

Identification and Model Application of Household Income Poverty and Asset Poverty in China

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Abstract: In order to measure the poverty status of Chinese households, the households were first identified under the income and asset criteria, then the incidence and gap rate of income poverty and asset poverty were analyzed by using the information of grouping variables. Finally, the prediction effect was analyzed by comparing the traditional model and the decision tree model, and the generated decision tree structure was used to reflect the internal poverty-causing variables of households. It provides some reference for displaying the poverty status of Chinese families and predicting the poverty status in the future.

Keywords: Poverty, Decision tree, Poverty prediction.

1. Introduction

The year 2018 was a decisive year in China's poverty alleviation campaign, with 97 percent of the population lifted out of poverty by the end of the year. China's anti-poverty cause has achieved remarkable results[1]. Under the current income standard, although the total number of poor people in China is decreasing year by year, some family poverty problems, such as poverty due to illness or disability, are difficult to cure[2]. Therefore, some scholars have proposed to use asset standards to dig out the root causes of poverty in deeply poor families, so as to formulate corresponding policies, actively and quickly help the poor out of poverty, and effectively prevent the families from falling into poverty again after poverty alleviation.

Accurate identification of poor families is the first step in combating poverty. Identifying poor families is mainly divided into the following aspects. The first is to identify the criteria, taking into account the factors of "no worries, three guarantees" and the family's ability to generate income[3-6]. The second is to identify the scope, take the families in a certain region as the research object, adhere to the principle of openness, justice and transparency to ensure that the phenomenon of wrong poverty, poverty leakage will not happen again, and analyze the poverty structure and characteristics of the families in this region according to local conditions. Then there is the identification method. Most scholars identify income poverty by comparing the per capita net income of a family with the official poverty line[7-9]. However, for the identification of asset poverty, it is difficult to obtain asset variables and the country has not published the official poverty line for assets. Finally, poverty prediction. Due to the lag of the official data, it is impossible to predict the poverty in the future. Therefore, how to accurately predict family poverty by using the known information is the further research direction of scholars[10]. Correctly predicting and analyzing the development trend of all poor families is of great significance for improving the relevant social security system and promoting social justice and harmony.

2. Methodology

2.1. Poverty identification method

There are slight differences in poverty measurement results

under different standards. In order to achieve the purpose of complementation and comprehensive analysis, this paper uses the two standards for identification at the same time. The identification methods are as follows:

Income poverty is identified by comparing the per capita net income of resident households with the official poverty line. The calculation formula is as follows:

$$if_poverty = \begin{cases} 0, & income > poverty_line \\ 1, & income < poverty_line \end{cases}$$

Where, *income* denotes the per capita net income of a household, *poverty line* denotes the official poverty line, if *if_poverty* = 0 denotes non-income poor households, if *if_poverty* = 1 denotes income poor households.

The identification of asset poverty is to regression the ratio of family welfare level to poverty line through the characteristics of the head of the household such as the years of education, family size, etc. The asset poverty value is obtained by multiplying the calculated regression coefficient with characteristic variables, namely the asset poverty index. The calculation formula is as follows:

$$\frac{welfare}{poverty_line} = \sum_{i=1}^n \beta_i X_i$$

$$A_i = \sum_{i=1}^n \hat{\beta}_i X_i$$

Where, *welfare* represents family welfare level, *X_i* represents family background variable, *β_i* is regression model coefficient, *β̂_i* is the estimate of regression model coefficient, *A_i* is family asset index, and the number of background variable is n. If *A_i* > 1 represents non-asset poor households, if *A_i* < 1 represents asset poor households.

2.2. Poverty forecasting method

In this paper, the decision tree method of machine learning model is used to predict and classify family poverty. The basic principle of this method is to use the tree graph to represent the expected value of each decision, calculate the value of the objective function and finally optimize the classification of the decision method with maximum benefit and minimum cost. Figure 1 is the flow chart of the decision prediction process.

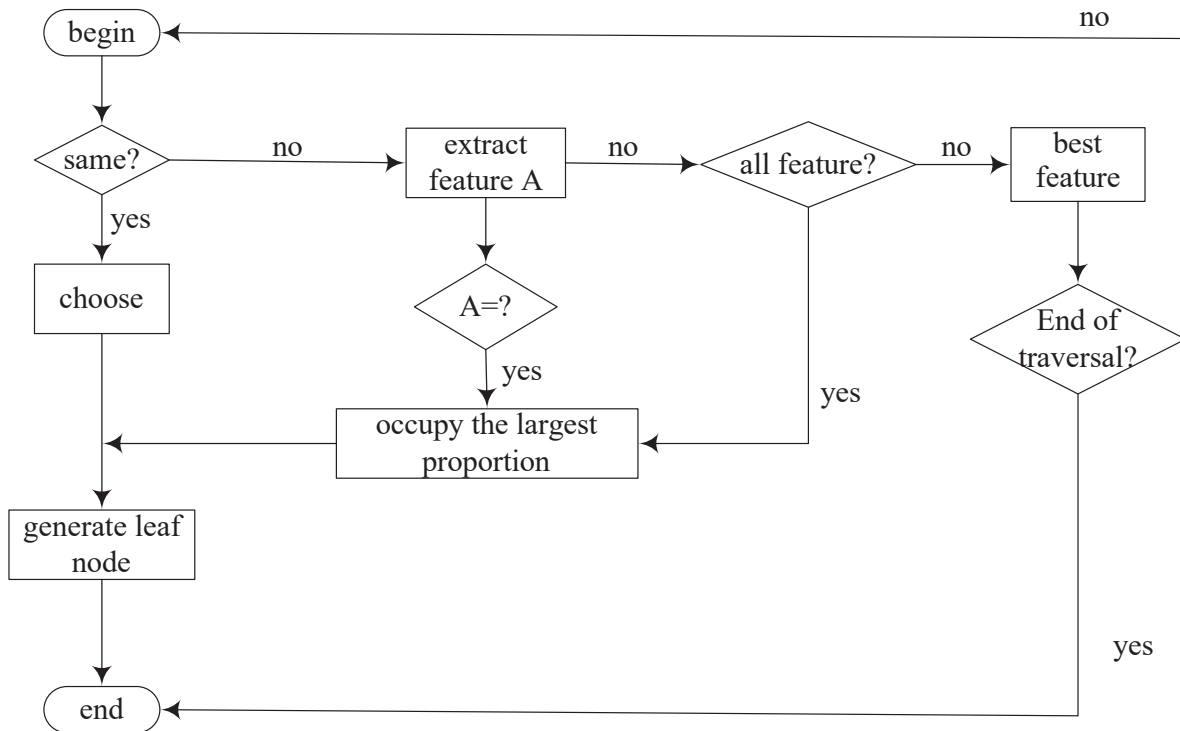


Figure 1. Decision tree prediction decision flow chart

3. Results and Discussion

3.1. Chinese family poverty identification

Based on the data of China Household Tracking Survey in

2018, the income poverty and asset poverty status of Chinese households were calculated respectively, and the poverty status of resident households was analyzed by the poverty incidence rate and poverty gap rate. The specific results are shown in Table 1.

Table 1. Comparison of household poverty identification in China

Poverty situation	Incidence rate of poverty(%)		Notch rate of poverty(%)	
	Rural area	city	Rural area	city
Income poverty	1.653	0.851	31.471	25.944
Asset poverty	3.858	2.447	74.283	56.942

As can be seen from the results of Table 1, the poverty situation of rural families in China is more serious than that of urban families, and the poverty incidence is 0.802% higher. However, for both rural and urban households, the poverty under asset standard is wider and deeper than that under income standard. The gap of asset poverty of rural households reaches 74.283%, indicating that many families can hardly get out of asset poverty by their own ability.

3.2. Different groups of Chinese family poverty status

According to the background variable information, the families were analyzed according to the characteristics of the head of the household, the level of education and the size of the family, so as to analyze the degree of poverty faced by different families and the causes of poverty. The specific results are shown in Table 2. Through analysis, it can be

concluded that the better the conditions of the household head, the less the burden of the family, the less likely to fall into poverty. Families with six or more people have the highest incidence of income poverty (4.952 percent), while families with poor health have the highest income poverty gap rate (51.178 percent), and families with an uneducated head have the highest asset poverty gap rate (90.323 percent).

3.3. Chinese household asset poverty prediction using different methods

By outputting the prediction results of traditional regression model and machine learning model, it can be found that the performance of decision tree model is better, which can obtain higher accuracy and AUC, and can accurately predict the asset poverty situation of households with different characteristics, providing certain theoretical basis for the formulation of anti-poverty policy suggestions.

Table 2. Income poverty and asset poverty of Chinese households discussed by groups

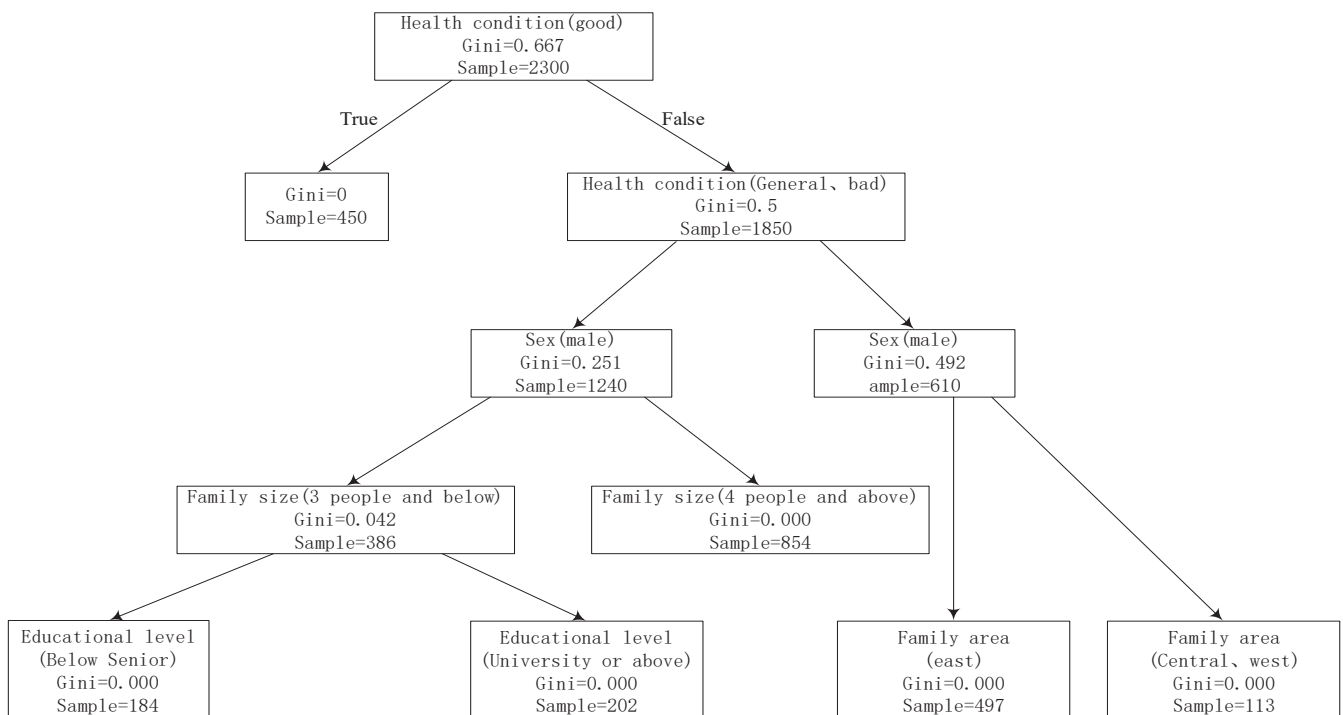
Background variable	Income poverty		Asset poverty	
	Incidence rate(%)	Notch rate(%)	Incidence rate(%)	Notch rate(%)
Gender of household head				
male	1.459	26.454	2.956	55.385
female	1.950	30.628	3.517	59.651
The education level of the head of the household				
uneducated	4.216	50.326	5.239	90.323
Primary school education	4.017	49.251	6.322	74.912
Junior high school education	2.574	38.304	3.227	68.219
High school education	2.003	24.831	2.353	60.288
University degree or above	0.608	21.368	1.219	41.547
Whether the head of the household has a job				
no	3.515	30.527	5.234	71.227
yes	1.263	23.662	1.982	56.283
Family size				
3 people and below	1.325	16.249	2.004	49.616
Four to six people	3.831	23.065	3.876	56.328
6 people and above	4.952	34.218	5.578	67.594
Physical condition of family members				
good	0.823	9.624	0.831	47.221
general	1.076	19.63	1.925	53.964
bad	1.968	51.178	2.784	77.528
Home area				
Eastern part	1.153	18.725	1.552	49.291
Central part	1.697	26.932	2.264	57.609
Western part	2.607	33.651	3.335	73.554

Table 3. Comparison of models based on asset poverty prediction results

Model comparison	Accuracy rate	AUC	error
Traditional model	51.83%	0.529	165.228
Decision tree model	69.551	0.783	97.297

Since the decision tree model has a good performance in predicting asset poverty, the poverty-causing structure of poor

families can be more clearly reflected by drawing the tree structure, and the drawing results are shown in Figure 2.

**Figure 2.** Poverty structure of asset-poor households in China

As can be seen from Figure 2, the poor physical condition of the head of household is affected by gender. Among them, when the size of male-headed households is three or less, the families with a high school education or less are asset-poor households, while the families with a college education or above are non-asset-poor households. In contrast, female-headed households in the East were all non-asset-poor, while households in the Midwest were asset-poor.

4. Conclusion

In order to analyze the overall and regional poverty situation of Chinese resident families, this paper also measures and analyzes Chinese poor families from different perspectives, and uses more accurate methods to predict family poverty. The main contents of this paper include: First, the asset poverty of Chinese households is identified according to the availability of information, the appropriate method is selected and the asset poverty line is obtained. Second, it analyzes the results of poverty status of Chinese households under both income and asset criteria, and compares and analyzes the differences brought by different perspectives in groups with different characteristics and their sizes. Thirdly, machine learning model is used to predict the asset poverty of Chinese households, and the advantages and disadvantages of traditional prediction models are compared to mine the useful information that can be obtained in machine learning model.

Through research, it can be found that the poverty situation of rural families in China is more serious than that of urban families. For both rural and urban families, the poverty under the asset standard is wider and deeper than that under the income standard. The better off the head of a household is and the less the burden on the family, the less likely he is to fall into poverty. The decision tree model has better prediction performance than the traditional model and can be used to analyze the poor structure.

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