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Statistical Measurement of the Overall Scale of Urban Poverty in China

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Abstract: As China is undergoing rapid urbanization and social transformation, the research on urban poverty has become increasingly important. So far, the Chinese government has still not drawn an official urban poverty line. The statistical measurement of the overall scale of urban poverty in China is carried out based on three aspects: price adjustment, income distribution data, and main poverty-stricken population, in which the trend analysis of the poor population, the maximum likelihood estimation, and the recent price adjustment are used as measures. The arithmetic average of the urban poverty population, measured via the above three different measures, is taken to obtain the current overall scale of urban poverty in China, which is 10.816 million.

Keywords: Urban poverty; Statistical measurements; Maximum likelihood estimation

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1. Introduction

Urban poverty is a worldwide prominent problem, and foreign scholars, especially western sociologists, demographers, and urban geographers have paid much attention to it over a long period of time. Since the mid-1970s, along with economic restructuring and social transformation, new urban poverty problems, such as unemployment, low income, insecurity, and immigrant poverty, have emerged in the industrialized world, especially in many big cities, making the issue of urban poverty more complicated.

At present, China is in the social transformation stage of rapid urbanization. Urban poverty is a major problem that China is trying to solve, and the research on urban poverty in China is becoming more and more important. Compared with western countries, China's urbanization, regional differences between urban and rural areas, as well as the characteristics and causes of urban poverty have their own particularity. There are relatively more theoretical studies on urban poverty abroad, whereas domestic research remains to be further deepening, especially on the measurement of the overall scale of urban poverty.

2. Principle of urban poverty line demarcation and its influencing factors

As of now, the Chinese government has not drawn an official urban poverty line. Before delimiting the urban poverty line, it is necessary to analyze the basic principle of delimiting a poverty line and its influencing factors.

First, the delineation of urban poverty lines should reflect economic system differences. Chen Zongsheng proved that compared with private economy, public economy belongs to the low-income differential economy, and the institutional goal is to pursue common prosperity [1]. At the same level or

stage of economic development, public economy tends to stipulate a higher poverty line.

Second, the urban poverty line should truly reflect the level of economic development. In the early stages of development, survival is the main consideration, and poverty lines are usually drawn relatively low to better measure the standard of living people can sustain. However, with the gradual improvement of the economic development level, the demarcation of urban poverty line should be changed according to different periods and levels of economic development.

Again, the demarcation of urban poverty line should be comparable. On the one hand, it should be convenient for vertical comparison to be compared with the country's historical period. On the other hand, it should also be convenient for horizontal comparison to be compared between countries (regions) as well as urban and rural areas in China. There is a need to learn from the experience and standards of the world's major economies, without imitating or "based on the gourd" in regard to China's urban poverty line.

Finally, the urban poverty line should be able to easily and realistically measure the scale of poverty. In other words, from the perspective of measurement effect, the demarcation of poverty line can easily and effectively distinguish those poor groups with relatively low-income level among the urban residents. Some scholars have questioned and criticized the effectiveness of China's "low poverty threshold" [2], arguing that China's urban poverty rate and poor population are extremely flexible to the poverty line [3]. This may be misleading, but it also reminds us that the poverty line should have clear and definite character.

3. Statistical measurement of the overall scale of urban poverty in China

3.1. Statistical measurement based on the main poverty-stricken population

3.1.1. Urban registered unemployed population and floating population

After the 1990s, Chinese cities began to enter the transition period of simultaneous transformation of economic system and social structure. During the transition period, as the reform of state-owned enterprises continued, the household registration system continued to relax, and a large number of laid-off and unemployed people as well as floating population appeared in various cities.

From 1990 to 2017, the number of registered unemployed people in cities increased year by year. If the number of laid-off employees from state-owned enterprises and collective enterprises are included, the number of unemployed people will be even more. The number of floating population in cities increased from 21 million in 1990 to 244 million in 2017, an increase of nearly 10 times, accounting for about 18 percent of the total population.

At the same time, the composition of urban poor population is complicated, and the number of urban poor population is expanding. The registered poor population with laid-off workers and retired people as the main body and the floating population with migrant workers as the main body have become the main body of urban poor population in the transition period. Compared with the traditional poor population, these new poor groups are large in number, widely distributed, and have strong willingness as well as ability to work. Solving the poverty issue among these groups is of great importance to the realization of the goal of building a well-off society in an all-round way.

3.1.2. Residents receiving the city's minimum living allowance

If the urban subsistence allowance line is assumed as the urban poverty line, the change of the number of urban residents receiving the minimum living allowance will reflect the change of the scale of the main urban poor population. From 1996 to 2002, the poverty population in the main cities increased rapidly, from 849,000 in 1996 to 20,647,000 in 2002, an increase of 24 times. During this period, urban poverty became increasingly prominent and attracted many scholars to conduct research.

From 2002 to 2012, the number of people living in poverty in major cities remained between 20.5 million and 23.5 million, and the issue of urban poverty did not deteriorate as the government began to implement a series of anti-poverty measures. After the 18th National Congress of the Communist Party of China, the poverty-stricken population in major cities has shown a downward trend, and the urban poverty issue has been effectively managed with gradual improvement. According to the latest statistics from the Ministry of Civil Affairs, in February 2020, the number of people receiving the minimum living allowance in Chinese cities was reduced to 8.421 million.

According to the latest data of average minimum living security of provinces and cities in China in 2019, Shanghai has the highest standard of living allowance, reaching 1,160 yuan per month, while Ningxia has the lowest, marking only 443.6 yuan per month, with a difference of nearly two times. The subsistence allowance standard in central provinces is around 600 yuan per month, while the average subsistence allowance at Yangtze River Delta is significantly higher than the national average (640.73 yuan per month). China's urban poverty line ranges from 5,323 yuan to 13,920 yuan per person per year, with an average of 7,689 yuan per person per year.

In 2019, the average subsistence allowance for urban residents in China was 7,689 yuan per person per year, 19.6 percent of the median per capita disposable income of urban residents in China (39,244 yuan per year), and tended to exceed the subsistence poverty standard. The poor, defined by this standard, includes poor families who cannot maintain basic survival and require government assistance. After years of effort, the number of urban subsistence allowance recipients has dropped to about 8.6 million, accounting for only about one percent of the permanent population.

3.2. Statistical measurement based on income distribution data

Based on existing research, it can be assumed that the per capita disposable income of urban residents obeys the log-normal distribution. The distribution function can be determined by calculating the parameters in the overall distribution based on the sample data, using the maximum likelihood method of segmentation. The log-normal distribution model is shown below.

The density function of the lognormal distribution is as follows:

$$f(x) = \frac{1}{x\sigma\sqrt{2\pi}} \exp^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}$$

Its distribution function is as follows:

$$F(x) = \int_0^x \frac{1}{x\sigma\sqrt{2\pi}} \exp^{-\frac{(\ln x-\mu)^2}{2\sigma^2}} dx = \phi(\frac{\ln x - \mu}{\sigma})$$

Where, μ and σ are parameters.

According to the per capita disposable income of urban residents grouped by grade from 2009 to 2018, the scatter chart is drawn; that is, the probability distribution function of per capita income from 2009 to 2018 (**Figure 1**). It can be seen that with the passage of time, the curve moves to the right and the tail of the curve elongates, indicating that with the development of economy, the overall income level of urban residents in China has risen substantially. The gap between the rich and the poor is also widening, and the income gap between the rich and the poor is wide.

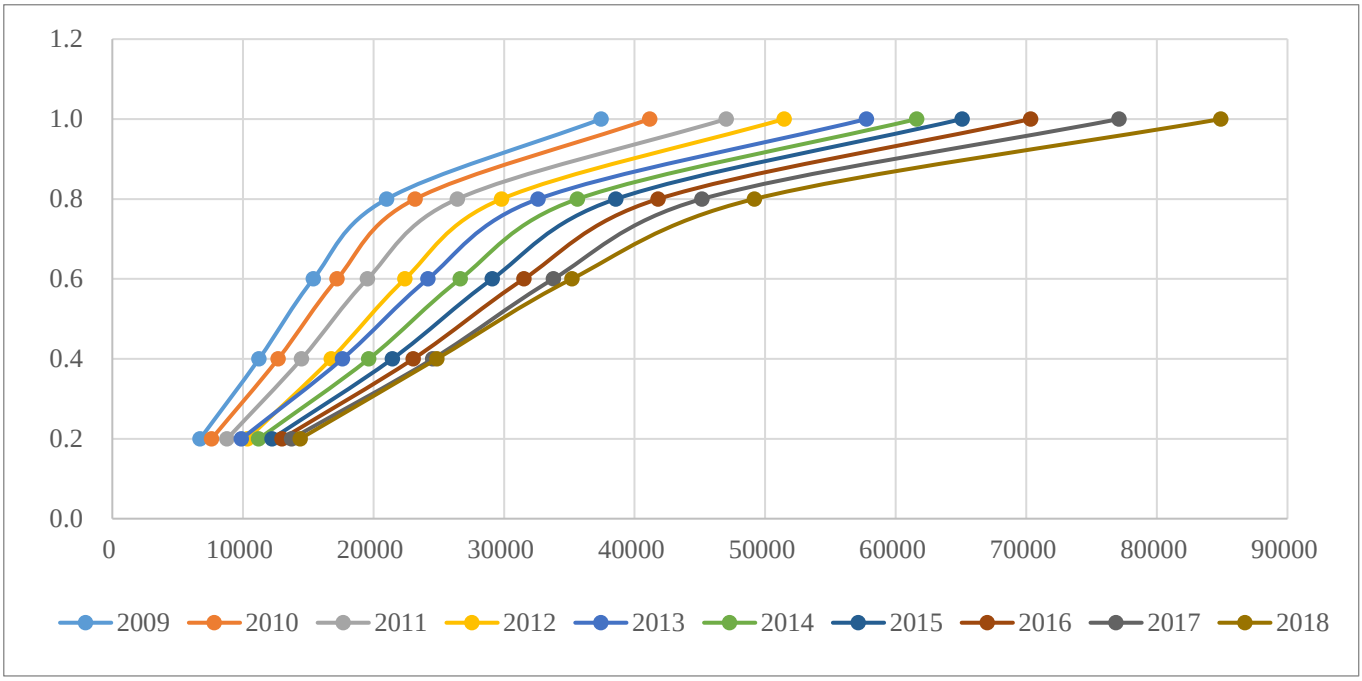

Figure 1. Probability distribution function of per capita income from 2009 to 2018

For the parameter mean and the variance, the maximum likelihood estimation method is used.

$$L(\mu,\ \sigma^2)=(2\pi\sigma^2)^{-\frac{n}{2}}\frac{1}{\prod_{i=1}^{i=n}x_i}\exp\left(-\frac{\sum_{i=1}^{n}(\ln x_i-\mu)^2}{2\sigma^2}\right)$$

$$LnL(\mu,\sigma^2)=-\frac{n}{2}Ln(2\pi\sigma^2)-\ln\prod_{i=1}^{i=n}x_i-\frac{\sum_{i=1}^{n}(\ln x_i-\mu)^2}{2\sigma^2}$$

$$\begin{cases}\dfrac{\alpha LnL(\mu,\sigma^2)}{\alpha\mu}=\dfrac{\sum_{i=1}^{n}(\ln x_i-\mu)}{\sigma^2}=0\\[2ex]\dfrac{\alpha LnL(\mu,\sigma^2)}{\alpha\sigma^2}=-\dfrac{n}{2\sigma^2}-\dfrac{\sum_{i=1}^{n}(\ln x_i-\mu)^2}{2\sigma^4}=0\end{cases}$$

The maximum likelihood estimate of the parameters is as follows:

$$\mu=\frac{1}{n}\sum_{i=1}^{n}\ln x_i,\quad \sigma^2=\frac{1}{n}\sum_{i=1}^{n}(\ln x_i-\mu)^2$$

Maximum likelihood estimation is used for the sample data. From the calculation, the mean is 10.46, and the variance is 0.41. From this, the log-normal distribution function of annual per capita income can be obtained. **Figure 2** shows that it is feasible to use the log-normal distribution function formed by the parameters of maximum likelihood estimation as the distribution function of per capita disposable income of urban residents.

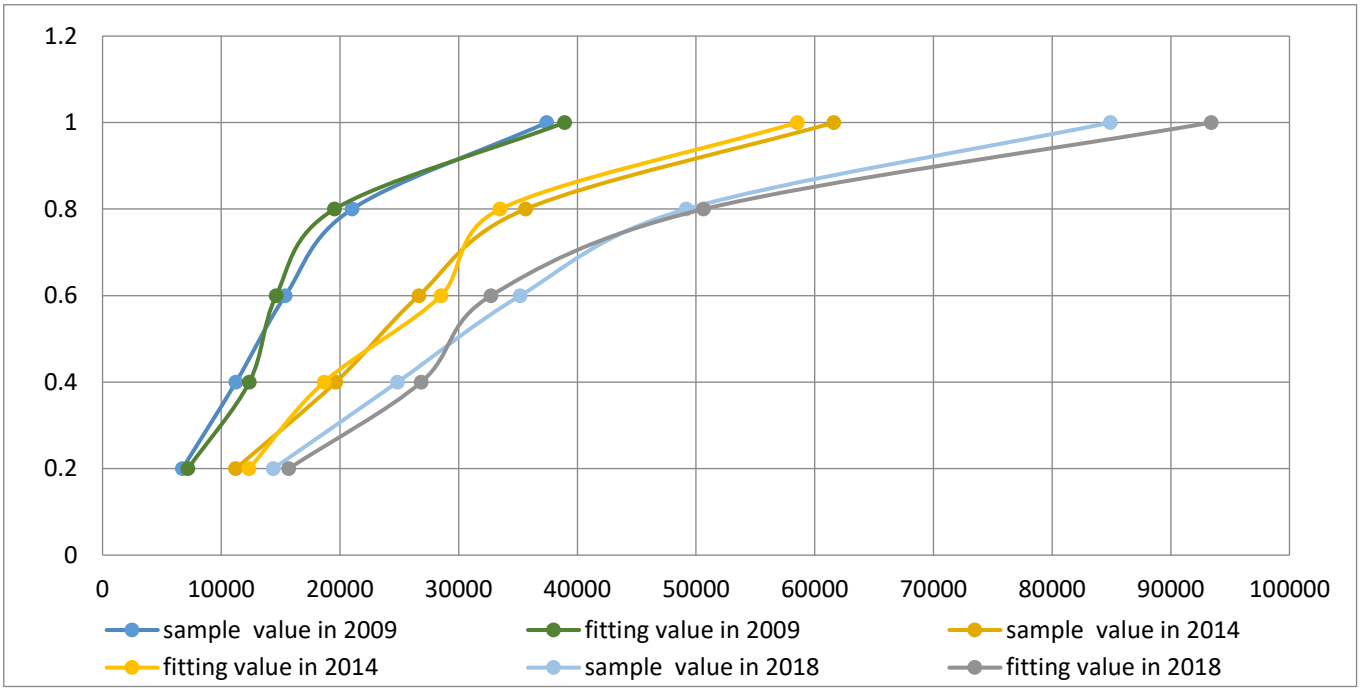

Figure 2. Data fitting in 2009, 2014, and 2018

Compared with the urban poverty line of certain countries, most countries demarcate the poverty line at 50 percent of the national median income of residents. In light of China's actual situation, China's urban poverty line is reasonably defined at two-fifths of the median per capita disposable income of urban residents (taking the bottom 20 percent of per capita disposable income of urban residents as the standard).

The latest data showed that in 2019, the median per capita disposable income of urban residents in China was 39,244 yuan, based on which the urban poverty line was calculated at 15,697.6 yuan. Taking this as the upper limit of the integral, the cumulative probability density calculated by integrating the log-normal probability density function was 0.01271 (with 5 decimal places kept). By the end of 2019, the number of urban residents in China was 848.43 million, and the overall scale of China's urban poor population in 2019 was about 10.566 million.

3.3. Statistical measurement based on price adjustment

Chen Zongsheng and Yu Tao pointed out that urban poverty line varies greatly with different standards, and it is not ideal to simply adopt any one standard [4]. In order to absorb the strengths of poverty lines from various perspectives and take into account the above-mentioned basic principles, especially the differences in economic development, it has been proposed that China's urban absolute poverty line adopts a "five-section" poverty line standard, each of which corresponds to a certain level of economic and social development, the living standards of the residents, and institutional reform.

Chen Zongsheng and Yu Tao put forward the main methods and basis of urban poverty line demarcation over five periods [4].

In the first period, from 1980 to 1990, the urban poverty line borrowed directly from the rural poverty line and adopted the base line plus price index method. In the second period, from 1991 to 1996, the World Bank's poverty line of US $1.9 per person per day was chosen as the standard. In the third period, from 1997 to 2004, the World Bank's median poverty line of US $2.50 per person per day was assumed as the standard. In the fourth period, from 2005 to 2009, the Martin line method based on basic food and nutritional value standards was selected [5]. In the fifth period, from 2010 to now, the multiple relationship between

the base period and the recent standard is selected, and the poverty line standard is determined according to the recent price adjustment.

It can be seen from the measurement results that the stepped urban poverty line of the above periods reflects the strength of each poverty line, several principles that should be followed in determining the poverty line, and the obvious stage changes of China's economy during this period, as well as conforms to the theoretical standards determined by several experts [6]; that is, it is higher than the urban subsistence allowance line of certain provinces and regions, but lower than the income line of the fixed 5 percent of the low-income class. Therefore, it can be said to be a more appropriate and scientific urban poverty line standard.

According to the above analysis, the multiple relationship between the base period and the recent standard is selected, and the current urban poverty line standard of China is determined according to the recent price adjustment. After calculation, the overall scale of China's urban poor population is about 13.278 million.

4. Conclusion

Through the arithmetic average of the Urban Poverty Scale, measured via the above three different measurement methods, it can be concluded that the overall scale of urban poverty in China is 10.816 million. The world bank has set a poverty standard of $2 per person per day for basic living needs. According to the above income distribution function, the poverty line is derived, and the corresponding Engel coefficient is examined. From calculation, the food expenditure of China's urban poor is about US $2.1 per person per day, which is relatively consistent with international standards.

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Disclosure statement

The authors declare no conflict of interest.

Author contributions

Jinyang Liu conceived the idea of the study, Xiong Zhang performed the experiments, and Dan Wu analyzed the data as well as wrote the paper.

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