Research on Optimal Allocation of Resources and Improvement of Total Factor Productivity——Taking Shaanxi as an Example

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Abstract: Taking Shaanxi province as an example, the panel data of 10 cities in Shaanxi province from 2005 to 2016 were used to explore the influence of factor resource allocation on total factor productivity. The results show that the allocation of factor resources has a positive effect on total factor productivity, that is, the better the allocation of resources, the higher the total factor productivity. The results of regional regression showed that the rationalization of resource allocation in Guanzhong and Northern Shaanxi significantly promoted the local total factor productivity, and the promotion effect of resource allocation in northern Shaanxi was greater than that in Guanzhong.

1. Introduction
Since China implemented the Western Development Strategy, the economic development of Shaanxi Province has accelerated significantly. However, compared with developed regions, the overall economic strength of Shaanxi is not strong, the development speed is relatively slow, and the economic quality index is far behind the national average. In order to solve the problem of low growth efficiency, the economic growth model driven by traditional factors such as labor and capital is unsustainable. It is necessary to optimize resource allocation and improve total factor productivity to promote high-quality development. Before reaching the equilibrium of economic growth, there are differences in the output efficiency of different industries. When the production factors are transferred from industries with lower production efficiency to those with higher production efficiency, this kind of resource reallocation will promote economic growth, Channery said This is the "total allocation effect". The market-oriented reform of factor allocation in Shaanxi Province is relatively lagging and has formed a misallocation of production factor resources. Therefore, we need to promote the growth of total factor productivity by optimizing the factor replacement effect caused by resource allocation. This article will study the impact of resource allocation on total factor productivity.

At present, there are a large number of literatures at home and abroad to investigate TFP and seek the improvement path of TFP, among which there are many literatures on TFP measurement (Lu X, Lian Y, 2012; Sun Z, Liu L, 2016; Xuan Y, Yu Y, 2017)[1][2][3]. Many foreign studies have re-examined economic growth and development from the perspective of distorted resource allocation. Hsieh and Klenow (2009)[4] used micro-data of Chinese industrial enterprises to reveal that 49% of the difference in TFP between China and the United States was caused by differences in resource allocation efficiency. Brandt etc. (2013)[5] pointed out that the loss of China's TFP due to factor market distortions reached...
30%. Some domestic documents have also begun to discuss the problem of distortion of resource allocation. Zhu X etc. (2011)\[6\] found that if the distortion of capital and labor allocation is effectively eliminated, China's agricultural TFP will increase by more than 20%. Gong G and Hu G (2013)[7] based on Hsieh & Klenow’s method of measuring resource allocation efficiency, breaking through the assumption of constant returns to scale in the model, using the variance of the marginal output of capital and labor to measure the degree of distortion of capital and labor. It shows that the optimal allocation of capital and labor can both increase TFP. Gai Q etc. (2015) [8] found that factor market distortions affect the efficiency of enterprise resource allocation and directly reduce total factor productivity. Empirical analysis shows that if the distortion of the capital market is improved, the total factor productivity of the manufacturing industry can increase by 57.79% on average during the sample period. Qian X etc. (2018)[9] took China’s 2009 Ten Major Industry Revitalization Plan as a natural experiment and found that through capital allocation channels, enterprises’ total factor productivity has been improved. Yang X etc. (2019)[10] found that the industrialization of the industrial structure and the advanced structure of the service industry are conducive to the improvement of TFP.

The above research deeply analyzes the distortions in the Chinese economy and has strong practical significance. However, the above scholars' research on the optimal allocation of resources and total factor productivity is basically based on national or provincial research. They rarely go deep inside the province, analyze local economic development, and study smaller-scale resource allocation and total factor productivity. The problem provides theoretical basis and policy reference for the local government’s total factor productivity improvement. And this is exactly what the actual economic development needs. Based on the foundation of local development, this paper selects Shaanxi, which is similar to the national macro-industrial structure, as an example. On the basis of local development, this paper selects Shaanxi province, which is similar to the evolution trend of national macro-industrial structure, as an example, and takes 10 cities in Shaanxi from 2005 to 2016 as the research objects. By building the relationship model between resource allocation and total factor productivity in Shaanxi, this paper explores the relationship between resource allocation and total factor productivity.

2. Model and data
Before estimating total factor productivity, it is usually necessary to set the form of the production function. In practical applications, the Cobb-Douglas production function (C-D production function) has become the most common form of function, and the C-D production function usually takes the following form:

\[
Y_{it} = A_iL_{it}^\alpha K_{it}^\beta
\]  

(1)

\(Y_{it}\) represents output, \(L_{it}\) and \(K_{it}\) represent labor and capital input respectively. \(A_i\) is commonly known as TFP. By taking the logarithm of Equation (1), it can be transformed into the following linear form:

\[
y_{it} = \alpha l_{it} + \beta k_{it} + \mu_{it}
\]  

(2)

Where, \(l_{it}\) and \(k_{it}\) represent the logarithmic form of \(L_{it}\) and \(K_{it}\) respectively. The residual term of Equation (2) contains information in logarithmic form of the TFP \(A_i\).

However, when the above simple linear estimation method is used for TFP estimation, there will be unavoidable measurement technical problems. Therefore, consider the following production function:

\[
y'_{it} = \alpha + \beta w'_{it} + \gamma x_{it} + \omega_{it} + \epsilon_{it}
\]  

(3)

Among them, \(y'_{it}\) is the logarithmic value of output, \(w'_{it}\) is a series of free variables, which are also
logarithmic values, $x_i$ is a series of state variables, which are logarithmic values, $\omega_i$ is unobservable productivity, and $\varepsilon_i$ is a white noise impact. Generally speaking, the state variable is usually capital, and the free variable is usually labor. Investment is used as a proxy variable for unobservable productivity shocks.

The optimal allocation of resources is embodied through the transformation of industrial structure, so that resources can be rationally distributed among the three industries, and the transformation from factor input to structural efficiency improvement can be realized. The allocation effect of production factors directly affects the increase in total factor productivity (Yu Y etc., 2016)[11]. Therefore, the degree of coupling between the factor input structure and output structure can be used to measure the rationalization of resource allocation, namely

$$E = \sum_{i=1}^{n} \left| \frac{Y_i}{L_i} - 1 \right|$$

Among them, $Y$ represents output, $L$ represents labor input, $i$ represents the $i$-th industrial sector, and $n$ is the total number of industrial sectors. This paper proposes an indicator to measure the rationalization of resource allocation. The smaller the value of $E$, the more reasonable the allocation of economic resources; the larger the value of $E$, the more unreasonable the allocation of resources.

The total factor productivity that can be obtained by the Equation (3) estimation, the total factor productivity change will be affected by a series of factors, in order to further analyze the influencing factors of the total factor productivity change, a dynamic econometric empirical model is constructed:

$$TFP_t = \alpha + \beta E_t + X_t + \mu + \varepsilon_t$$  \hspace{0.5cm} (4)

Among them, $TFP$ is total factor productivity; $E$ is the rationalization of resource allocation; $X$ is a series of control variables.

The data in this article comes from the 2005-2016 Shaanxi Regional Statistical Yearbook and China City Statistical Yearbook. This article uses GDP as the output variable, labor variable selects the number of employees in the three major industries, and fixed asset investment as the investment variable. In this study, capital stock refers to fixed assets. This article uses perpetual inventory of fixed assets commonly used in academia. Method to calculate fixed assets (Wang W etc., 2017)[12], the control variables selected the proportion of the number of colleges and universities in each region to the total population and the proportion of education expenditure in each region in fiscal expenditure.

After the above processing, the statistical characteristics of the main variables used in this article are shown in Table 1.

| Variable | Variable description | N  | mean  | sd   | min  | max  |
|----------|----------------------|----|-------|------|------|------|
| lnY      | The logarithm of the output variable | 120 | 6.600 | 0.970 | 4.270 | 8.750 |
| lnK      | The logarithm of the output variable | 120 | 7.800 | 1.250 | 4.930 | 10.65 |
| lnL      | The logarithm of the labor variable | 120 | 3.350 | 0.740 | 2.200 | 5.300 |
| lnI      | The logarithm of the investment variable | 120 | 6.330 | 1.180 | 3.540 | 8.680 |
| people   | Regional population   | 120 | 373.680 | 202.78 | 82.99 | 883.21 |
| kfre     | The proportion of regional higher education students to the total number | 118 | 0.0200 | 0.020 | 0.020 | 0.100 |
3. Result analysis

Table 2: The direct impact of rationalization of resource allocation on total factor productivity

|       | (1)       | (2)       | (3)       | (4)       |
|-------|-----------|-----------|-----------|-----------|
| E     | -0.391**  | -0.462*** | -0.297**  | -0.333**  |
|       | (0.175)   | (0.198)   | (0.158)   | (0.158)   |
| kfre  | 268.782** | 267.895   | 1231.955*** | 1231.955*** |
|       | (143.387) | (197.894) | (450.337) | (450.337) |
| kedu  | 73.503*   | 73.503*   | 86.096*** | 86.096*** |
|       | (23.984)  | (23.984)  | (21.927)  | (21.927)  |
| people|          |          | -0.721*** | -0.721*** |
|       |          |          | (0.212)   | (0.212)   |
| _cons | 113.025***| 110.009***| 92.442*** | 343.111***|
|       | (2.511)   | (2.454)   | (5.278)   | (7.094)   |

City FE: YES YES YES YES
Observations: 120 118 118 118
F: 4.98 2.97 3.37 8.71

Note: ***, **, * indicate significant levels of 1%, 5%, and 10%.

The results show that the key explanatory variable \( E \) is significantly negative, which means that the resource allocation rationalization index is negatively correlated with total factor productivity, that is, the worse the resource allocation rationalization index, the lower the total factor productivity, that is, the rationalization of resource allocation will promote total factor productivity improvement. The results show that the greater the proportion of the total population in the area of higher education institutions, the greater the increase in total factor productivity; the greater the proportion of regional education expenditure in fiscal expenditure, the greater the increase in total factor productivity; and the greater the number of regional populations, it will reduce the total factor productivity.

At the same time, Shaanxi is the province with the longest latitude from north to south. Shaanxi is divided into three regions: northern Shaanxi, Guanzhong and southern Shaanxi. Northern Shaanxi is arid with strong winds; Guanzhong is rich in water and soil, and commerce and trade are concentrated; Southern Shaanxi has a mild climate and wide geographical location. Due to the regional differences in Guanzhong, Southern Shaanxi, and Northern Shaanxi, this article will be divided into samples.

Table 3: The direct impact of rationalization of resource allocation by region on total factor productivity

|       | Guanzhong | Southern Shaanxi | Northern Shaanxi |
|-------|-----------|------------------|------------------|
| E     | -0.360**  | 0.109            | -6.323***        |
|       | (0.140)   | (0.195)          | (1.212)          |
| kfre  | 719.355*  | 324.325          | -2430.441*       |
|       | (417.502) | (744.739)        | (1329.104)       |
| kedu  | 99.143*** | 35.195*          | 96.937*          |
|       | (25.877)  | (19.256)         | (44.561)         |
| people| -0.274    | -0.859*          | 1.266            |
|       | (0.200)   | (0.494)          | (1.095)          |
| _cons | 197.251** | 326.013**        | -174.863         |
|       | (84.789)  | (140.176)        | (294.852)        |

City FE: YES YES YES
Observations: 58 36 24
F: 7.67 1.92 26.61

Note: ***, **, * indicate significant levels of 1%, 5%, and 10%.
From the results of group regression, there are still big differences between the three regions: it is found that the rationalization of resource allocation in Guanzhong and northern Shaanxi significantly promotes the increase of local total factor productivity, while the rationalization of resource allocation in southern Shaanxi has no effect on the local TFP. And compared with northern Shaanxi, the resource allocation rationalization index in Guanzhong has a smaller impact on total factor productivity. This is because the overall development level of Guanzhong area is higher than that of other areas, and the corresponding resource allocation is more reasonable, and the impact on TFP is relatively small.

4. Summary and policy recommendations
This paper analyzes the relationship between the rationalization level of resource allocation and total factor productivity and finds: (1) The more unreasonable resource allocation, the lower the total factor productivity; (2) The results of regional regression show that the rationalization of resource allocation in Guanzhong and Northern Shaanxi has significantly promoted the local total factor productivity, and the promotion effect of resource allocation in northern Shaanxi is greater than that in Guanzhong. Therefore, it is necessary for Shaanxi to focus on the coordination and coupling of factor endowments and resource allocation in the region, improve the aggregation quality of the industrial structure, and further promote the continuous improvement of total factor productivity. At the same time, the focus of the policy on the optimal allocation of resources is in northern Shaanxi and Guanzhong, especially in northern Shaanxi, so as to promote the improvement of the province's factor productivity and promote high-quality economic development.

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