The Path Analysis of Farmers' Income Structure in Yunnan Province

Yongtian XIAO, Yu CUI, Lijia HU *

Beijing Normal University, Zhuhai, Zhuhai 519087, China

Abstract The problem of farmers' income growth is the key of issues concerning agriculture, countryside and farmers, so the farmers' income growth is the fundamental starting point for agricultural and rural economic development. In this paper, we use the statistics concerning farmers' income in Yunnan Province from 1995 to 2012, to perform the path analysis of components of farmers' income in Yunnan Province, study the path of influence of components of farmers' income on farmers' net income, and then set forth the policy recommendations for increasing farmers' income in Yunnan Province.

Key words Yunnan Province, Farmers' income structure, Path analysis

1 Introduction

The Central Government has always attached great importance to the issues concerning agriculture, countryside and farmers, and farmers' income growth has been a top priority among these issues. Yunnan is a province of the People's Republic of China, located in the far southwest of the country. It spans approximately 394000 square kilometers and has a population of 45. 7 million (2009). The capital of the province is Kunming, formerly also known as Yunnan. The province borders Vietnam, Laos and Burma. The region maintains a strong agricultural focus. Agriculture is restricted to the few upland plains, open valleys, and terraced hillsides. Level land for agriculture is extremely scarce and only about 5 percent of the province is under cultivation. The agricultural population accounts for more than 80% of total population, and the total number of agricultural labor force accounts for over 70% of the province's workforce. Although the farmers' income always showed an upward trend from 1995 to 2012, the overall level is still low, and it is an economically underdeveloped province. In 1995, the per capita net income of farmers in Yunnan was 1010. 97 yuan, and it increased to 5416. 54 yuan in 2012. In terms of the absolute number, during the period 1995 − 2012, per capita operating income of rural households increased from 792. 04 yuan to 3328. 1 yuan; per capita wage income of farmers increased from 120. 84 yuan to 1435. 87 yuan; per capita property income of farmers increased from 57 yuan to 234. 19 yuan; per capita transfer income increased from 41. 09 yuan to 418. 58 yuan. In terms of the relative number, the share of family operating income and property income of farmers in farmers' net income showed a downward trend. The proportion of family operating income declined from 78. 3% in 1995 to 61. 44% in 2012, and the proportion of property income decreased from 5. 64% in 1995 to 4. 32% in 2012. The proportion of wage income and transfer income of farmers showed an upward trend. The proportion of wage income increased from 12% in 1995

to 26. 51% in 2012, and the proportion of transfer income increased from 4. 06% in 1995 to 7. 73% in 2012. The components of farmers' income make different contribution to farmers' income, so the direct and indirect effects are not the same. In this paper, we use SPSS software to perform the path analysis on components of farmers' income in Yunnan Province, and analyze the path of influence of components of farmers' income on farmers' income, in order to provide a reference for increasing farmers' income and promoting rural development in Yunnan Province.

2 Path analysis

Path analysis, the continuation of simple correlation analysis, is to decompose the correlation coefficient on the basis of multivariate regression. The direct path, indirect path and total path coefficients signify the direct effects of one variable, and the indirect and comprehensive effects of other variables on the dependent variable, respectively. For the general multivariate linear regression analysis, assuming the independent variables are X_1, X_2, $\cdots$, X_k and the dependent variable is Y.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k \qquad (1)$$

$$\bar{Y} = \beta_0 + \beta_1 \bar{X}_1 + \beta_2 \bar{X}_2 + \cdots + \beta_k \bar{X}_k \qquad (2)$$

Formula (1) − (2):

$$Y - \bar{Y} = \beta_0 (X_1 - \bar{X}_2) + \cdots + \beta_k (X_k - \bar{X}_k) \qquad (3)$$

Both sides of formula (3) are divided by the standard deviation (δ_Y) of the explained variable Y at the same time:

$$(Y - \bar{Y})/\sigma_Y = \beta_1 (X_1 - \bar{X}_1) + \cdots + \beta_k (X_k - \bar{X}_k)/\sigma_Y$$

$$(Y - \bar{Y})/\sigma_Y = \beta_1 \frac{\sigma_{X_1}}{\sigma_Y} \frac{(X_1 - \bar{X}_1)}{\sigma_X} + \cdots + \beta_k \frac{\sigma_{X_k}}{\sigma_Y} \frac{(X_k - \bar{X}_k)}{\sigma_{X_k}} \quad (4)$$

Using the least square method, the regression coefficients of independent variables in formula (4) are calculated, and on this basis, the following decomposition equation of simple correlation coefficient can be obtained by transformation:

$$\begin{cases} P_{1Y} + r_{12}P_{2Y} + r_{13}P_{3Y} + \cdots + r_{1k}P_{KY} = r_{1Y} \\ r_{21}P_{1Y} + P_{2Y} + r_{23}P_{3Y} + \cdots + r_{2k}P_{KY} = r_{2Y} \\ \cdots \\ r_{k1}P_{1Y} + r_{k2}P_{2Y} + r_{k3}P_{3Y} + \cdots + P_{KY} = r_{KY} \end{cases} \quad (5)$$

where r_{ij} is the simple correlation coefficient of X_i and X_j; riY is the simple correlation coefficient of X_i and Y; P_{iY} is the direct path, namely the partial correlation coefficient after the standardization of X_i and Y; $r_{ij}P_{jY}$ is the indirect path, which signifies the indirect effect of X_i on Y through X_j; $\sum_{i \neq j} r_{ij}P_{jY}$ signifies the total indirect effect of X_i on Y through other variables. The above equations indicate that the correlation coefficient (r_{ij}) of any independent variable X_i and dependent variable Y is equal to the sum of direct path coefficient (P_{iY}) of X_i and Y and indirect path coefficient ($r_{ij}P_{jY}$) of X_i and Y. Given that people can not consider all factors influencing the dependent variables when setting the model, there is a need to further calculate the path effect (P_{uY}) of omitted variables and error term on the dependent variable Y, namely residual effect, and it is calculated as follows:

$$P_{uY} = \sqrt{1 - (P_{1Y}r_{1Y} + P_{2Y}r_{2Y} + \cdots + P_{KY}r_{KY})} \qquad (6)$$

If the residual effect is very small, it indicates that the path analysis has grasped the key variables; if the residual effect is very large, it indicates that the path analysis may have missed some major factors, and it is thus necessary to find other factors for analysis.

3　Empirical analysis of components of farmers' net income

Assuming the explained variable Y is rural per capita net income; X_1 is the per capita operating income of rural households; X_2 is the per capita wage income for farmers; X_3 is the per capita property income for farmers; X_4 is the per capita transfer income for farmers. Using SPSS18.0 statistical analysis software, we perform the path analysis of the standardized statistics from 1995 to 2012 in Yunnan Province.

3.1　Regression model parameter estimation of farmers' net income

We establish the multivariate linear regression model $Y = f(C, X_1, X_2, X_3, X_4)$, and use SPSS18.0 software for parameter estimation, as shown in Table 1.

Table 1　The multivariate linear regression model

Model	Parameter estimation	The standard error	Standardized parameter estimation	t value	P value
C	−1.379	1.193	0.000	−1.156	0.269
X_1	1.001	0.002	0.575	647.391	0.000
X_2	0.998	0.004	0.286	263.761	0.000
X_3	1.018	0.014	0.049	74.464	0.000
X_4	0.992	0.006	0.097	171.22	0.000

Through the analysis of the results in Table 1, it is found that the parameter estimates of X_1, X_2, X_3 and X_4 are significant at the 0.05 confidence level. R^2 is 1.0, F value is 1.203E7, and DW value is 2.858, indicating that the model estimate is good, and basically there is no serial correlation, so the multivariate linear regression model established is tenable. From the theoretical analysis, it is found that the standardized parameter estimates for each explanatory variable are the direct path coefficient of factors influencing farmers' net income. According to formula (6), the path effect coefficient is calculated as follows:

$$\sqrt{1 - (0.575 \times 0.997 + 0.286 \times 0.994 + 0.049 \times 0.970 + 0.097 \times 0.971} = 0.027$$

The residual effect is less than 0.05, indicating that the path analysis has grasped the main factors affecting farmers' net income.

3.2　Path analysis of factors influencing farmers' net income

In Table 2, underlining "−" means the direct path of factors affecting farmers' net income, and others mean indirect path. The simple correlation coefficient can be decomposed into the direct path and indirect path. For example, 0.049 is the direct path of rural per capita property income influencing farmers' net income, which means that for each additional unit of standard deviation of rural per capita property income, farmers' net income can be increased by 0.047 units of standard deviation; 0.274 is the indirect path of rural per capita property income influencing farmers' net income through farmers' per capita wage income.

Table 2　The path coefficients and simple correlation coefficients of influencing factors

Influencing factors	X_1	X_2	X_3	X_4	The simple correlation coefficient with Y
X_1	0.575	0.282	0.047	0.093	0.997
X_2	0.571	0.286	0.045	0.092	0.994
X_3	0.556	0.274	0.049	0.091	0.970
X_4	0.555	0.273	0.045	0.097	0.971

As can be seen from the above table, for the direct path coefficients, $P_{1Y} > P_{2Y} > P_{4Y} > P_{3Y}$, and from the correlation between each variable and Y, $r_{1Y} > r_{2Y} > r_{4Y} > r_{3Y}$. In addition, the sign of P_{1Y}, P_{2Y}, P_{4Y} and P_{3Y} is consistent with that of r_{1Y}, r_{2Y}, r_{4Y} and r_{3Y} (positive), and also consistent with the partial correlation coefficients between them and farmers' net income. It indicates that the direct effect of these four factors on farmers' net income is positive, that is, the farmers' net income can be directly increased by increasing farmer's family operating income, wage income, property income and transfer income. Although the sign of direct path coefficient of farmers' property income and transfer income is consistent with that of the simple correlation coefficient, the direct path coefficient is very small, indicating that the direct effect is not very obvious. Using SPSS for correlation analysis, we can obtain the direct correlation coefficient of each variable, and using SPSS for the analysis of the correlation coefficient between varia-

bles, we can obtain the indirect path coefficient of variables to Y. Using SPSS for correlation analysis, we select variables X_1 and X_2, and calculate the correlation coefficient $r_{12} = 0.994$, so the indirect path coefficient of X_1 to Y through X_2 is $r_{12} \times P_{2Y} = 0.994 \times 0.286 = 0.282$. Similarly, we can calculate the indirect path coefficient of X_2, X_3, X_4. By analyzing the indirect path coefficients, it can be found that the indirect path coefficient of other influencing factors through the per capita operating income of farmers is relatively large, followed by per capita wage income of farmers and per capita property income of farmers, which is related to the direct path coefficient of per capita property income of farmers (only 0.049).

4 Conclusions and recommendations

Through analysis, we can find that farmers' net income relies heavily on family operating income and both the direct path and indirect path coefficients of family operating income to farmers' net income are large (direct coefficient of 0.575), so increasing family operating income can more effectively increase farmers' net income. For Yunnan Province, through the collective forest tenure reform, it can make farmers have the ownership of trees and right to woodland use, and fully mobilize the enthusiasm of farmers for engaging in agricultural activities, thereby improving the income of farmers. In addition, it is necessary to vigorously develop agriculture with plateau characteristics in Yunnan Province, and take full advantage of unique geographical advantages, climate advantages and species advantages in Yunnan Province to develop the industries with characteristics. In terms of wage income for farmers, it mainly comes from farmers' working elsewhere and development of township enterprises. On the one hand, migrant workers are subject to many restrictions, due to difficulties in transfer of surplus labor and low level of education. On the other hand, due to various factors, the development of township enterprises has been greatly restricted, and the opportunities for the rural labor force to achieve local non-farm employment are reduced, so the wage income of farmers is not high. Therefore, there is a need to strive to improve the quality of the rural labor force. It is necessary to develop basic education, adult vocational education and continuing education in rural areas, to make farmers more responsive to market demand and the actual needs of the rural economy, thereby increasing wage income of farmers. Although the direct and indirect

path effect of property income and transfer income on farmers' net income is very small, their role can not be ignored, and constantly improving the property income and transfer income of farmers can effectively alleviate the pressure arising from slow growth of family operating income and wage income. Therefore, it is necessary to deepen the rural financial reform, play the role of cooperative financial support for agriculture and improve the rural financial system in Yunnan Province in order to accelerate property income growth of farmers. It is also necessary to innovate upon and improve the social security system in rural areas, enhance social security coverage in rural areas, gradually establish and improve the social security system for farmers in accordance with the characteristics of Yunnan Province, in order to increase the transfer income of farmers.

References

[1] JING YH, XING LW. The path analysis and its application[J]. Statistical education, 2006(2):24 – 26. (in Chinese).

[2] DU J. The realization of path analysis in Excel and SPSS[J]. Journal of Shaanxi Meteorology, 2012(1):15 – 18. (in Chinese).

[3] DU JJ, CHEN ZW. Method of path analysis with SPSS linear regression[J]. Bulletin of Biology, 2010(2): 4 – 6. (in Chinese).

[4] CHEN Y. Farmers' income: an comprehensive analysis based on the calculating economic model[J]. On Economic Problems, 2007(1):82 – 84. (in Chinese).

[5] WANG SS. Study on the income structure of farmers of Yunnan Province [D]. Yunnan:Yunnan Agricultural University, 2012:6. (in Chinese).

[6] LIU GY. A positive study on the farmer's income growth in Yunnan[D]. Chongqing:Southwest University, 2008:4. (in Chinese).

[7] HUANG RY. Thinking on Yunnan "the three problems of agriculture" in Yunnan[J]. Journal of Agricultural Education, 2004(3): 6 – 8. (in Chinese).

[8] YANG YL, XU YG. The empirical analysis on the source structure of farmers'income in Yunnan[J]. Problems of Forestry Economics, 2011,31(4): 365 – 367. (in Chinese).

[9] CHEN Y, WANG YP. Factors affecting the net income in farmers' household business and their contribution to their total income[J]. Journal of Agrotechnical Economics, 2004(5):11 – 15. (in Chinese).

[10] ZENG LQ. Structure of farmer's income and increase of farmer's income [J]. Productivity Research, 2007(3):21 – 22. (in Chinese).

[11] Monitoring Group of The Collective Forest Tenure Reform. The collective forest tenure reform[R]. Beijing: China Forestry Publishing House, 2012: 116 – 142. (in Chinese).

[12] LU QC. Survey on relationship of household income and education level in rural region of Yunnan[J]. Education & Economy, 2007(4):7 – 10. (in Chinese).

agricultural machinery operating, and agricultural machinery brokers, and speed up transformation of operating mechanism of county, township and village agricultural machinery station, to realize diversified service organizations. In the methods of agricultural machinery operating service in Chongqing, leasing service and operation contracting lag behind and need energetic development. Specifically, those agricultural machinery operating service organizations with many types of agricultural machinery and tools can provide leasing service, while regions with much labor and idle land can moderately develop operating contract. In

conclusion, all regions should actively develop and improve suitable organizations form and methods of agricultural machinery operating service in accordance with actual local situations.

References

[1] The yearbook of agricultural machinery in China, 2013 [M]. Beijing: China Agricultural Science and Technology Press, 2013:169 – 238. (in Chinese).

[2] YANG ML, DENG GY, GUAN L, *et al.* The plan of constructing national agricultural mechanization demonstration base in Chongqing [R]. 2011:54 – 60. (in Chinese).