Empirical Analysis on the Influencing Factors of the Net Income of Farmers——A Case of Hebei Province, China

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Abstract According to the relevant data of farmers'net income from the *Hebei Statistical Yearbook* 2009, seven indicators are selected covering regional gross production x_1, the total output of the primary industry x_2, the number of the people employed x_3 and the number of the large livestock at the end of year x_4 and so on, to analyze the factors that affect the per capita net income of farmers. The results show that the regional gross production x_1 is in positive proportion to the total output value of the primary industry and the influneces are great; the total output value of the non-agricultural industry x_5 and the local financial expenditure x_6 are the important factors that affect the income of farmers; though the total value of rural residents'fixed investment x_7 is in positive proportion to the income of farmers, the degree is not so great; the regression coefficient of the number of people employed x_3 and the number of the large livestock at the end of year x_4 is negative and the number of people employed x_3 is a positive correlation to the net income of farmers. Based on the above analysis, the countermeasures on improving the income of rural residents are put forward: firstly, optimizing the rural indutrial structure, promoting the developement of the primary industry and improving the regional total output of production; secondly, expanding the development channel of non-agricutlural economic and attracking the rural surplus laborers; thirdly, enlarging the local financial expenses and Expanding the developmental space of the three agricultural issues concerning peasants, countryside and agriculture.

Key words The per capita net income of farmers, Influencing factors, The principal component regression, Hebei Province, China

Since the reform and opening up, Chinese economy has developed rapidly and the income level of rural and urban residents has increased continuously. The central conference on rural issues points out the toughest year of economic development, in 2009, the average net income of farmers in the whole country has initially broken though 5 000 yuan, 8.5% more than the actual growth of the last year, which means that farmers'income in China has been increased by the rate of more than 6% for six consecutive years, and this is the first time since last two decades. Nevertheless, there is still great gap between the farmers' net income and the disposable income of urban residents, and the rate of urban to rural income has increased from 2.57 in 1978 to 3.31 in 2008. The Expanding urban and rural gap is comprehensively caused by many factors. In this case, it is necessary to study the main factors that influence the net income of farmers, and lift the net income level of farmers in China.

Hebei Province, as an agricultural province, the rural residents account for 82% of the whole population. There are great rural surplus labors, so it is of great practical reference to choose Hebei Province as the study area. In view of this, we use the principal component analysis and the least squares regression to establish the principal component regression model, and then the principal influencing factors are identified and the countermeasures are put forward according to the empirical results.

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1 Data source, indicators choosing and research method

1.1 Data sources The data comes from the 2009 *Hebei Statistical Yearbook* and the time from 1997 to 2008 is considered.

1.2 The introduction of the indicators The net income of farmers can be divided into two parts including agricultural income and non-agricultural income. The regional gross production (described by GDP) is an important indicator of economic growth. The higher the regional gross production, the more developed the economy, and the indicator can reflect the average per capita net income of farmers from the overall point of view, so the regional gross production is selected as the first indicator x_1. As a agricultural province, the total output of the primary industry still share a larger part of proportion in farmers' income and it still contributes more to farmers' income, and it is the key to the increase of farmers' net income. However, the agricultural operation scale and the level of mechanization are the important factors that affect the development of the primary industry. The gross output of the primary industry x_2, the number of people employed in the primary industry x_3 and the number of the large livestock at the end of year x_4 can be used to reflect the developmental status of the primary industry from different perspective. So the three indicators are selected to analyze the factors that affect agricultural income of farmers. With the further reform of economic system and the adjustment of industrial structure, the sharp increase of the non-agricultural income of the farmers' net income will be the highlight to increase the farmers' income, so we choose the gross output of non-agricultural industry x_5 as an indicator to reflect the non-agricultural income. At the same time, the governmental expenditure x_6 and the individual investment in fixed assets x_7 are also the impor-

tant factors that affect the degree and speed of the agricultural and non-agricultural development, so they are selected as the indicators. Based on above analysis, the seven indicators from x_1 to x_7 are selected to analyze the influences on the farmers' per capita net income Y, and take Hebei Province for example to conduct empirical analysis.

1.3 Research method In multiple statistical analyses, the linear regression analysis is frequently used to inspect the influence of independent variables on induced variables. But in most cases, there is always strong linear correlation between multiple variables, so it will result in insignificance of the linear regression model. It is found by test that there is strong linear correlation between the seven variables. So the principle component regression analysis is adopted in this paper.

The principal components analysis is firstly used to avoid correlation between these independent variables and then analyze the influences of each independent variable on induced variables. The principal component analysis is widely used in multivariate statistical analysis. It reorganizes the original indicators into a group of new and independent comprehensive indicators to replace the original indicators. According to the actual needs, we will extract few comprehensive indicators to reflect the original information as much as possible. The principal component regression analysis[1] merges the principal component analysis and multivariate regression analysis. This method can avoid the multi-colinearity among the independent variables in the regression analysis, so it enhances the economic explanation of the established model. The basic steps of principal component regression analysis are as follows:

Step 1: Standardization. For convenience, we denote x_i as the standardized variable of X_i, i. e.

$$x_i = (X_i - \overline{X_i})/\sigma_{x_i},\ i = 1, 2, \cdots, n$$

Step 2: Calculation of the principal components.

$$F_1 = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n$$
$$F_2 = a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n$$
$$\vdots \qquad \vdots$$
$$F_n = a_{n1}x_1 + a_{n2}x_2 + \cdots + a_{nn}x_n$$

Step 3: Selection of the principal components. The number of the principal components k is determined according to actual need. Generally the cumulative variance contribution rate is set no less than 80% so as to ensure less loss of data information.

Step 4: Principal components regression analysis. The regression model is given by conducting the least square regression between the k principal components and Y:

$$Y = b_1F_1 + b_2F_2 + \cdots + b_kF_k$$

Step 5: Model analysis. By restoring the principal components into original variables, a new model is achieved to reflect the true relations between the original variables.

$$Y = (b_1a_{11} + b_2a_{21} + \cdots + b_ka_{k1})x_1 + (b_1a_{12} + b_2a_{22} + \cdots b_ka_{k2})x_2 + \cdots + (b_1a_{1n} + b_2a_{2n} + \cdots + b_ka_{kn})x_n$$

2 Empirical research on the factors that influence farmers' net income——a case of Hebei Province

Since the eleventh five-year plan, the growth of farmers' net income has exhibited the sustainable characteristics, however, the income gap between the rural residents and urban residents has become wider and wider (Fig. 1). In 2009, the disposable income of urban residents in Hebei Province is 14 718.25 yuan, 9.5% more than that in 2008; but the net income of farmers is 5 150 yuan, 354 yuan more than that in 2008, with the growth rate of 7.4%. Therefore, it is necessary to find out the key factors that affect the income growth of farmers in Hebei Province, which is of great theoretical and practical significance for narrowing the urban and rural gap.

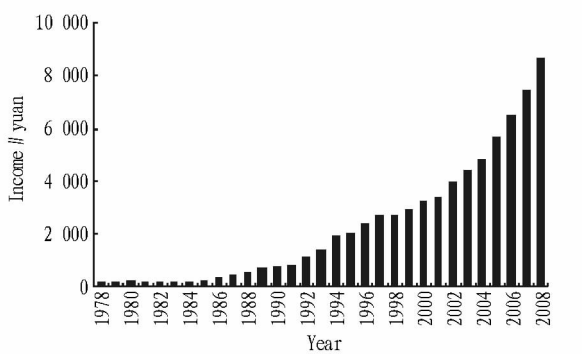

Fig. 1 Income gap between urban and rural areas of Hebei Province

2.1 The principal components analysis Through testing, we find that each two of the seven indicators has strong linear correlation (Table 1), so the least square regression analysis can not be directly used to describe the relations among the variables. In order to accurately describe the relations of the variables, the principal component analysis is firstly used to avoid the multi-collinearity and then the least square regression model is established between the principal components and the induced variable.

Table 1 Linear correlation coefficient matrix of variables

Indicators	x_1	x_2	x_3	x_4	x_5	x_6	x_7
x_1	1.000	0.992	−0.934	−0.812	0.999	0.997	0.961
x_2	0.992	1.000	−0.927	−0.745	0.989	0.985	0.933
x_3	−0.934	−0.927	1.000	0.840	−0.933	−0.922	−0.920
x_4	0.997	0.985	−0.922	−0.830	0.996	1.000	0.973
x_5	−0.812	−0.745	0.840	1.000	−0.817	−0.830	−0.900
x_6	0.961	0.933	−0.920	−0.900	0.956	0.973	1.000
x_7	0.999	0.989	−0.933	−0.817	1.000	0.996	0.956

By the maximum variance rotation criterion, SPSS11.5 is used to generate the principal components. The factor matrix and variance contribution rate are presented in Table 2. It can be seen that the contribution rate of the cumulative variance of the first two principal components is 98.02%. So the principal component are described as follows:

$$F_1 = 0.873x_1 + 0.920x_2 - 0.760x_3 + 0.853x_4 + 0.867x_5 - 0.426x_6 + 0.738x_7$$
$$F_1 = 0.484x_1 + 0.391x_2 - 0.583x_3 - 0.903x_4 + 0.491x_5 + 0.514x_6 + 0.655x_7$$

2.2 The least squared regression The least squared regression between two principle components and the induced variables is conducted by Eviews5.0, the model is as follows:

$$Y=0.619F_1-0.279F_2$$
$$t=(10.311)\quad(-3.757)$$
$$R^2=0.997\,7\quad \overline{R}^2=0.997\,3\quad F=2\,007.890$$

Through testing, the regression coefficients are statistic significant at the confidence level of 1%, and there is no serial correlation, heteroscedasticity and collonearity between the principal components, so the regression model obtained by principal component regression is reasonable.

Table 2 Factor matrix and variance contribution rate of principal component analysis

Indicators	Principal components		Eigen values	Contribution rate//%	Contribution rate of cumulative variance//%
	F_1	F_2			
x_1	0.873	0.484	4.391	62.733	62.733
x_2	0.920	0.391	2.476	35.371	98.104
x_3	−0.760	−0.583			
x_4	−0.426	−0.903			
x_5	0.867	0.491			
x_6	0.853	0.514			
x_7	0.738	0.655			

The result of the unit root test of the residual series is given in Table 3. The absolute value of the ADF in the third model is larger than the absolute value of the critical value at the 1% significance level, so the residual series is stable at the 1% significance level. A long-term, stable and balanced relation exits between the net income of farmers (Y) and two principal components (F_1, F_2).

Table 3 The unit root test of residual series

Test models	ADF test	Critical value			P value	Stable
		1%	5%	10%		
Model 1	−4.086 9**	−4.297 073	−3.212 70	−2.747 68	0.013 6	Yes
Model 2	−3.689 3*	−5.295 384	−4.008 16	−3.460 79	0.075 5	Yes
Model 3	−4.382 7***	−2.792 200	−1.977 70	−1.602 10	0.000 5	Yes

Note: ***, ** and * refer to 1%, 5% and 10% significance level respectively.

Restoring the principal components into the original indicators, we can get the following equation:

$$Y=0.41x_1+0.46x_2-0.31x_3-0.01x_4+0.40x_5+0.38x_6+0.27x_7$$

It can be seen that the economic significance of regression coefficients are reasonable, which indicates that the pricipal component regression analysis used in the paper is effective.

2.3 Analysis on the regression results It can be seen from the regression results that the economic significance of each indicator obtained by principal component analysis is reasonable. The regional gross production x_1 and the total output of the primary industry x_2 are in positive correlation to the per capita net income and have great influence on it. The larger the regional gross production, the higher the economic development level, the more job opportunities and the higher the income level of farmers. The primary industry provised the main source of farmers'income and founded the basis of the rural economic interests. The poor output of the primary industry indicates the poor econimic effciency of rural areas and also the low income of farmers. The model shows that, the indicator x_2 is the most important influnecing factor on farmers'income increase, which is in accordance with the reality of Hebei Province.

The gross output of non-agricultural industry x_5 and the expenditure of local governments x_6 are also the important factors and the regression results show that the influences are great as well. The expenditure of local government reflects the attentions the supports from the local government to the agriculture. The higher output of the non-agricultural industry exhibits the higher developmental level of industry and service industry, which will inevitably lift the employment rate of farmers. And the farmers' income will increase substantially. The individual fixed investment value of farmers x_7 is in positive correlation to the farmers' income, however, the influential is weaker than the factors mentioned above. The individual fixed investment reflects the activity and scale of the agricutlure or non-agriucltural industry undertaken by farmers, such as the agriucltural equipments, factory buidlings, machines and so on. The investment of farmers in fixed assets has the characteristics of stages (some equipments can be used for many years). All of these factors influence the increase of farmers'income, but the influnces are relatively small.

The regression coefficients of the number of people employed in the primary industry x_3 and the number of the large livestock at the end of year x_4 are negative, which show that they have negative correlation with the net income of rural residents. The more people employed in the primary industry, the lower the efficiency of farmers' production and the less time spend on other businesses, which prevents the increase of farmers' income. More big animals reflect the underdeveloped productivity and the lower degree of machanization, which will inevitably result in the slow increase of income. This is in accordance with the regional discrepacies of economic developement in Hebei Province.

3 Countermeasures and suggestions

3.1 Optimizing rural industrial pattern and promoting the development of the primary industry to improve the regional gross production It can be seen from the empirical analysis that the gross output of the primary industry has the greatest influence on the net income of farmers net income, so the government should positively promote the development of the primary industry so as to push forward the regional economic development to stimulate the increase of farmers' income. The regional gross production reflects the economic development status of the region. Optimizing agricultural industrial structure and pushing forward the development of the primary industry is the tendency of accelerating the rural industrialization and an effective way for improving the farmers' income. The government should rely on the natural resource advantages of Hebei Province and take the market demands as the guidelines to develop the advantages of being an agricultural province in terms of grain, livestock, vegetables, fruits and so on. To develop the distinctive agriculture is an efficient way to increase the potential of developing the primary industry.

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63.2% counties (cities, districts) are below the average level of Hubei Province, showing that there are great differences in the economic development and the development is imbalanced. According to the rank of F, the 76 counties (cities, districts) are divided into three types. The first type is $F>1$, including Qianjiang City, Daye City, Jiangxia District, Xiantao City, Zengdu District, Huangpo District, Hanchuan City, Tianmen City, Xinzhou District, Xiaonan District. They belong to areas with relatively developed county economy; and their comprehensive scores of economic development are far higher than other regions. The second type is $0<F<1$, including Yiling District, Yidu District, Caidian District, Enshi City, Yangxin County, Zhijiang City, Danjiangkou City, Zhongxiang City, and Guangshui City. They belong to areas with medium developed county economy. The third type is $F<0$, including the rest of 48 counties (cities, districts). They belong to areas with less developed county economy.

3 Countermeasures

County economy is not equal to economy at county level. It is a modern regional economy with regional characteristics. Development of county economy should be planned from the aspects of building modern industrial system, promoting the industry and agricultural complementation, and enhancing the coordinated development of regional economy. Affected by the strategic arrangements and policies, county economy in Hubei Province has achieved rapid development with great contribution, dynamic strength, and good economic returns. However, it also has some disadvantages, such as imbalanced development, poor comprehensive quality and inferior economic structure, which are also the major factors for the backward development of county economy in Hubei Province. Therefore, during accelerating the development of county economy, a good job should be done mainly in the following aspects: adhering to the reform of market economy, developing private economy, speed up the process of industrialization, making efforts to support leading enterprises, promoting the industrialized operation of agriculture, further attracting foreign investment, carrying out industrialization during the development of projects and enterprises, changing soft environment by measures, and promoting the development of county economy by innovation. During the economic development in the future, counties (cities, districts) should adopt development strategies according to their own characteristics and promote the harmonious and healthy development of economy and society.

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3.2 Expanding the developing channel of non-agricultural economy and attracting the rural surplus labors The non-agricultural income is an important income source. The higher regression coefficient of the gross value of the non-agricultural industry in the model indicates that it has great positive influence on the net income of farmers. So the government should strengthen the support on improving the non-agricultural income of farmers and it can be realized by transferring the rural surplus labors. Firstly, the geographic advantages of adjacent to Beijing and Tianjin and the Bohai Economic Circle should be fully displayed. In addition, the government should develop the production and deep processing of the distinctive agricultural products as well as to encourage developing the agricultural enterprises to absorb more rural surplus labor. Secondly, the government should strengthen the guidance on agricultural enterprises by establishing a perfect rural labor market and training farmers to increase their working skills. Moreover, the export and shift of surplus labor between regions and countries is a good choice to promote the employment rate of the farmers.

3.3 Increasing the local financial expenditure and expanding the developmental space of agricultures The favorable environmental and financial support policy is the basis for farmers' income increase. The government should increase the financial support, lessen the burden of farmers and provide certain preferential policies. For example, the government should provide financial support and loose loan policy to set up more township enterprises. Secondly, the government should increase the fund input to improve the infrastructure construction and ensure the sustainable development of the primary industry, which will provide a favorable space to improve the income of farmers. For example, more money should be invested to construct the mountain roads so as to transfer the agricultural by products and the internet should be generalized for farmers to know more about the market demand and adjust the production plan. Finally, we should try to apply for the national financial subsidies to increase the total financial expenditure. Chinese government attaches great importance to three agricultural problems concerning agriculture, countryside and peasants. Hebei Province should take this opportunity to positively win over the financial subsidies provided by the nation to develop the rural economy.

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