The relationship between rural employment rate and rural development: An analysis based on a bivariate VAR model

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Abstract. Rural development has been a traditional concern in China. With large rural populations, Communist Party of China focuses on solving the three agriculture-related problems. Currently, the transfer of rural population from country to city leads to an obvious reduction in employment in the primary sector. As a populous country, the agriculture is the foundation of China's national economy. This paper investigates the relationship between the employment in the primary sector and the total output value index of farming, verifying the effect of labor factor. The econometric investigation based on the bivariate VAR model shows the employment in the primary industry has a dynamic change characteristic to total agricultural production. Further, the relationship changes from negative to positive.

Keywords: Rural Economy; Employment; VAR model.

1. Introduction

Over recent years the Chinese government pays great attention to the development of rural economy and rural rejuvenation. As a country with the population of over 1.4 billion, the stable development of the primary industry is the cornerstone of the national economy. In the process of comprehensive deepening the reform, substantial rural labor has moved to the city, resulting in rural hollowing and population ageing. As a significant production factor affecting agricultural output, the loss of rural labor also has an important impact on the development of China's agriculture.

Because of its importance, the labor factor needs to be analyzed from many aspects. In terms of the total population, the Chinese population remains an increasing trend, but this is mainly due to the low death rate and the constantly release of the population policy in recent years. Chinese population growth is slowing down, with the female population of working age decreasing and the change of maternity concept, this trend will maintain for a long time. The decline of total population will directly affect the number of labors, China's agriculture remains a large demand for the cheap labor, this also means that if agriculture continues the previous production mode, its development speed is bound to slow down.

Compared with the total population growth slowdown, the problem of population structure is more serious. Under the influence of China's special family planning policy, China's population structure has shown a shrinking pattern in this century. With the passage of time, the aftermath of this policy consistently emerges. The most significant effects of low birth and death rates are population ageing and a reduced share of the labor factor. Among them, the problem of left behind old people in rural areas and the continuous loss of young adults is more serious than that in urban areas. However, compared with the secondary and tertiary industries, the primary industry has higher requirements on the physical fitness of the labors, which leads to the lower productivity of a large number of left-behind elderly people. The development of agriculture is trapped in the cycle of low return rate caused by the loss of labors, and the low income further leads to the migration of labor. And this dilemma must be solved by the development of production technology to promote rural productivity levels.

From the perspective of the technological development of the primary industry, the loss of some labors is not entirely negative. The adjustment of labor structure is an important driving force for the development of science and technology. The loss of labors has made it possible for a large amount of vacant and scattered land in the country to be consolidated for large-scale agricultural development and more efficient land use. At the same time, the demand for mechanization in scale agriculture is

much higher than that for decentralized agricultural production, which is increasing the market size of the agri-technology industry. High efficiency and precision of agricultural production can highly compensate for the problem of labor quantity reduction. The process of Chinese mechanization, however, is faced with many difficulties due to the special terrain structure of plateau and mountain mainly and the existence of special agricultural types such as terraced agriculture. The balance between the quality of labor force and the level of agricultural technology may become an important goal of China's agricultural development in the future.

In order to test the specific impact of labor employment on agricultural development, China's total agricultural output value index was selected to measure the development of China's agriculture, and the number of employments in the primary industry was selected to measure the level of rural labor. On this basis, a vector autoregressive model was established to test the influence of labor force on China's agricultural development. The rest of this paper includes literature review, introduction of model methods, interpretation of results and conclusions.

2. Literature review

Many Chinese scholars have studied the structure of labor, the influence of labor force transfer and agricultural development. Zhang Jingbo et al. (2022) tried to use VAR model to investigate the impact of labor transfer on rural income by taking Henan Province as an example, and found that the labor, affected by the income utility, constantly flows to the secondary and tertiary industries and invests part of the income into agricultural production while achieving the income growth [1]. However, whether the return of income increased by the development of secondary and tertiary industries can make up for the contraction rate caused by the loss of labor in the primary industry is also related to the employment situation in the primary industry. When Jia Ruoxi et al. (2020) studied the employment situation of the primary industry in Shanxi Province, they found that the scale of the employed people was constantly shrinking, the proportion in the three industries was constantly declining, and the productivity was lower than expectation [2]. In addition, the decline in employment in the primary industry has coincided with a growing problem of rural aging. China's rural aging population is characterized by large scale, fast growth rate, which also leads to rising rural dependency ratio and hindered economic development. [3,4] The continuous growth of the output value of the primary industry has not brought back employment. Some scholars believe that this is because there are still weak characteristics of Chinese agriculture, such as poor natural resources, low quality of producers and closed rural economic form. [5] Although agriculture maintain growth, Wang Jun et al. (2013) analyzed the factors that influence the employment decision of the primary industry through OLS method and found that the absorption capacity of labor in the primary industry is still insufficient, so it is necessary to further attract labor flow back through other approach. [6] Yu Xianzong (2017) researched the low efficiency of agricultural employment and the "labor employment trap". He compared the employment situation of China's primary industry and the degree of agricultural intensification with that of many countries around the world, and found that different with other economic power around the world, China's agricultural productivity is lower, which is mainly due to the rigidity of employment in China's agriculture. Thus, further land circulation and free employment are needed. The entry of high-quality talents into the primary industry to improve its productivity, and the entry of surplus rural labor into cities to further promote the development of the secondary and tertiary industries require the government to fully ensure that every Chinese citizen enjoys full and equal national treatment. [7]

The development of agriculture is of course influenced by many factors. Before investigating the employment of primary industry and the development of agricultural economy, it is necessary to consider with other important factors. Li Jiulin et al. (2022) found that agricultural infrastructure construction and scientific and technological innovation ability had the most significant impact on the resilience of agricultural economy in provinces and regions. In addition, the scale of agricultural economy, input of production factors, government support and other influencing factors also have a

certain impact on the resilience of agricultural economy, but the spatial difference cannot go unnoticed. [8] This shows the relationship between the number of labors in the primary industry and these factors in the process of China's agricultural development. For example, the different effects of labor circulation in different regions on the scale of agricultural economy will also have an indirect impact on China's agricultural development.

With the continuous development of China's rural revitalization, there has been a phenomenon of labor return. Fu Cui (2022) used the Logit model for quantitative analysis and found that returned labor could promote the cultivation of family farms after solving the dual endogeneity problem. [9] It also means the return of labor is conducive to the further development of rural economy.

The views of the above scholars mostly take labor and its employment as a major entry point to explore the causes and influences of industrial development. Yet, in terms of the details of agricultural development, although the total agricultural output value keeps growing, the total agricultural output value index has a partial downward trend. The relationship between the growth rate slowdown or even decline and the employment of the primary industry is the main topic of this paper. Meanwhile, it is also expected to further improve the internal logic between the employment and development of the primary industry.

3. Literature References

In this paper, China's total agricultural output value index is selected to measure the development of China's agriculture, and the number of employments in the primary industry is selected to measure the level of rural labor. The variable length is from 1992 to 2021, with data from the National Bureau of Statistics of China. Figure 1 shows the change trend of the index. As the figure shows, the total output value index of China has shown a gradually decreasing trend since 1992, and the decrease amplitude after 1995. Although there is a substantial increase in 2004 and 2021， it still could not change the speed of agricultural economic development is slowing down gradually. The light grey curve reflects the ratio between the number of people employed in the primary industry and the number of people employed in the total industries. This curve also presents an obvious downward trend, which shows that the ratio of employment in primary industry decreases year by year compared with the other two industries, and a large number of labors has transferred from primary industry to secondary and tertiary industries. Therefore, from the data presented in the chart, there is a positive correlation between the agricultural production index and employment in the primary industry. The conclusion of this article will analyze both more specifically.

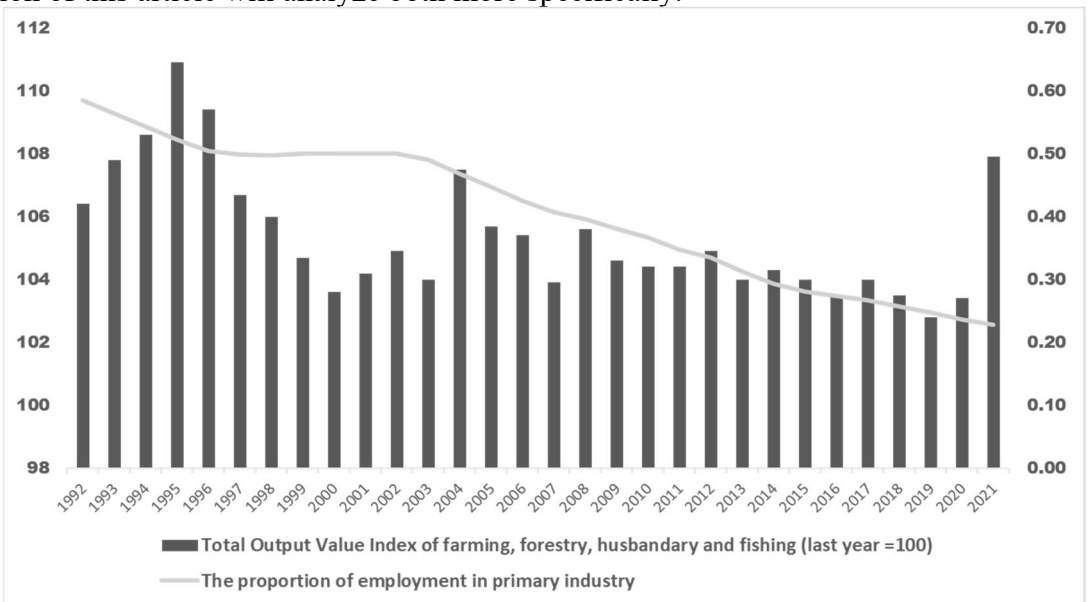

Figure 1. The variation trend of the proportion of employment in the primary industry and the total agricultural output value index

In order to further test the relationship between them, this paper establishes a bivariate vector autoregressive model. Vector autoregressive model is a more flexible model established for time series data. VAR constructs the model by taking every endogenous variable in the system as a function of the hysteresis value of all endogenous variables in the system, thus avoiding the requirement of structured model. The model form is as follows:

$$Y_t = C + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \cdots + \phi_p Y_{t-p} + \varepsilon_t$$

Where, $Y_t = \begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix}$, ε_t is a 2×1 dimensional white noise vector, C is the constant term vector, $\phi_1$to $\phi_p$is the coefficient vectors, and p is the number of lags of the modulus. Next, all the analysis results of the bivariable autoregressive model will be presented in turn.

4. Results

(1) Stationarity test

The premise of the establishment of VAR model is to ensure the stationarity of all variables. Only in this case, the existence of regression phenomenon be avoided. Therefore, this paper first tests the stationarity of the sequence to see whether the sequence is stationary, or integrated of order 1 or higher order. The test results are shown in Table 1.

Table 1. Stationarity test

variable	(c,T, d)	ADF statistics	The critical value (5%)	p value	conclusion
Employment	(c, 0,0)	-0.252	-2.989	0.932	Not smooth
D(Employment)	(c, 0,1)	-3.010	-2,997	0.034	smooth
lnProduction index	(c, 0,1)	0.435	-3.584	0.997	Not smooth
D (lnProduction index)	(c, 0,1)	-2.728	-2.626	0.069	smooth

According to the stationarity test results in Table 1, the first-order difference sequence of the two variables is stationary. Thus, it means both variables are integrated of order 1, which can be further analyzed.

(2) The selection of the number of lags

In the VAR model, the maximum lag order p of the explanatory variable is too small, and the residual may have autocorrelation, resulting in non-uniformly parameter estimation. Therefore, the p value should be appropriately increased. In other words, the autocorrelation of residual can be eliminated by increasing the number of lag variables, but the p-value cannot be too large. If p-value is too large, the effectiveness of model parameter estimation will be directly affected. Therefore, this paper requires to select the lag order of VAR model according to AIC and other criteria, and the final results are shown in Table 2.

Table 2. Test of the number of lags

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	66.0802				.000025	-4.92924	-4.90137	-4.83247
1	143.812	155.46	4	0.000	8.6e-08	-10.6009	-10.5173	-10.3106
2	153.565	19.507*	4	0.001	5.5e-08*	-11.0435*	-10.9041*	-10.5596*
3	155.417	3.7027	4	0.448	6.6e-08	-10.8782	-10.6831	-10.2008
4	157.184	3.5356	4	0.472	8.2e-08	-10.7065	-10.4557	-9.8355

According to the results in Table 2, the optimal number of lags is 2. Therefore, the bivariate VAR regression model with third-order lag is established as follows:

$$\begin{pmatrix} lnproduction\_index_t \\ employment_t \end{pmatrix} = C + \phi_1 \begin{pmatrix} lnproduction\_index_{t-1} \\ employment_{t-1} \end{pmatrix} + \phi_2 \begin{pmatrix} lnproduction\_index_{t-2} \\ employment_{t-2} \end{pmatrix} + \varepsilon_t$$

(3) Results of regression analysis

Table 3. Regression results table

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnproduction_index						
lnproduction_index						
L1.	.9878114	.2079931	4.75	0.000	.5801524	1.39547
L2.	-.2263335	.1762102	-1.28	0.199	-.5716991	.1190321
lnemployment						
L1.	-2.228684	.8054276	-2.77	0.006	-3.807293	-.6500746
L2.	1.756513	.7802336	2.25	0.024	.2272828	3.285742
_cons	1.985113	.5866536	3.38	0.001	.8352932	3.134933
lnemployment						
lnproduction_index						
L1.	-.0778331	.0484282	-1.61	0.108	-.1727506	.0170845
L2.	.0544642	.041028	1.33	0.184	-.0259492	.1348776
lnemployment						
L1.	1.509238	.1875322	8.05	0.000	1.141681	1.876794
L2.	-.5517718	.1816662	-3.04	0.002	-.9078309	-.1957127
_cons	.1875391	.1365938	1.37	0.170	-.0801799	.4552582

According to the coefficient and its standard error in the table, it is not difficult to find that there is a strong negative correlation between the level of rural development and employment in the primary industry. The change of agricultural production index has no direct influence on the employment share of the primary industry, conversely, the more employment in the primary industry, the smaller the current gross agricultural product, but the two show a positive correlation over time. Therefore, the employment in the primary industry has dynamic characteristics of the change of the total agricultural production. This is also comprehensive, the high employment in the primary industry leads to relatively low employment in the more advanced secondary and tertiary industries, thus cause a decline in the level of the overall national economy. Due to the high correlation between the three industries, the agricultural production index also decreased during the period. However, in the long run, since the labor is an important factor of production, employment in the primary industry increases, which in turn increases the total agricultural production.

5. Conclusion

According to the results of this paper, after the analysis between the level of rural economic development and employment in the primary industry in the past 20 years, there is a negative correlation between them, but it has been transferred positive correlation in the recent years. This shows that at the beginning of this century, the level of agricultural productivity increases quickly, which outweigh the negative impact of rural labor transfer. However, in recent years, the growth rate of productivity has slowed down, the primary industry has not attracted labor back, and the improvement of labor quality is not obvious, which leads to the slowdown of the growth rate of agricultural development. In the longer term, employment in the primary industry continues to decline and the shortage of working-age workers will continue to intensify. Therefore, this paper puts forward the following suggestions:

First, more attention needs to be paid to develop rural education, popularize nine-year compulsory education in rural areas, and constantly improve the quality of rural labor. The improvement of labor quality and the productivity level of the primary industry are evolving process, and the demographic

dividend will be transformed into the talent bonuses. In addition, China can further develop vocational technology training for farmers and gradually improve the mechanization of agriculture. And government could establish funds to support the development of agriculture through agricultural science and technology, explore various forms such as tax incentives and loan discount, ensuring the research and development and popularization of agricultural innovative technologies

Second, the government ought to increase publicity and subsidies for rural entrepreneurship to attract high-quality talents and capital to rural areas. At present, the development potential of rural areas is huge. Through the combination of characteristic agriculture and Internet, realizing the market expansion and rural migration return. Developing characteristic agriculture, rural areas could also set up the brand of agricultural products, refine agricultural production, package and market agricultural products, and strive to let local products go out.

Third, improve the rural social security system, especially to provide a perfect service system for the growing elderly population, reduce the cost of old-age care in rural areas, which will not only reduce the burden of young adults, but also have a positive impact on the increase of fertility rate. Since the gap between urban and rural areas is still very obvious, the government are expected to further improve the rural infrastructure, implement the urban assistance policy and improve the rural living standards.

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