

## The Relationship between Agricultural Wage Rates and Labor Productivity: Evidence from China

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**Abstract:** in recent years, there has been a large of shortage of migrant workers in China. This paper collected the panel data of 29 provinces in China from 1990 to 2010. Judging from the criteria of Minami and the panel data analysis method, it studied the changing trend of China's agricultural wage rate and compared the correlation between marginal productivity of labor and agricultural wage rate. The research has found that: (1) the agricultural wage rate in China has been increasing year by year since 2004; (2) the marginal productivity of labor increased year by year, exceeding the rate of agricultural wages between 2000 and 2005; (3) the correlation between agricultural labor wage rate and marginal productivity was strengthened from weak.

### 1. Introduction

Since 2004, the Pearl River delta, Yangtze River delta and other economically developed areas have seen a large-scale shortage of migrant workers, and gradually spread from the coastal areas to the central and western regions, there is a nationwide recruitment difficulty. Some researchers speculate that the Lewis turning point has come. According to the Lewis (1954) dual economic development model, if surplus labor force disappears or the labor market changes from the Lewis classical state to the neoclassical state, it indicates that the economy has passed the Lewis turning point, with the increase of agricultural labor productivity and the convergence of wages between traditional and modern sectors. At the same time, the central and western regions of rural workers employment difficulties also exist.

At present, Chinese academic circles have two views on this basic national condition proposition. Cai (2007, 2010) proves that economic development has entered the lewis transition zone by demonstrating the disappearance of demographic dividend. Wang (2009) judged that China has reached the shortcoming of the economy by analyzing the changing trend of agricultural wage rate. Wang (2007) argue that China's agricultural development has been at a Post-Lewis turning point. Nan (2009) estimate the number of surplus labors in the primary industry, proving that there is still a large number of surplus labors in China, but the number has a downward trend. Bai (2009) believes that the increase of farmers' wage rate in recent years may be related to government policies, and there is no sufficient evidence that the lewis turning point has arrived. Qing et al. (2011) conduct an empirical study through Minami's law and believed that China had not entered the second turning point of Lewis.

China is a developing country with typical Lewis dual structure characteristics, and the characteristics of China's economic development are consistent with lewis model. Since the reform and opening up, China has relied on non-modern sectors to provide a large number of cheap labor, actively developed labor-intensive industries, achieved rapid economic development, and created a miracle in the world. However, some labor shortages in recent years also indicate that China's demographic dividend era seems to be disappearing, and how to transform industries that have lost their comparative advantages.

## 2. Theoretical analysis

### 2.1 How to judge the Lewis turning point

According to the dual economic model, the change of Lewis turning point has two important signs: the number of surplus agricultural labor force decreases sharply and the agricultural wage rate rises sharply. So the specific screening can be divided into two main criteria. One is the wage standard, namely whether the modern sector and the traditional agricultural sector of the wage converge; The second is the quantity standard, namely the non-agricultural sector surplus labor force quantity whether disappears.

Minami (2010) once proposed five methods to determine the turning point. This paper will choose standard 1 and standard 2 proposed by Minami and study the correlation between wage and marginal productivity of labor in the department of living materials by comparing them. [7] Taking agriculture as the representative industry of the living material sector, this paper studies the changing trend of the agricultural wage rate in China. The marginal productivity (MPL) was estimated by the agricultural production function, and then compared with the agricultural wage rate. Finally, the correlation between the two was discussed.

## 3. Data and methods

### 3.1 Data

Agricultural output  $Y$  (unit: ten thousand yuan) the total output value of agriculture, forestry, animal husbandry and fishery in the statistical yearbook is adopted, and the agricultural total output value index is used for the adjustment to obtain the comparable price.

Capital input  $K$  should adopt the agricultural capital stock by definition, but the current estimation lacks unified data, leading to great divergence in the academic circle. Therefore, many scholars have used intermediate material cost to replace. Referring to the estimation of agricultural production function made by Lin (2005), this paper measures capital input by tractor horsepower and agricultural fertilizer quantity.

Agricultural labor input is represented by  $L$  (unit: ten thousand) adopts the number of rural agricultural employees and the number of primary industry employees over the years.

Land input is stand for  $N$  (unit: 1000 hectare) adopts the sown area of main crops.

All the above indicators are based on the data of provinces (municipalities directly under the central government and autonomous regions) in the statistical yearbook of China and the statistical yearbook of China's rural areas from 1990 to 2010. For the convenience of analysis, the data of Chongqing municipality were incorporated into Sichuan, without considering Hainan and Tibet.

### 3.2 Estimation of the rate of agricultural wages

Whether Lewis turning point appears or not, reflected the relationship between labor supply and demand. By studying the changing trend of farmers' wage rate, the relationship between supply and demand can be reflected from the side. When the demand for labor is greater than the supply, it will naturally lead to a rise in the farmers' wage rate.

According to the obtained data of agricultural wage rates in different provinces, according to the time series, the agricultural wage rates in Beijing and Zhejiang province show a trend of rapid rise, and the gap between them and other regions keeps widening. This reflects that the demand for labor in Beijing and Zhejiang is greater than the supply, and the phenomenon of labor surplus is likely to disappear, which is confirmed by the phenomenon of "shortage of migrant workers" in the Yangtze river delta region in recent years.

To facilitate comparison, Beijing and Zhejiang provinces, where wage rates have risen significantly, are compared with Guizhou and Gansu provinces, where they have risen slowly. As is shown in the figure, the agricultural wage rate in Beijing and Zhejiang province began to rise significantly from 1995, and began to rise sharply from 2004 to more than 6,000 yuan in 2010. The rapid increase of agricultural wage rate in 2004 is also corresponding to the phenomenon of shortage

of migrant workers, which has been intensified since 2004. Although the agricultural wage rate in guizhou and gansu province increased year by year, there was no significant change, reaching 1600 yuan in 2010.

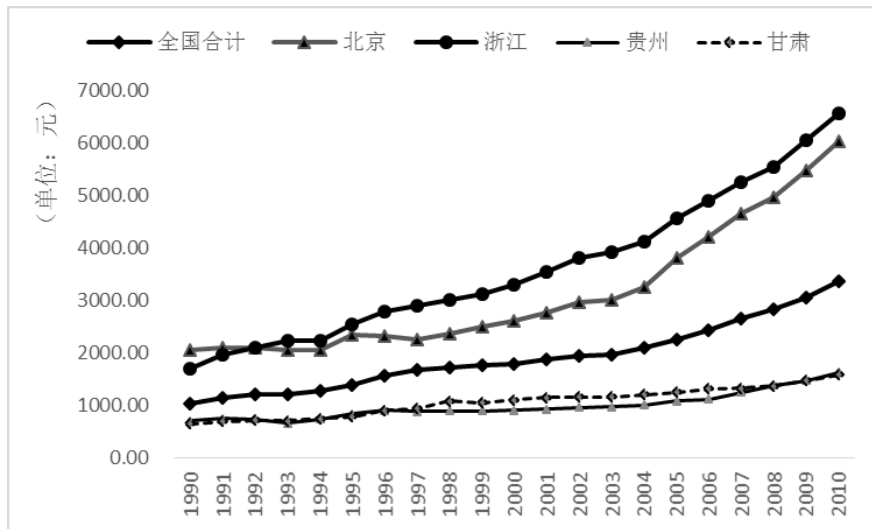


Figure 1. Actual agricultural wage rate in rural areas

Judging from the growth trend of the national agricultural wage rate, it can be divided into three stages: 1990-1996, 1997-2003, and 2004-2010. From 1990 to 1996, the rural agricultural wage rate increased year by year, with an average annual growth rate of 7.26%. From 1997 to 2003, the annual growth rate slowed down to 2.80%. From 2004 to 2010, the annual growth rate of agricultural wages reached 8.16%. In the long run, the agricultural wage rate shows a trend of increasing year by year, and some regions show a trend of rapid rise. The phenomenon of labor surplus may have disappeared.

### 3.3 Estimate the marginal productivity of agricultural labor

According to the general practice, the agricultural production function of China is set as the Cobb-Douglas production function.

$$Y = AK^{\alpha}L^{\beta}N^{\gamma}$$

For the convenience of measurement, take its logarithmic form, and add random perturbation term  $\mu$ :

$$\ln Y = \ln A + \alpha \ln K + \beta \ln L + \gamma \ln N + \mu$$

Where, Y represents output, K represents capital input, L represents labor input, N represents land input, and A represents constant.  $\alpha$ ,  $\beta$ , and  $\gamma$  are respectively the output elasticity of capital, labor and land, and assuming that the return to scale remains unchanged,  $\alpha + \beta + \gamma = 1$ .

The agricultural production function in the period of t in province I was constructed as follows:

$$\ln Y_{it} = \ln A_{it} + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma \ln N + \lambda t + u_i + \varepsilon_{it}$$

T is the time trend variable,  $u_i$  Represents the disturbance term that changes with provinces but is not affected by different factors between years.  $\varepsilon_{it}$  is a random error term.

## 4. Results

### 4.1 Regression results

Stata statistical analysis software was used to regression panel data of provinces and cities from 1990 to 2010. The calculated results are as follows:

$$\ln Y/L = -284.883 + 0.162 \ln \frac{K}{L} + 0,718 \ln \frac{N}{L} + 0.15T$$

(-64.86) (5.18) (6.27) (66.00)

$R^2 = 0.3439$ , the number of samples =397

According to the calculated results of the function, the equation is significant on the whole, and the three explanatory variables of agricultural labor force, capital input and sown area of crops are also significant. The elasticity coefficients of capital input and land input are 0.162 and 0.718.

By calculating the agricultural production function, the statistically significant elasticity of labor production can be obtained as  $\beta = 1 - \alpha - \beta = 0.120$

According to standard 1 of Minami (2010) to judge the turning point, before passing the turning point, the marginal productivity of labor (MPL) in the subsistence sector is low, and the wage (W) is determined by the general lowest living standard (SL) in the economy (classical wage level theory). After passing the tipping point, W would be equal to MPL (neoclassical theory of wage levels). In other words,  $W = SL$  and  $MPL < W$  before passing the turning point; And after the tipping point, MPL is equal to W. Therefore, the turning point can be determined by comparing agricultural wage rate with marginal productivity.

Table.1. Comparison of agricultural marginal productivity and agricultural wage rate

period	Average productivity	Production of elastic	Marginal productivity	Agricultural wage rate	W/MPL
	APL	Beta	MPL = APL * beta	W	
In 1990-1995	3818.70	0.120	458.2443	1211.78	2.64
In 1996-2000	10695.51	0.120	1283.462	1712.84	1.33
In 2001-2005	17492.18	0.120	2099.061	2031.51	0.96
In 2006-2010	26043.93	0.120	3125.272	2865.35	0.92

Table 1 shows the comparison between agricultural marginal productivity and agricultural wage rate. Marginal productivity is obtained by multiplying the estimated elasticity of production by the average productivity. According to the calculation results of the ratio of the two (W/MPL), before 2000, the agricultural wage rate was higher than the marginal productivity of labor. After 2000, and marginal productivity is basically flat. This shows that before 2000, the actual wage rate was not determined by the lower labor productivity, but by the lowest living standard and other institutional policies, and then the marginal productivity gradually increased, and the wage rate was determined by the productivity. This shows that China passed the first Lewis turning point, the "shortcoming", between 2001 and 2005.

According to Minami's (2010) criterion for judging the turning point, if there is a correlation between marginal productivity and agricultural wage rate, it indicates that when the turning point comes, agricultural sector and modern sector have the same wage determination mechanism (marginal productivity theory). Conversely, the turning point has not yet come.

It is assumed that the relationship between agricultural wage rate (W) and marginal productivity of labor (MPL) is:  $W = C + \mu MPL$ , the calculated results are shown in table 2.

Table 2. Correlation between marginal productivity and agricultural wage rate

period	The coefficient of mu	Decision coefficient $R^2$
In 1990-1995	0.230	0.2851
In 1996-2000	0.516	0.4968
In 2001-2005	0.732	0.5194
In 2006-2010	1.151	0.6962

Determination coefficient  $R^2$  Also known as goodness of fit, it reflects the fitting effect of regression function.  $R^2$  The larger the explanatory variable, the greater the correlation between the explanatory variable and the explained variable.

As can be seen from table 2, the judgment coefficient  $R^2$  from 0.2851 in 1990-1995 to 0.6962 in 2006-2010, the MPL coefficient increased from 0.23 to 1.151, indicating that the relationship

between agricultural labor wage rate and marginal productivity was strengthened by weakness, and that agricultural wage rate began to be determined by marginal productivity rather than the minimum living standard.

#### 4.2 Hausman test

When processing panel data, the effects of individual effects should be considered, which can be divided into fixed effect model and random effect model. The selection of the model can be determined by Hausman test. The null hypothesis  $H_0$  is a random variable  $u_i$  which has no correlation with explanatory variables, and then carries out hypothesis test. If it is satisfied, it is accepted as a random model. Instead, it is a select the fixed model.

Hausman test is carried out on the panel data, and the result is  $p=0.62$ , the original hypothesis is accepted, and the random effect model is selected for regression.

### 5. Conclusions and policy implication

This paper estimates the marginal productivity of labor by studying the growth trend of agricultural wage rate, and studies the comparison and correlation between the two. The study found that the agricultural wage rate began to increase significantly from 2004, and the marginal productivity of labor increased year by year, exceeding the agricultural wage rate in 2000-2005, and showing a strong correlation with the agricultural wage rate. This conclusion indicates that China reached the first turning point of Lewis around 2005, which indicates that China's labor market has changed from unlimited supply to limited surplus, and at the same time puts forward a reasonable explanation for the phenomenon of labor shortage and recruitment difficulty that began to appear in 2004.

China belongs to a large country economy, and there is a big gap in economic development between regions. Therefore, the time for different regions to reach the economic turning point is also different. Due to data and space constraints, this article does not specifically address differences between regions. But obviously, just because our economy has reached the Lewis turning point does not mean that all regions have crossed the turning point at the same time. In the actual policy implementation process, we should also take into account the differences between regions and adapt measures to local conditions.

The arrival of the first turning point of Lewis shows that the rural labor force has turned into a limited surplus, which brings severe pressure to the traditional Chinese labor-intensive industry with cheap labor force as its competitive advantage. But in practice, the Lewis inflection point is a period of years rather than a specific point. In the short term, China is still in the second stage of economic development, and there is still a gap between the marginal productivity of the subsistence sector and the modern sector. At this stage, China still has surplus labor force. However, in the long run, the country's development will eventually be transformed into economic integration from the two sectors of the livelihood sector and the modern sector. The transition of economic development will bring opportunities and challenges to China at the same time.

At the present stage, there is still a surplus of rural labor in China, which contains institutional and historical reasons. From the perspective of poverty, the problem of poverty in China's poor areas cannot be fundamentally solved without solving the surplus rural labor force. The country should take precautions, be deeply aware of the opportunities and challenges brought by Lewis turning point, accelerate the pace of reform in system and policy, fully tap the potential of current demographic dividend, and realize the leap of economy.

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