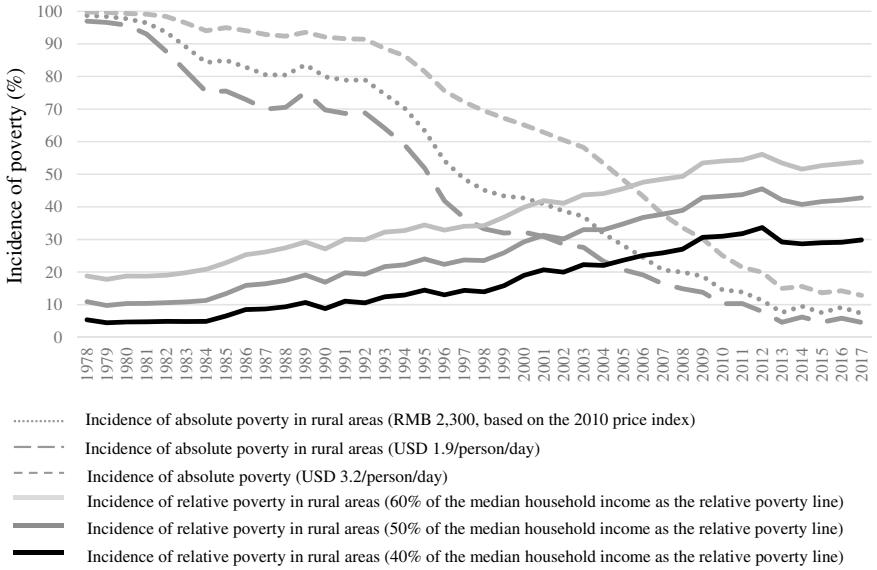

Fig. 1 Changes in Rural Poverty in China at Different Periods under Absolute Poverty Line and Relative Poverty Line: 1978–2017. *Note* The data are collated by the author based on the articles of Wang et al. (2020)

poverty level based on the absolute poverty line and relative poverty line began to present "reverse" changes, and the current absolute poverty line had been inadequate to effectively identify some vulnerable population, which indicated that the rules of setting poverty line for China's rural areas should be adjusted appropriately. Taking the national policy development orientation into consideration, it is inevitable to shift from absolute poverty line to relative poverty line. As for the most suitable time to transit to relative poverty line, China's actual situation and national development strategy objectives need to be taken into account, which is not further explained here.

In general, based on the trend of changes in poverty obtained by different poverty lines, the falling proportion of the poor population's incomes indicates that the gap between the absolutely poverty and the overall development level of China's rural areas is widening, with the problem of rural relative poverty highlighted. Appropriate income difference is reasonable in the stage of low economic level. Making some people rich first helps to enhance the enthusiasm of workers and further improve the economic production efficiency of the country. At the same time, it is also an inevitable approach to allow those who become prosperous first to help those who lag behind and finally achieve the goal of common prosperity. However, when the country's economic development reaches a higher level, at which time the people's living standards are generally improved, and they can fully enjoy various social benefits and resources, or even leading to the waste of resources, the rural areas still have many residents who can barely maintain their own subsistence level, which is obviously contrary to the principle of fairness and justice. More seriously, relative

deprivation is an inevitable outcome of relative poverty, preventing the poor from fully accessing the resources of education, medical treatment and social security, which does not help the poor people to develop sustainably, but can predispose them to the "poverty trap". Great importance should therefore be attached on such issue. Based on this, starting with the story presented in Fig. 1, the following is a description of the changes in rural absolute and relative poverty amid the rural economic growth and gap changes in China.

2 Methods and Data

2.1 Data and Ungrouping Methods

This section will explore into the rural absolute and relative poverty amid the widening gap between growth and income. Before that, the samples and main methods adopted in this section are introduced.

With respect to the data, our samples were taken from the income data of rural residents in 20 groups in the *China Yearbook of Rural Household Survey* over the years, and the average household population information was used to convert the household income data into per capita income. After simulating the large sample data, the income data of the lower quintile population was selected as the research object to draw graphics.[3] First of all, the data published by the National Bureau of Statistics are macro-grouped data. All rural residents are divided into 20 groups in order of low to high net income, which consists of per capita net income, household resident population and other information, according to the income interval of RMB100, RMB200 and RMB500. This set of data has the advantages of annual continuity and strong nationwide representation, which is suitable for long-term timing and history description. However, the rough information presented by the grouped data is much less favorable for our understanding of the overall income distribution of rural residents, thereby leading to difficulty in grasping the pattern of population income distribution in highest income group, especially since 1995, the National Bureau of Statistics had taken "RMB5000 and above" as the income classification criteria for highest income group.

In order to render the data more suitable to the research, different scholars utilized different data processing methods, but all with the same core idea: presupposing that the distribution of rural residents' incomes follows a particular distribution form, and then conducting the data fitting. Lin (2003), for instance, chose the fitted GQ or Bata Lorenz curve to obtain the national poverty index based on the national grouping data, but this method was only applicable to the data obtained before 2000, which turned into a complete failure with the more rough data provided by the National

[3] Except in 1980, the rural impoverished population was far lower than that number of the households with lowest 20% income, so the poor population is the proper subset of the samples selected.

Bureau of Statistics[4]; Wang et al. (2006), by setting a quadratic piecewise function, used the quadratic spline function approximation method to obtain the density function of the income distribution of rural residents, which, although being more scientific, assumed that the income of rural residents followed a Pareto distribution, showing high subjectivity. Besides, the Pareto distribution had been proved not to be suitable for the study of low-income groups (Kang and Jiang 2009); Other scholars, by directly setting the income distribution of rural residents to follow the lognormal distribution, used a regression method to estimate the Lorenz curve, which also had strong subjectivity (Hu et al. 2007; Wan and Zhang 2009; Kang and Jiang 2009), with the problems of relatively vague income grouping data of rural high-income groups.

Different from previous studies, we chose the Ungrouping method (Shorrocks and Wan 2008) to process data, which mainly aims to construct a set of large sample synthetic samples that can accurately match the original data on the basis of the original grouping data. The biggest advantage of this method is that it is suitable for data of any grouping forms, which to some extent, makes up for the problem of fuzzy distribution of high-income groups. The data simulation process of Ungrouping method is divided into two steps: the first step is to construct the synthetic samples according to the preset distribution function[5]; the second step is to constantly adjust the synthetic samples to fit the original data as much as possible. Using the micro data of the United States 2000 Current Population Survey (CPS), two scholars tested the accuracy of the Ungrouping method. The test was divided into two aspects: (1) with absolute deviation as the evaluation standard, it was proved that there was little difference between the synthetic samples and the real distribution under the premise of using the appropriate distribution form; (2) the error between the inequality indexes calculated with synthetic samples and actual data was found to be within 5%.

According to the second test method, we simulated and tested six distributions in turn,[6] and found that in addition to the GQ distribution, the error between the other five calculations and the data published by the National Bureau of Statistics was within 4%, of which the SM distribution with the generalized Pareto Distribution and Weibull Distribution characteristics had the least error (see Table 1), so we chose the SM distribution as the basis for constructing the data. The reason why other distribution forms are not adopted is that the uniform distribution is quite

[4] In terms of the method itself, Villasenor and Arnold (1989) proposed that the GQ method could only obtain effective numerical results under certain conditions. The Lorenz curve obtained on the basis of Beta function (Kakwani 1980) often produce negative values (even for income data), which violates the validity of the Lorenz curve (Minoiu and Reddy 2006).

[5] It should be noted that six distribution forms were listed in the Stata program, but only five distribution types were mentioned in the article by Shorrocks and Wan (2008): LN, GQ, Beta, generalized Bate and SM distribution.

[6] The simulation results were tested by measuring Gini coefficient and poverty incidence index H. Among them, the calculation of Gini coefficient was helpful to evaluate the fitting effect of synthetic samples on the distribution of all rural population, while the calculation of H index was more revealing - because the poor people occupied a small proportion in rural population, it was not easy to accurately estimate a more refined result based on grouping data.

Table 1 Calculation error of inequality index under synthetic samples of different distribution (%)

	1980		1990		2000		2010		1980–2010	
	Gini	H	Gini	H	Gini	H	Gini	H	Gini	H
LN	3.92	−1.87	−3.25	0.53	0.84	−0.90	2.09	−0.69	0.80	−1.15
Normal	3.68	−0.75	−3.37	0.02	0.63	−0.90	−6.09	−0.69	−1.75	−0.61
Uniform	3.80	−2.80	−3.42	0.53	0.48	−1.80	−7.77	−1.85	−2.27	−1.91
Beta	3.86	−2.05	−3.27	0.01	0.96	0.08	0.73	−0.69	0.41	−1.26
GQ	63.51	62.90	41.07	161.66	23.00	117.52	19.68	116.94	33.99	94.70
SM	3.75	−1.12	−3.27	0.01	0.92	0.01	−3.63	−0.69	−0.90	−0.72

Source The data is calculated and collated by the author according to *China Yearbook of Rural Household Survey* and *China Statistical Yearbook* over the years

Note: ① Gini refers to Gini coefficient, H refers to poverty incidence index. The data in the table is the calculation error under different indexes; ② The six distribution forms are lognormal distribution (Log normal), normal distribution (Normal), uniform distribution (Uniform), Beta distribution, General Quadratic Lorenz Curve and SM distribution (Singh and Maddala, 1976); ③ The benchmarks for the comparison of calculation errors are extracted from the Gini coefficient and poverty incidence index provided in *China Yearbook of Household Survey* and *China Statistical Yearbook* over the years; ④ The first eight columns of the inequality index is the comparison between the errors of the inequality index in the same year, while the latter two columns is the comparison of the mean errors after calculating the mean value of the inequality index from 1980 to 2010.

different from the actual distribution of rural impoverished population in China. GQ distribution can obtain effective numerical results only under certain conditions (Villasenor and Arnold 1989); Lorenz curve fitted by Beta distribution (Kakwani 1980) is prone to negative values (Minoiu and Reddy, 2006); the strict (logarithmic) normal distribution hypothesis is more suitable for fitting homogeneous population (Wang 2005; Liu et al. 2009), which is not in line with the actual situation in rural China.

2.2 Rationality Explanation of Selected Income

The per capita net income of families is taken as an indicator to measure the degree of income inequality and poverty by us, which suffers from the criticism by some scholars. First of all, some scholars believe that the net income does not cover implicit welfare subsidies and self-owned housing rent, which cannot fully reflect the actual welfare level of rural residents (Kahn and Li, 1999). However, Luo (2012) holds that this will not result in serious deviation because "the implicit welfare subsidies obtained by rural residents are very small and the phenomenon of renting houses in rural areas is also very rare".

Secondly, with regard to the method of simply converting household data into the number of head count, the impact of household size and structure is neglected—the same per capita income level does not necessarily mean that individuals from different

families have the same amount of actual resources. In addition, the disparity between the age and gender structure of different members will also affect their consumption demand. Generally speaking, scholars are inclined to standardize household size by using the equivalent scale of fixed elasticity. To be specific, n_i represents the number of populations of household i and its equivalent scale is $k_i = n_i^{\theta}$. θ represents the scale elasticity. The smaller its value is, the higher the degree of equivalent scale is. When $\theta = 1$, there is no scale economy. $\theta = 0.5$ is the equivalent scale commonly used in OECD countries but this scale elasticity is not suitable for China. This is because most Chinese families are nuclear families. In terms of the expenses such as education expenditure, the consumption expenditures of children and adults are very close. Therefore, it is desirable that the per capita net income (i.e., $\theta = 1$) is regarded as a measure level of welfare (Wan and Zhang 2006; Luo 2012).[7]

2.3 Kernel Density Estimation

The research of poverty is generally inseparable from the measurement and calculation of poverty index. The traditional poverty index is provided with the advantages of accuracy and easy comparison. However, the poverty index is a one-dimensional value after all. The same poverty index may correspond to an infinite number of distribution forms. The income change information and corresponding policy meanings implied in different distribution forms are also different. Figure 2 shows several income distributions. The vertical line is the poverty line and the distribution curve on the left of the poverty line is the income distribution pattern of the impoverished population. In senario 1, the population density increases with the increase of income; Senario 2 is the opposite. In senario 3, the impoverished population is mostly concentrated in the range of higher income level and almost no one's income is less than RMB150. On the contrary, in senario 4, the income situation of the impoverished population is extremely bad and no one's income is higher than RMB150. If the poverty indexes of the above four senarios are calculated, although the H-indexes of senarios 1 and 2 may be the same, the H-indexes (poverty headcount ratio) of situations 3 and 4 may be the same. In addition, the PG indexes (poverty gap index) of situations 1 and 3, 2 and 4 may be the same, but the distribution map shows that there are essential differences in these four senarios. Besides, the corresponding poverty alleviation policies are also different.[8]

[7] In the process of calculating the one-dimensional poverty index in the following chapters, the data that we have access to are based on households. Due to the calculation needs, it is necessary to convert the household data into head count data. This conversion means that we must make a strong assumption of the average distribution of household income among household members. As is known to all, the per capita net income of different members of the household is different on the whole and this processing will inevitably reduce the accuracy of the data. This is certainly also a sacrifice that must be made in the data calculation.

[8] Refer to Chap. 5 for the definition of H index and PG index.

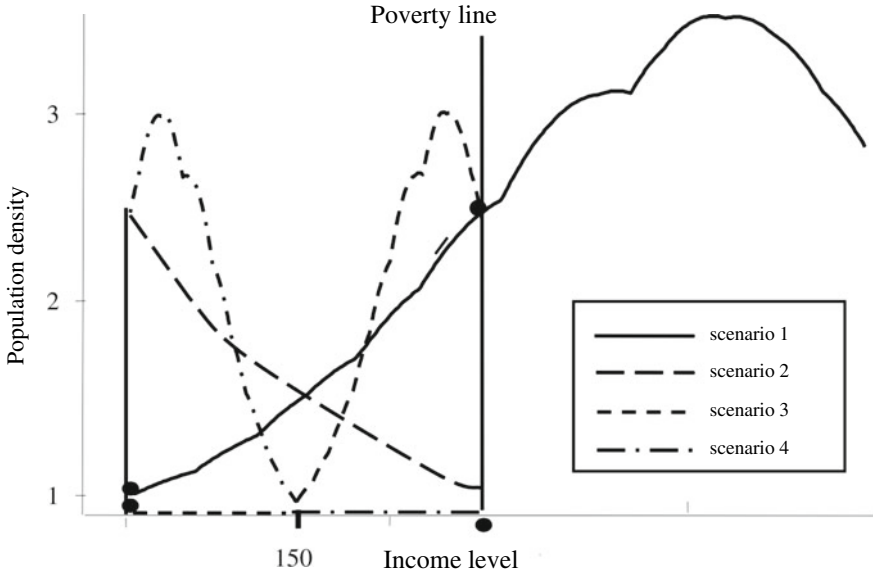

Fig. 2 Several different situations of income distribution of impoverished population under the same poverty index

As a result, the research of income distribution is very necessary. The position, spread and distribution modality of the distribution curve can display massive effective information. In the meantime, it is also beneficial to broaden the research scope—just draw the poverty line at the corresponding position of the distribution map to study the distribution under the specific poverty line. The rural poverty line set by the Chinese government is low and the actual number of impoverished populations may be more than the official data. Before the objective poverty alleviation standard is determined, most of low-income population may be "potential impoverished population". Therefore, we take rural low-income households as the drawing sample and include the low-income population whose income is higher than the poverty line into the scope of the research in combination with the income changes of different poor people. This also reflects another value of our research—striving to establish a link between poverty alleviation standards and poverty status. After observing the changing relationship between the poverty line and the income distribution curve, we find that one of the important reasons for the continuous reduction of the impoverished population shown by the official data is that the unchanged poverty line or slow growth rate, which is obviously not a reasonable way to reduce poverty.

There are many methods to draw the population income distribution map, which can be divided into two categories: parametric methods (such as Lorenz curve, Pareto distribution, lognormal distribution) or nonparametric methods. The parametric methods are highly subjective. Once the income distribution in reality is in an unknown state, the drawing results may deviate. The nonparametric methods do

not need to be equipped with the preset function forms and have better adaptability to the estimation of unknown distribution (Wu et al. 2010). We use a widely used method, kernel density estimation (Plackett 1971; Silverman 1986). This method is provided with a certain form of kernel function to smooth the rough distribution data and then obtain the density curve. Its basic principle is: assuming that the cumulative distribution function $F(x)$ of a set X can be expressed as $F(x) = P\ [X < x]$, the density function of its income is $f(x)$. Let $f_n(x)$ be the kernel density estimation, then the kernel density estimation formula at the income level x is:

$$\widehat{f_n}(x) = \frac{F_n(x+h_n) - F_n(x-h_n)}{2h_n} = \frac{1}{2h_n}\int_{x-h_n}^{x+h_n} dF_n(t)$$
$$= \int_{x-h_n}^{x+h_n} \frac{1}{h_n} K\left(\frac{t-x}{h_n}\right) dF_n(t) = \frac{1}{nh_n}\sum_{i=1}^{n} K\left(\frac{X_i - x}{h_n}\right) \quad (1)$$

where, $K(\cdot)$ is a kernel function that is used for smoothing the distribution modality of data within a given smoothing parameter $h_n > 0$. h_n is called smoothing parameter to determine the width of kernel function estimation interval. This method has certain requirements for sample size and too small sample size will affect the mapping accuracy. Perhaps it is for this reason that few scholars use the nuclear density method to study poverty.[9] A better solution is to use the Ungrouping method to generate large sample simulation data based on the existing grouped data and then use the kernel density method to draw.

2.4 Perspective on Relative Poverty

As the level of economic development is a significant factor influencing relative poverty, we introduce the per capita net income level of rural residents as the "economic development factor" to investigate the changes in the relative income of the impoverished population. To be specific, the processing process of relative data is: assuming that the per capita annual net income of rural residents is $x_1, x_2, \ldots, x_m$; x_{ij} $(i = 1, 2, \ldots, m; j = 1, 2, \ldots, n)$ represents the per capita net income in j year of the i income group. $\overline{x_j}$ represents the average income level of rural residents in j year and y_{ij} represents the relative situation of per capita income in the i income group in the j year:

[9] At present, only two pieces of literatures are provided with relevant researches: Chen and Wang (2011) adopted the micro data of China Health Nutrition Survey (CHNS) to study rural poverty. Chen (2010) adopted the grouped data of provincial cities and towns to expand the sample size and study the urban poverty. However, the micro data does not have annual continuity and it is also debatable whether it is nationally representative. Chen Juan's thought of expanding the sample size is good but it is difficult to apply the same method to the research of rural poverty.

$$y_{ij} = \frac{x_{ij}}{\overline{x_j}} \tag{2}$$

The income level is transformed from the absolute number to the relative number in this manner. Similarly, the absolute poverty line can be transformed into the "relative poverty line". With regard to this data processing method, the impact of development factors on poverty is fully considered and the problem of ignoring the relative differences of rural population caused by the simple use of absolute standards is solved. This method will certainly obliterate the absolute income change information, so the following contents will show a comprehensive analysis in combination with the change forms of the absolute come and relative income.

3 Absolute Poverty Changes of Rural Poverty

3.1 Research Design at a Glance

The research thought of this part is to combine rural development and can be divided into two categories: Firstly, it is based on the old poverty line to consider the changes of rural poverty in the period from 1980 to 2010—that is, the period before the national introduction of the standard of RMB2300 in 2010 constant price. During this period, we mainly used the 20 kinds of grouping income data of rural residents provided by *China Yearbook—Rural Household Survey* over the years. After using the Ungrouping method to simulate the detail drawing of the data, we selected the income data of the lower quintile population as the research object to draw the graph.[10] The graphic sample indicates the evolution of income distribution of rural low-income people in China in 1980–2010, including changes in absolute income and relative income. Besides, an absolute income growth model with a declining relative level can be observed. From the perspective of time, the investigation period is divided into two sections with year 1995 as the dividing point and the graph is drawn at five-year intervals. The reason for this division is that the phased evolution characteristics of rural development reform and official poverty alleviation policies are taken into consideration. In addition, it is to avoid the case that it is difficult to distinguish the curves graphically due to too dense annual curves.

For the development in the new period, that is, after 2011 (2011–2020), China views the comprehensive elimination of extreme poverty in rural areas as the top priority as a result of China's comprehensive battle against poverty alleviation. With the targeted poverty alleviation strategy, China will pool the strength of the whole country and adopt the unconventional work mode to work together to win the battle against poverty. For example, according to the causes of poverty and poverty relief

[10] Except in 1980, the number of rural impoverished population was much lower than that of the lowest 20% income households, so impoverished population is deemed as a proper subset of the selected sample.

needs of the impoverished population, it is important to customize support measures and use targeted "Five Measures for Poverty Elimination" to accurately alleviate the poverty of poverty registration households. Meanwhile, China establishes a five-level government work responsibility system and a strict supervision and assessment system, increases central and local financial investment and improves the mobilization system for the whole society to participate in poverty alleviation, which is beneficial to strengthening poverty alleviation cooperation between the east and the west and targeted poverty alleviation by enterprises and institutions of central and state organs and the army in intensifying resident assistance. Based on the above background, China put more stress on the relative poverty line and the overall growth of rural residents' income as well as international comparison to analyze from the above perspective.

3.2 Stage 1: 1980–1995

It is necessary to illustrate the graphic structure prior to the analysis of the changes of poverty in each period: (1) Horizontal axis and vertical axis. The horizontal axis of the absolute income distribution map represents the actual per capita income level (RMB) based on year 1980. The horizontal axis of the relative income distribution map represents the relative level of income. The vertical axis in the distribution map represents the population density. (2) Absolute poverty line and "relative poverty line". The vertical line perpendicular to the horizontal axis represents the poverty line. The absolute poverty line is treated at a constant price in 1980. The state only resets the poverty alleviation standard in some years, so the absolute poverty line will remain unchanged in some years. However, such problems do not exist in the "relative poverty line". The right shift of the absolute poverty line indicates the improvement of the absolute level of poverty alleviation standards and vice versa. The left shift of the "relative poverty line" means that the relative level of the poverty line reduces. Moving to the left means that the relative level is lower and the gap between poverty alleviation standards and per capita income is larger. (3) Curve position, ductility and shape. The position of the curve is deemed as a reflection of the overall income of residents. The right shift of the curve means the improvement of residents' income level and vice versa. Ductility reflects income inequality. The stronger the ductility is, the higher the degree of income inequality is, and vice versa. The distribution pattern reflects the polarization of income distribution and different income distribution maps may show single-peak or even multi-peak distribution patterns. From 1980 to 1995 in the early stage of reform and opening up, the core density curve of rural residents' income distribution kept shifting to the right on the whole, which means that the income of low-income class generally increases and the poverty population decreases rapidly at this stage (see Fig. 3). To be specific, the horizontal axis coordinates in 1980 corresponding to the wave peaks of the one high and one low curve are 80 and 120 respectively. The peak density is 0.172 and 0.145 respectively, showing a left deviation trend, which means that the income level of

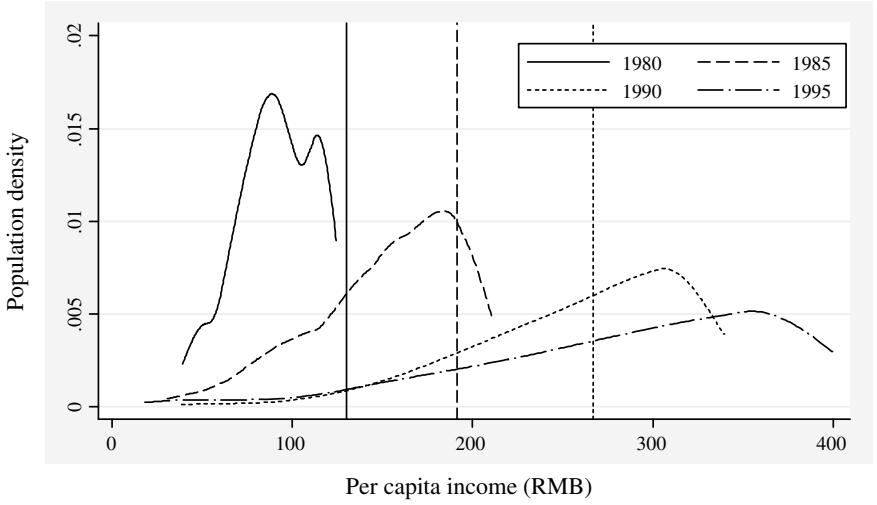

Fig. 3 Changes in Absolute Income of Rural Low-Income Class: 1980–1995. *Data source* Collated by the author according to *China Yearbook—Rural Household Survey* over the years

the vast majority of the low-income population is low and is less than RMB80 (the income corresponding to the peak value of 0.171). The overall distribution curve is located at the left end of the RMB130 poverty line, indicating that the income of the low-income class in that year is lower than the subsistence level and those people belong to the impoverished population. In the later stage, the income of rural residents, including some low-income groups, increased rapidly due to the positive impact of the land system reform and the government's increase in the purchase price of agricultural products. Compared with 1980, the density curve in 1985 shifted significantly to the right and the horizontal axis coordinate corresponding to the wave peak increased from RMB80 to RMB180. Although the poverty line of RMB191 still covers most of the population, it has been improved compared with the previous state. The wave peak density of this time decreases from 0.17 to 0.11 and the peak width is broadened. In addition, the ductility of the distribution curve is enhanced, meaning that the phenomenon of residents' income inequality begins to appear. Besides, the corresponding horizontal axis coordinates of the left tail of the curve are located in the left much than before, but the vertical axis coordinates are significantly lower, which indicates that the income level of a small number of the poorest population decreased absolutely in 1985, even lower than the lowest value in 1980. This may be related to the serious agricultural natural disasters in 1985 (Xu, 2010).

From 1990 to 1995, the wave peak of the density curve shifted further to the right, which is a sign of the process of residents getting rich through hard work under good institutional conditions. In 1990, the peak of the distribution curve shifted to the right side of the poverty line for the first time. The income corresponding to the horizontal axis coordinate increased to RMB280, exceeding the poverty line of that year (RMB267), which means that the vast majority of the rural population has

gotten rid of absolute poverty. Statistics indicate that the poverty headcount ratio of this time has decreased from 26.8% a decade ago to 9.4%, reducing the number of roral poor by 165 million. The number of impoverished population had been reduced to 65 million by 1995, less than 50% of the low-income population and 8% of the total population. However, the distribution curve does not shift to the right as a whole. In addition, when the relative position of the tail at the left end of the curve remains unchanged, the density curve continues to stretch downward to the right and the peak density also decreases from 0.08 to 0.05. For one thing, the above phenomenon shows that the income level of some low-income population has not been significantly improved, that is, this part of population has not enjoyed the fruits of economic development; for another, it shows that the degree of income inequality within the low-income class is further enlarged.

3.3 Stage 2: 1995–2010

China stepped into the rapid economic development stage in the late 1990s, which is shown in Fig. 4 as the continuous improvement of the absolute income level of the low-income class. To be specific, the wave peak continues to shift to the right and the income corresponding to the horizontal axis coordinate increases from RMB350 in 1995 to RMB480 in 2000, RMB580 in 2005 and RMB840 in 2010, with an average annual growth rate of 6%. In this process, the absolute position of the tail at the left end of the distribution curve is relatively fixed, meaning that the income of a small part of the poorest population in rural areas has not experienced a significant

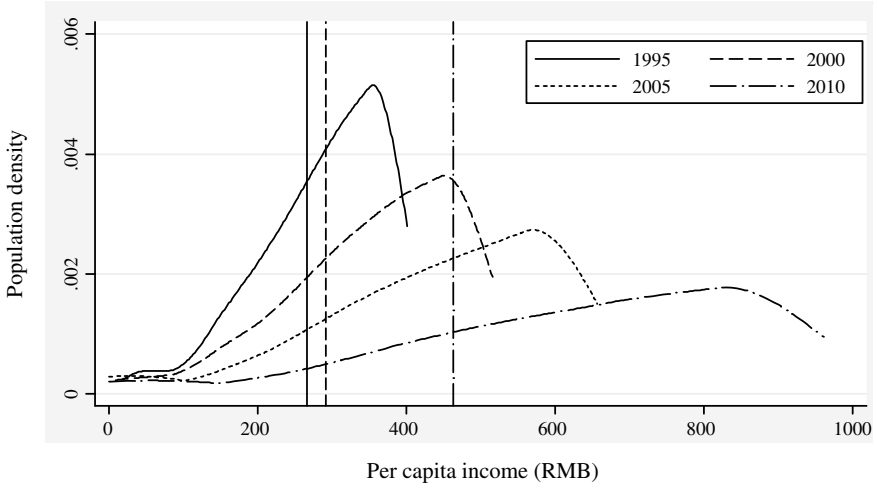

Fig. 4 Changes in the Absolute Income of Rural Low-Income Class: 1995–2010. *Data source* Collated by the author according to *China Yearbook—Rural Household Survey* over the years

increase during this period. In the meantime, the height of the wave peak continues to decrease, indicating that the concentration of income distribution of the low-income class population decreases. In addition, the income growth rate of the poorer population is slower than that of the richer population.

This period witnessed the increase of the absolute level of the rural poverty line and the slow improvement rate. Compared with 1995, the poverty line in 2000 was only increased by RMB25. After a long time, the poverty alleviation standard remained unchanged. The government raised the poverty line to RMB450 until 2008. The average annual growth rate of the officially designated poverty line from 1995 to 2007 was less than 5% on the whole.[11] The change of the poverty line lagged behind the income growth rate of the low-income class. Under the circumstance of a difference between the poverty line and the income growth rate of the low-income class, as long as the income of the impoverished population continues to grow, the number of the impoverished population will continue to decrease. Official statistics show that the number of the rural impoverished population decreased from 65 million to 26.88 million (see Schedule 1) during this period.

3.4 Stage 3: 2011–2020

Looking back, two adjustments for the poverty line have been made according to social development since China's reform and opening up. In 2008, the proportion of rural basic food expenditure was reduced from 85% set in 1978 to 65%, realizing the first adjustment of the poverty line in an absolute sense. In 2010, according to the *Outline of Development-driven Poverty Alleviation in Rural Areas (2011–2020)*, the poverty alleviation standard was further widened to consider factors such as "two assurances and three guarantees". The poverty line was further raised under the condition of meeting the stable subsistence level. According to the calculation of Xian et al. (2016a, b) the proportion of food in the current poverty line further decreased to 53.5% in 2014. The two adjustments are to improve the poverty line by reducing the proportion of food expenditure in the poverty line and increasing the proportion of non-food expenditure. The logic behind them lies in the gradual decline of the proportion of food expenditure (Engel coefficient) accompanied by the improvement of social living standards. However, more non-food expenditures should be included in the absolute poverty line meeting the minimum living needs.

Since 2010, China's per capita rural disposable income has increased from about RMB6000 to about RMB16,000 in 2019. The rural living standard has been greatly improved, which has rapidly reduced the incidence of rural poverty from 17.2 to 0.6%. During this period, China's rural poverty line is RMB2300/year/person at the

[11] To carry out the international comparison of poverty, the National Bureau of Statistics formulated the low-income line with reference to the standard of "one dollar one day" and published it from 2000. In 2008, China officially abolished the absolute poverty line and took the low-income line as the new official poverty alleviation standard to further raise the absolute standard of the poverty line.

constant price of 2010 all the time. After omitting the influence of price factors and the weight of food consumption of the impoverished population, the rural poverty line has not changed since 2010. Figure 5 shows that the relative value of the standard line of rural poverty and per capita rural disposable income decreased from 36.7% in 2010 to 20.1% in 2018 at a calculation basis of the nominal value (i.e. without considering price factors). It can be found that the scale of rural impoverished population has changed since 2010 and the relative value of the standard line of rural poverty and per capita rural disposable income has decreased from 36.7% in 2010 to 20.1% in 2018. The sharp decline of this proportion is not only associated with the obvious increase of rural income but also related to the unchanged poverty line and the adoption of a complete absolute concept. When the poverty line remains absolutely unchanged, the increase of per capita income will result in the decline of poverty incidence. A new question for China's poverty assessment arising from this is put forward: Is there a standard behind the poverty line to determine whether the poverty line should be improved with the improvement of income and living standards?

It is an indisputable fact that the current poverty line in rural China is low regardless of vertical or horizontal comparisons. However, the low poverty line cannot be a sufficient condition to improve the poverty line. With regard to the establishment and change of the poverty line, it is necessary to understand the economic connotation behind the poverty line. The current poverty line is RMB2300/person/year calculated at the constant price of 2010 and the logic behind it lies in two aspects: Firstly, taking the economic development of domestic rural areas and the subsistence premise of "eating enough food and wearing warm clothes" as the starting points,

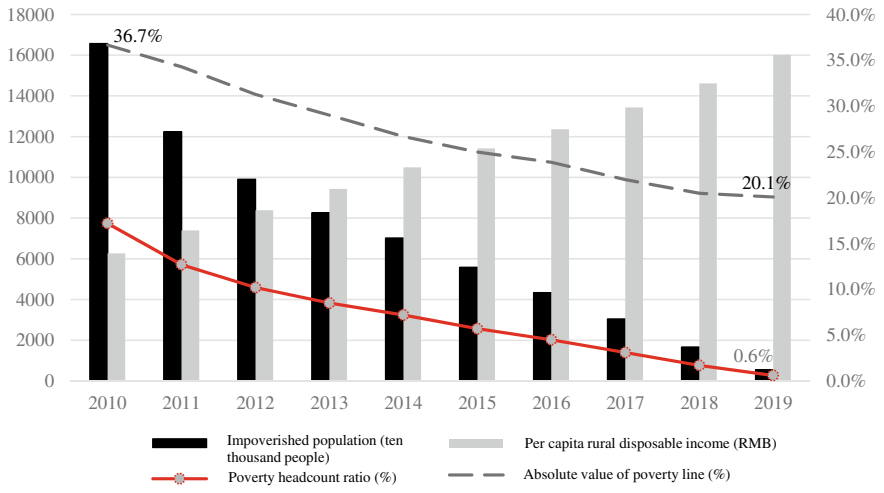

Fig. 5 Changing Trend of Per Capita Rural Disposable Income and Poverty Since 2010. *Note* The data are from *China Statistical Yearbook* and *China Statistical Yearbook—Household Survey* and the poverty line data are from the current rural poverty line of the National Bureau of Statistics: http://www.stats.gov.cn/tjzs/cjwtjd/201308/t20130829_74325.html

it is needed to further meet the basic living needs of "two assurances and three guarantees". Secondly, according to the world poverty line, it corresponds to the USD1.9/person/day published by the World Bank. It can be seen that the main focus of the internal logic of the current poverty line is the "extreme poverty" in absolute poverty, that is, the daily phenomenon of "abject poverty". From this perspective, the main reason why the current poverty line is too low is that the subject of attention and support is the "abject poverty group", which is the goal line of comprehensively solving the subsistence problem.

As the economic society develops, "extreme poverty" will still be regarded as a significant object of poverty alleviation but the concept of poverty should no longer be confined to the absolute poverty of solving the "subsistence problem". Since the reform and opening up, China's sustained and strong economic growth has fully solved the "subsistence problem". However, the problems of unfair income distribution and social differentiation have become more and more prominent due to the continuous expansion of income inequality. The general public's understanding of poverty has imperceptibly changed from "absolute poverty" to "relative poverty". There is even a "subjective" understanding of poverty: the poor do not necessarily think they are poor and the rich do not necessarily think they are rich. Economic society development has expanded the extension of poverty and the general improvement of income level has also accelerated the withdrawal of absolute poverty from the historical stage. The focus of poverty should no longer be limited to "extreme poverty" groups but should put stress on the development of low-income groups, the accelerated growth of income, and even the income distribution of the whole society based on China's sustained economic development, which is actually the core issue of relative poverty.

4 Relative Poverty Changes of Rural Poverty

4.1 Stage 1: 1980–1995

From the perspective of relative income, some conclusions different from the intuitive feeling will be obtained. Figure 6 shows that the relative distribution curve keeps shifting to the left, indicating that the relative income of the low-income class and the impoverished population is decreasing. This trend is in line with the policy goal at that time, that is, under the principle of giving priority to efficiency and giving balanced consideration to fair distribution, it is more reasonable to moderately enlarge the income inequality between rural low-income population and other population. Specifically, the relative income level of the most impoverished population (i.e. low-income population) was high in 1980. A double-peak distribution is shown in the density curve and the population size of rural households with relative income in the range of 0.4–0.6 was large. In 1985, the distribution curve changed from double peaks to single peak and the peak value increased from 0.3 to 0.4 five years ago.

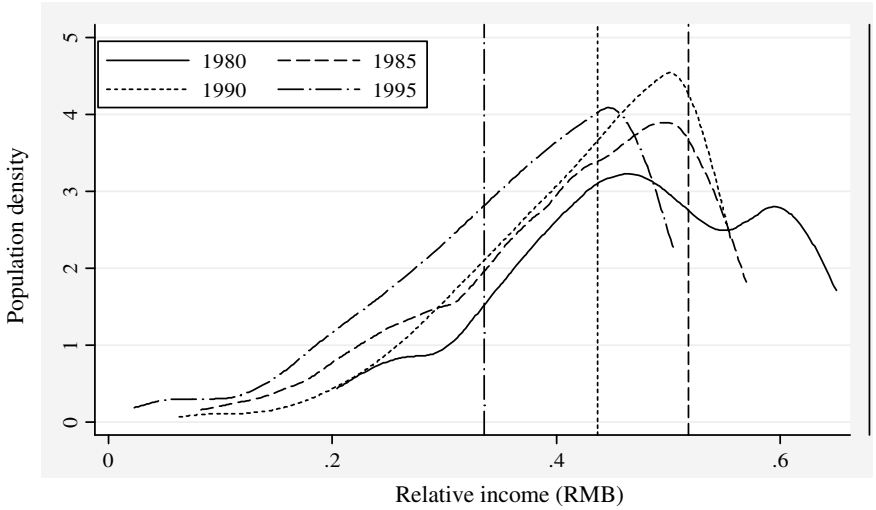

Fig. 6 Changes in the Relative Value of Income of Rural Low-Income Class: 1980–1995. *Data source* Collated by the author according to *China Yearbook—Rural Household Survey* over the years

The overall distribution shifted slightly to the left. The tail at the left end of the curve shifts to the left significantly and the corresponding horizontal axis coordinate decreases from 0.2 five years ago to 0.08. The relative poverty of the impoverished population in 1990 was better than before. Specifically speaking, the wave peak height increases and the corresponding horizontal axis coordinate does not change. The corresponding population density near the tail of the left end of the curve is lower than before. However, after 1995, this improved trend could not be maintained. The peak value corresponding population density decreases from 0.45 to 0.4 and the relative distribution curve shifts significantly to the left. The corresponding horizontal axis coordinate at the left end of the curve further approaches 0. The relative poverty of the rural low-income class and the impoverished population shows a further deterioration trend. At this stage, compared with the rapid improvement of the income level of rural residents, the relative value of the poverty line continues to decline. However, the relative standard is always higher than 0.4. The relative value of the poverty line is lower than 0.4 for the first time until 1995 and the poverty line shows a downward trend.

4.2 Stage 2: 1995–2010

Influenced by the gradual shift of the focus of national development to cities and the deterioration of the terms of trade of agricultural products, the income growth rate of rural residents slowed down and the low-income population was the most affected

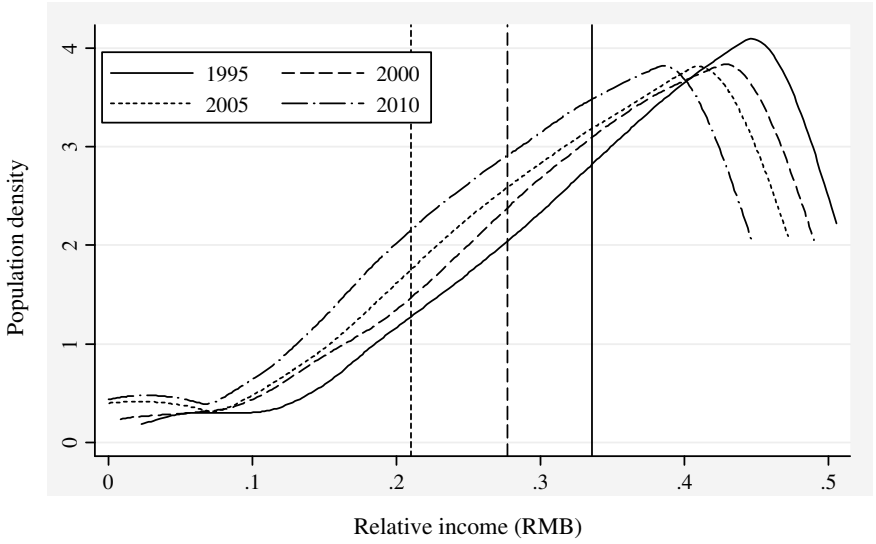

Fig. 7 Changes in the relative income of rural low-income class: 1995–2010. *Data source* Collated by the author according to *China Yearbook—Rural Household Survey* over the years

in the middle and late 1990s. From 1995 to 2010, the per capita disposable income of China's urban population increased by an average annual rate of 9.7% and the per capita net income of rural residents increased by an average annual rate of 9.5% at a calculation basis of the variable price. In contrast, the average annual growth rate of per capita net income of low-income residents is only 7.8% and the growth rate of per capita net income of the impoverished population is less than 5%.[12]The income inequality within rural areas has been enlarging and the phenomenon of relative poverty has become increasingly prominent. In Fig. 7, the above phenomenon is shown as the continuous left shift of the relative income distribution curve (except for 1995–2000). The left shift range of the distribution curve at this stage is small, which is far lower than the change ranges from 1980 to 1995, showing a more serious result of the deterioration of relative poverty. The horizontal axis value corresponding to the wave peak of the curve in 1995 is approximately 0.45, decreases to 0.43 in 2000, further decreases to 0.41 five years later, and decreases to below 0.4 in 2010. This means that the income of the vast majority of the rural low-income population is less than 40% of the average level and the problem of relative poverty is becoming more and more prominent. Viewing from the left end of the distribution curve, it is found that its tail shows a trend of constant left shift and tilt up. The relative level of the income of the poorest population is infinitely approaching 0, indicating the possibility of income solidification of the income of the poorest population.

[12] The calculation is based on the per capita GDP, per capita urban disposable income and per capita rural net income provided by the National Bureau of Statistics over the years.

In addition, we find that the curve shows an outward expansion style left shift trend and the outward expansion phenomenon mainly concentrated in the vertical axis coordinate range of 0.08–0.35 (the most obvious in 2005–2010). Coupled with the warped tail at the left end of the curve, it shows that while the relative income of the low-income class continues to decline, the relative income level of the poorer population decreases greater. During this period, the relative value kept shifting to the left and the moving range was far greater than the variation range of the distribution curve as a result of a small absolute increase in the official poverty line. Under such conditions, the area enclosed by the left of the poverty line and the distribution curve continues to decrease and the number of impoverished population under the official poverty alleviation standard continues to decrease.

Compared with the previous founding from the absolute perspective, for one thing, the problem of absolute poverty in rural areas still deserves attention on the whole. The living conditions of some extremely impoverished population are very poor. Effective assistance should be given to them in terms of economic justice and the improvement of people's livelihood; for another, the phenomenon of relative poverty is increasingly obvious accompanied by economic development. If the problem of relative poverty is not solved in time, the relatively impoverished population is likely to be transformed into the absolute impoverished population. This kind of result is not conducive to the realization of the development goal of common prosperity of residents and is more likely to affect the sustainable development of the economy, and even cause social unrest. The above problems mean that the Chinese government requires appropriately changing its poverty alleviation thinking and taking advantage of proper poverty alleviation means to improve the accuracy of poverty alleviation positioning and invest limited poverty alleviation funds into more needed impoverished areas and populations. Besides, it is necessary to expand the connotation of poverty by integrating the connotation of development into the concept of poverty alleviation and implement poverty alleviation policies aimed at improving the feasible development ability of the impoverished population.

4.3 Stage 3: 2011–2020

Economic growth and the improvement of social living standards do not necessarily result in 100% rise of the poverty line, which is also the reason why China has adopted a constant poverty line since 2010. However, the standard of basic living needs should also be gradually improved accompanied by the forward development of the social economy and the general improvement of living standards. Although it is not a 1:1 relationship, it should also be gradually adjusted according to economic development.[13]

In 2019, China's per capita GDP has exceeded USD10,000 and its per capita gross national income is USD9470, which is far higher than the average level of medium-income countries. So, China evolves into a country with above-average income. However, China's poverty line is particularly incompatible with the degree

Table 2 Comparison of economic development degree and poverty line

Absolute classification	Median	Mean value	China/median
Low-income country	1.91	2.23	1.20
Medium and low-income country	3.21	3.87	0.72
Medium and high-income country	5.48	5.61	0.42
High-income country	21.7	21.19	0.11

Relative classification	Median	Mean value	China/median
A minimum of 25%	1.86	2.11	1.24
25%-50%	3.34	3.65	0.69
50%-75%	5.62	6.17	0.41
A minimum of 25%	22.2	21.45	0.10

Data source Jolliffe and Prydz (2016). The absolute classification index is the four types of national standards defined by the World Bank according to the classification of per capita national income and the relative classification index is the standard for dividing the poverty line of each country according to the quantile interval collected by the author. China's poverty line is USD2.3/person/day calculated by Xian et al. (2016).

of economic development. From the perspective of all countries in the world, the current poverty line in China is the closest to that of low-income countries, which is lower than the poverty line of medium and low-income countries of USD3.2/person/day, and lower than the poverty line of medium and high-income countries of USD5.5/person/day, not to mention the gap with the poverty line of high-income countries. In the current stage, China's current poverty line is in the ranks of 25–50% of the international poverty line. However, it is only equivalent to 72% of the poverty line of medium and low-income countries, 42% of medium and high-income countries and 10% of high-income countries (Table 2).

In terms of horizontal international comparison, the improvement of the degree of economic development will trigger the increase of income poverty line measured by purchasing power parity (whether absolute poverty or relative poverty). The elasticity between this poverty line and income economic growth is often less than 1. Except for the extremely poor countries in the world, it is significantly greater than 0 among other countries (Ravallion and Chen 2011). Ravallion (2015), compared the poverty lines of countries around the world and found that countries with higher economic development are provided with higher poverty lines. Ye and Yin (2019) found that the rural poverty line of China's current standard has been slightly higher than the extreme poverty line of the World Bank since 2010 through the research. Xian, et al. also believed that by eliminating 30% of the price difference between urban and rural areas at a calculation basis of the purchasing power parity, China's rural poverty line in 2011 has been equivalent to USD2.3/person/day and exceeds the international poverty line of USD1.9 person/day published by the World Bank[20]. However, what is noteworthy is that the absolute poverty line of USD1.9/person/day published by the World Bank is the mean value of the poverty line of the poorest 15 countries in the world, thus it is the absolute poverty line set by considering

the global extremely impoverished population. In fact, the poverty line of medium-income countries should be USD3.2/person/day and that of medium and high-income countries should be USD5.5/person/day. Wang and Zeng held that the post-2020 new poverty line standard should not only be higher than the World Bank's standard of USD1.9/person/day but also exceed the moderate poverty line of USD3.2/person/day. This is because the moderate poverty line is the average standard of developing countries (Ravallion et al., 2018).

In conclusion, the overall results show that the rural poverty level has been significantly alleviated by constructing the poverty index system to calculate China's rural poverty index. However, the other types of poverty measure indicators show an irregular change trend of alternating rise and fall and the comprehensive poverty situation has deteriorated except for the continuous reduction of the poverty headcount ratio, which is in sharp contrast to the rapid improvement of China's economic development level in the same period. We also find that the absolute income growth rate of the rural poor is slow from the population income distribution map. In addition, the relative income distribution does not improve with the economic development but worsens. In the middle and late 1990s, the poverty alleviation standard increased slowly and the relative standard decreased. The existing poverty line fails to cover all the rural impoverished population, making it increasingly difficult to adapt to the anti-poverty task in the stage of rapid economic development and to meet the objective requirements of building a moderately prosperous society in all aspects for the poverty line formulated according to the subsistence standard. The "warped-tail" phenomenon in the relative income distribution map indicates that the number of the poorest population has an upward trend, which deserves attention. In the later investigation, we will start with the research on the relationships between economic growth and poverty as well as income inequality and poverty to gradually explore the decomposition of poverty and deeply and carefully investigate the impact of China's economic growth and changes in income inequality on the whole rural areas and different types of rural residents since the reform and opening up.

5 Poverty Alleviation Beyond the Official Statistical Results

Overall speaking, we see China's achievements in the fight against poverty and find some problems worthy of attention with respect to the changes in the absolute and relative poverty levels of China's rural low-income class. Taking 2008–2009 as an example, the "story of poverty alleviation" beyond the official statistical results has been introduced in the form of Appendix.

Figures 3, 4, 5, 6, 7 and 8 indicate that the number of impoverished population under the official poverty line is decreasing both in absolute and relative distribution maps. There are two aspects for explaining this phenomenon: in terms of the absolute value, the income level of the low-income population is continuously improving and an increasing number of rural poor have gotten rid of the subsistence problem. Therefore, the total number of rural poor is continuously decreasing based

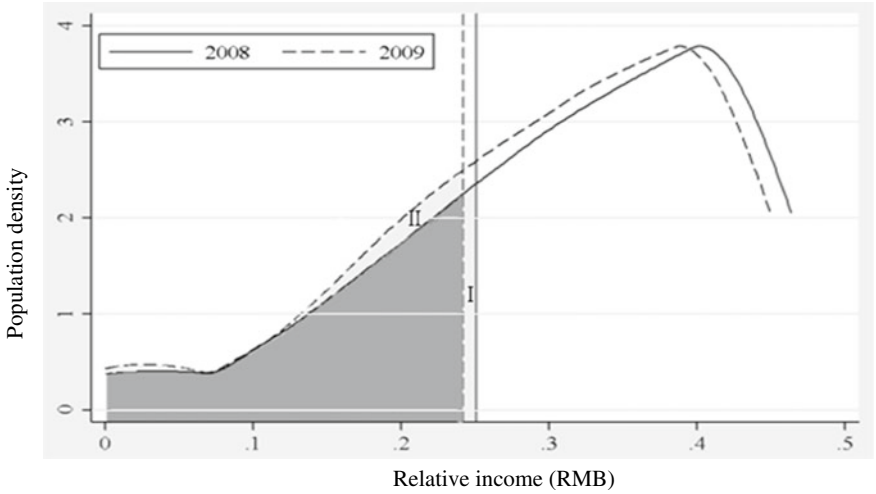

Fig. 8 "Relative Poverty Line" and Reduction of Poverty: 2008–2009. *Data source* Collated by the author according to *China Yearbook—Rural Household Survey* over the years

on the subsistence level. In terms of the relative value, the low adjustment range and frequency of the poverty line during this period and the growth of the poverty line lags behind the income growth of the low-income class. Besides, there are some "unreasonable" factors in the reduction of the rural poor. In this regard, we will study this issue by establishing the link between the poverty line and the change of low-income population.

Like the previous drawing principle, the area enclosed by the left of the poverty line and distribution curve in Fig. 8 represents the impoverished population size. The driving forces for reducing rural poor (reducing area) can be as follows in theory: (1) the relative level of the poverty line remains unchanged and the left distribution curve moves vertically downward. (2) The relative level of the poverty line remains unchanged and the tail at the left end of the distribution curve becomes shorter (or the distribution curve moves to the right as a whole). These two situations respectively represent the reduction of the number of rural poor and the increase of the relative income level of the poor, which is more reasonable. However, there is still a third way to reduce the area: the shape and position of the distribution curve remain unchanged and the "relative poverty line" moves to the left. China's poverty alleviation achievements mainly came from the third way after 1995. For example, in the income change map of the low-income class population drawn by the relative standard from 2008 to 2009,[13] the light-colored region I represents the increase of the poverty caused by the decrease of the relative income level of the poverty. The light-colored region II represents the reduction of the poverty caused by the reduction of the relative level of the poverty line. The area of region II is larger than that of

[13] The changes in other years have also been observed by us and the basic trend of changes is in line with the trend shown in the Fig. 1, so it is not listed one by one.

region I, so it is finally manifested in the continuous reduction of the poverty. But this is by no means the best way of poverty reduction. Nowadays, raising the poverty line is an inevitable trend. Assuming that the relative standard of the poverty line in Fig. 8 moves to the right, the area of region II will reduce and the area of region I will increase. When the area of region I is greater than that of region II, the poverty will increase.[14] That is to say, some of the existing poverty alleviation achievements are produced from the relatively low poverty line. If the poverty line is higher (more reasonable), the poverty size will expand.

6 Discussions and Summary

6.1 Discussion 1: From Absolute Poverty Line to Relative Poverty Line

The above analysis also plays an enlightenment role for us regarding the necessity of adjusting the poverty line to ensure that more "potential impoverished population" is included in the scope of poverty alleviation. In 2011, the Chinese government significantly adjusted the poverty alleviation standard. The existing poverty line was adjusted from RMB1274 in 2010 to RMB2300 (constant price of 2010; about USD361/person/day) and the corresponding rural impoverished population increased from 26.88 million to 128 million.

The sharp increase in the poverty line is a reflection of the government's in-depth understanding of rural poverty and firmer determination to fight poverty. However, the standard of RMB2300 is still an absolute poverty line (refer to the international standard of "one dollar one day") and it is impossible to track the dynamic changes of poverty. The low-income line is one example: China set the "low-income line" in 1998 and officially took it as the aid standard for the impoverished population in 2008 with reference to the standard of "one dollar one day" (purchasing power parity of 1995), which greatly increased the poverty line in that year. However, this trend was not sustained. The relative level of the poverty line fell again in subsequent years. Besides, the RMB2300 poverty line mainly refers to international standards, so the following problems must exist: firstly, there is a shortage of objective reference basis for the determination of China's domestic absolute poverty line. Secondly, "one dollar one day" is set by the World Bank based on the poverty situation of the 10 poorest countries in the world, which is not consistent with the current level of economic development of China. Thirdly, the World Bank has also set the absolute standards of "USD1.25 /per person/per day" and "USD2/person/ day", which means that the absolute level of the poverty line still has room for improvement.

[14] A similar conclusion can be obtained by using absolute values for analysis, which is not analyzed in detail due to article length limitation.

In this regard, the poverty line in China's rural areas in the future can actually be higher. It is suggested to adopt the relative poverty line and take the coefficient of mean value of 0.4–0.5 as the standard to define "relative poverty".[15] The reason why this standard is selected is that the setting method of the international relative poverty line is taken into account. More importantly, it meets China's development needs. China's poverty line has begun to fall since the 1990s, which has become a consensus in the theoretical circle. If the absolute values of the poverty line in 1990 and 1995 are converted into relative values respectively, it will be found that the relative value of the poverty line decreases rapidly (from 0.44 to 0.34).[16] The anomaly of absolute value change implies the lag of relative development level. At the time of failure to meet the survival and development needs of the impoverished population by the absolute value, the relative value will inevitably respond. In this sense, the absolute standard and relative standard are interlinked. Coupled with China's current economic development and poverty alleviation standards, 0.4 is taken as the lower limit of the relative poverty line based on this.[17] When the level of economic development is further improved, it is important to consider further promoting the relative poverty line.

6.2 Discussion 2: The "Warped-Tail" Phenomenon

We mainly highlight the overall change of the distribution curve in the above contents. However, if we carefully examine the information displayed at the tail of the left end of the distribution curve in Figs. 3, 4, 5, 6, 7 and 8, we will find that such information is a phenomenon worthy of attention. In the absolute distribution map, the corresponding horizontal axis coordinates of the tail at the left end of the curve basically do not change while the tail continues to move to the right in the relative map. The vertical height of the tail from the horizontal axis is increasing and the "warped-tail" feature of the distribution curve is obvious in the distribution map of absolute income or relative income. For example, the horizontal axis coordinate corresponding to the tail of the left end of the curve in 1980 is 0.2 in Fig. 6, that is, the income of the poorest population is equivalent to 20% of the average income level of rural residents. After that, the relative income level of the poorest population continues to decline. The horizontal axis coordinate corresponding to the tail decreases to 0.07 in 1985

[15] Refer to Chap. 10 for the setting method of the relative poverty line.

[16] In the following years, the official poverty line showed a slowdown growth of the absolute value and a sharp decline of the relative value. From 1995 to 2007, the nominal value of the poverty line increased by only RMB17 per year and the average income of the rural population increased by RMB150 per year in the same period. The difference between the two was nearly 10 times and the relative poverty line in 2007 also decreased to 0.19.

[17] The period from 1990 to 1995 is the initial stage when the absolute values and relative values of rural poverty line of China decreases. During this period, the relative poverty line drops from 0.44 to 0.34. Then, the relative poverty line of rural China can be roughly estimated to be about 0.4 through comprehensive consideration.

and about 0.05 in 1990. In 1995, the horizontal axis coordinate corresponding to the tail of the left end has infinitely approached to 0. In Fig. 8, the vertical axis coordinate corresponding to the tail of the left end of the distribution curve does not fall but rise, showing that the number of population with relative income in the range of 0–0.1 does not decrease with the increase of years but increases slightly. The above phenomenon indicates that there is always a part of the poorest population in rural areas in the process of economic development. Their absolute income level has not been improved and their relative income level has been decreasing. Besides, the number of this part of the population has increased. This phenomenon deserves attention and it is necessary to find possible causes.

First of all, the poorest population is neglected in the implementation of poverty alleviation policies. Looking back at Fig. 3, although the overall income level of the low-income class continues to improve, the overall right shift of the distribution curve has not been realized. In addition, the income level of a small part of the poorest population has always been solidified in the constant lowest level range, indicating that the poverty reduction effect of economic development benefits the wealthier among the impoverished population more while the poorest population rarely benefits from it.[18]This may be associated with the government's behavior of "robbing the poor to help the rich" in the allocation of poverty alleviation resources, which originates from one-sidedness and deviation in the use of poverty indicators—generally speaking, the evaluation standard of poverty alleviation performance is mainly the poverty incidence H-index. If only taking this index as a reference, the most "effective" way of reducing H-index is to give priority to helping the wealthier impoverished population whose income is close to the poverty line and "ignore" the poorest population, which will lead to the "trickle-down effect"[19] stopping at the wealthier population among the impoverished population and unable to benefit the poorest population.

Secondly, it is difficult to implement development-oriented poverty alleviation in the poorest areas. For one thing, the impoverished population often lives in areas prone to climate change and frequent short-term natural disasters, which will not only interfere with the local production and operation but also seriously interfere with the specific implementation performance of development-oriented poverty alleviation. For another, many of the existing poorest population belong to ethnic minorities. To solve their poverty problem, it is necessary to comprehensively consider many factors, including geography, customs, beliefs, history, etc. In addition, some practical problems will exist in the implementation of poverty alleviation policies. For example, relevant evidence shows that with the joint-stock reform of the Agricultural Bank of China, its commercialization has increased significantly. The local institutions of the Agricultural Bank of China are often unwilling to provide credit funds

[18] Shen (2012) made supplementary proof of this by calculating and decomposing the FGT index from 2000 to 2010.

[19] The trickle-down effect refers to the fact that economic development can provide more jobs for the poor and the government can give more transfer payments to the poor to improve the income and non-income status of the impoverished population.

for families in impoverished areas and there are fewer and fewer loans are provided for rural families (Du et al. 2005).[20]

Thirdly, the impoverished population in the poorest areas is easy to fall into the "poverty trap". A considerable part of China's impoverished population lives in remote and barren areas with the main engagement in traditional agricultural activities. Under such conditions, the impoverished population is easy to fall into the "poverty trap"—low labor productivity is prone to cause economic poverty. To sustain human survival, excessive reclamation of agricultural land is easy to cause ecological poverty. Ecological poverty will aggravate economic poverty, which is often accompanied by poverty in terms of education level, values and political participation consciousness of the impoverished population. The lack of human capital will trigger the reduction of labor productivity and the aggravation of economic poverty and ecological poverty again.[21]

6.3 Summary

In short, by analyzing the dynamic changes of the income of China's rural low-income and impoverished population under the condition of economic development, the research results are as follows: 1. the absolute income growth rate of the rural impoverished population is slow. The relative income distribution status is not improved with the economic development but worsens. 2. In the middle and late 1990s, the poverty alleviation standard increased slowly and the relative standard decreased. 3. The existing poverty line fails to cover all the rural impoverished population, making it increasingly difficult to adapt to the anti-poverty task in the stage of rapid economic development and to meet the objective requirements of building a moderately prosperous society in all aspects for the poverty line formulated according to the subsistence standard. 4. The "warped-tail" phenomenon in the relative income distribution map indicates that the number of the poorest population has an upward trend. The above phenomenon implies the following reasons: although it is reasonable to appropriately widen the disparity between the income of the impoverished population and the average income level in the stage of China's rapid economic

[20] Nearly half of China's poverty alleviation funds are subsidized loans managed by the Agricultural Bank of China. These loans are mainly used for the development of rural leading enterprises in impoverished areas according to central-government policies.

[21] The above analysis is close to the "circular and cumulative causation" theory of Gunnar (1957). In terms of capital accumulation (Nurkse 1953; Nelson 1956; Leibenstein 1957), Gu and Zhang (2001) calculated and compared the initial per capita capital stock in China. Then, they proposed that the per capita net capital stock in Sichuan, Guizhou, Yunnan, Inner Mongolia, Shanxi, Chongqing, Hunan, Henan, Jiangxi, Guangxi and Anhui provinces is lower than the unstable equilibrium point and some people may fall into the "poverty trap". Besides, the author analyzed the net income growth of the lowest 5% population in the CHIPs (1988, 1995, 2002 and 2007) data and found that the income growth rate of the vast majority of the population was less than 5%, which also indirectly provided evidence for the above viewpoints. Considering that this is not the research focus of this chapter, the specific calculation results are not listed.

development, excessive polarization will inevitably hinder economic development. Once the relative income level of the impoverished population is too low, "relative disparity" will make the impoverished population lagged far behind the economic development, affecting the realization of the independent development ability of the impoverished population and hindering the liberation of the shackles of poverty and achievement of prosperity for the impoverished population. In this sense, it is necessary to put stress on the relative poverty of impoverished groups in the stage of rapid transformation from a low-income country to a medium-income country for China. In addition, the income increase of the poorest groups cannot be ignored because poverty alleviation for them is regarded as the most difficult task.

References

Benjamin, D. et al. 2005. *Income Inequality during China's Economic Transition. Working Paper 238*, University of Toronto.

Chen, Y., and H. Wang. 2011. Construction and Application of Bipartite Recursive Algorithm Based on Kernel Density Estimation ———a New Non-Parametric Method to Measure the Given Income Population Scale. *Statistics & Information Forum* 9: 3–8.

Du, Y., A. Park, and S. Wang. 2005. Migration and Rural Poverty in China. *Journal of Comparative Economics* 33 (4): 688–709.

Gunnar, M. 1957. *Rich Lands and Poor: The Road to World Prosperity*. New York: Harper Publishers.

Jolliffe, D., and E. B. Prydz. 2016. *Estimating International Poverty Lines from Comparable National Thresholds*. The World Bank Working Paper.

Kakwani, N. 1980. *Income Inequality and Poverty: Methods of Estimation and Policy Applications*. New York: Oxford University Press.

Kang, P., and C. Jiang. 2009. Parametric and Nonparametric Methods for Measuring Poverty and Income Distribution Inequality. *The Journal of Quantitative & Technical Economics* 5: 120–131 [in Chinese].

Leibenstein, H. 1957. The Theory of Underemployment in Backward Economies. *Journal of Political Economy* 56 (2): 91–103.

Li, S., X. M. Yue, T. Sicular and H. Sato. *The New Trends of China's Income Distribution: Study on China Residents' Income Distribution V*. Beijing: China Financial & Economic Publishing House (in Chinese).

Lin, B. 2003. Economic Growth, Poverty Reduction and Policy Choices. *Economic Research Journal* 12: 15–25 [in Chinese].

Liu, J., J. Zhang, and X. Liu. 2009. Dynamic Changes of Income Distribution in China from 1991 to 2006: Decomposition Analysis Based on Kernel Density Function. *The Journal of World Economy* 10: 3–13 [in Chinese].

Luo, C. 2012. Economic Growth, Inequality and Poverty in Rural China. *Economic Research Journal* 47 (2): 15–27.

Luo, C.L., S. Li, and T. Sicular, 2020. The Long-Term Evolution of National Income Inequality and Rural Poverty in China, *China Economic Review*, 62: 101465.

Luo, C., S. Li, and X. Yue. 2021. An Analysis of Changes in the Extent of Income Disparity in China (2013–2018). *Social Sciences in China*, 1: 33–54 + 204–205.

Minoiu, C., S. G. Reddy. 2006. *The Estimation of Poverty and Inequality through Parametric Estimation of Lorenz Curves: An Evaluation*. Working Paper.

Nelson, R.R. 1956. A Theory of the Low-Level Equilibrium Trap in Underdeveloped Economies. *The American Economic Review* 46 (5): 894–908.

Plackett, L. 1971. *An Introduction to the Theory of Statistics.* Edinburgh: Oliver and Boyd.
Ravallion, M. 2015. *The Economics of Poverty: History, Measurement, and Policy*. Oxford: Oxford University Press.
Ravallion, M., and S. Chen. 2011. Weakly Relative Poverty. *Review of Economics and Statistics* 93 (4): 1251–1261.
Shen, Y. 2012. The Impact of Economic Growth and Inequality on Rural Poverty in China. The Journal of Quantitative & Technical Economics, 29 (8): 19–34 [in Chinese].
Shorrocks, A., and G. Wan. 2008. Ungrouping Income Distributions: Synthesising Samples for Inequality and Poverty. *UNU-WIDER Working Paper*.
Silverman, W. 1986. *Density Estimation for Statistics and Data Analysis.* London: Chapman and Hall.
Singh, S.K., and G.S. Maddala. 1976. A Function for Size Distribution of Incomes. *Econometrica* 44 (5): 963–970.
Villasenor, A., and B.C. Arnold. 1989. Elliptical Lorenz Curves. *Journal of Econometrics* 40: 327–338.
Wan, G. and Y. Zhang. 2006. Income Growth and Inequality to Poverty. *Economic Journal* 6: 112–123.
Wan, G., and Y. Zhang. 2009. How Precisely Can We Estimate Vulnerability to Poverty? *The Journal of Quantitative & Technical Economics* 6: 138–148 [in Chinese].
Wang, H. 2005. The Household Income Mobility and Its Equalizing Long-term Income in China. *Economic Research Journal* 1: 56–66 [in Chinese].
Wang, Z., C. Fan, and Y. He. 2006. Estimating China's Rural Poverty. *Management World* 3: 71–81 [in Chinese].
Wu, P., X. Jin, and L. Ma. 2010. China's regional Economic Development Gap from the Perspective of Numerical Distribution and Spatial Distribution (1952–2008). *Economic Science* 5: 46–58 [in Chinese].
Xian, Z., P. Wang, and W. Wu. 2016. Rural Poverty Lines and Poverty Monitoring in China. *Statistical Research*, 33 (9):312 [in Chinese].
Xie, Y., and X. Zhou. 2014. Income Inequality in Today's China. *Proceedings of the National Academy of Sciences* 11 (19): 6928–6933.
Ye, X., and H. Yin, 2019. From Eliminating Absolute Poverty to Alleviating Relative Poverty: China's History of Poverty Reduction and Poverty Reduction Strategies after 2020. *Reform* 12 [in Chinese].