International Journal of Research Studies in Science, Engineering and Technology
Volume 3, Issue 7, July 2016, PP 33-37
ISSN 2349-4751 (Print) & ISSN 2349-476X (Online)

# Evaluation on the Effectiveness of Regional Investment in the Western Regions

**Dong Yue**

Inner Mongolia University of Technology School of Management

**Abstract:** *The investment efficiency is an important decision basis for the investment in the West. Through using the method DEA, putting the 11 provinces in western China as the research object, we establish the input and output indicators of regional investment, and then analyze the change of investment efficiency, make multi-level effectiveness evaluation. Finally, we put forward some suggestions to improve the investment in the western region area.*

**Keywords:** *the western region, regional investment, DEA, effectiveness*

## 1. INTRODUCTION

In March 2000, Premier Zhu Rongji in the "Government Work Report" clearly pointed out that implementation of the western development strategy and accelerating the development of the central and western regions are the important decisions which the CPC central committee made for the new century. Up to now, the country has accumulated billions of dollars to improve infrastructure conditions and ecological environment in the western region, providing the basic support for the introduction of private capital. But for the resources, environment, the population quality and other influence aspects, the western region investment effect is uneven. In this paper we select the 11 provinces which mentioned in the western development strategy, evaluate the effectiveness of the investment in a grading way, and we expect these work can provide scientific basis for the national investment decision, further narrow the gap between the East and the West and finally help our country to achieve the common prosperity.

DEA (Data Envelopment Analysis) is a method which is used to evaluate the effectiveness of same type decision making units. Feng Zhenhuan, Zhao Guojie (2004) proposed the DEA classification effectiveness evaluation method on the basis of the basic principle of DEA, and applied the method to China regional investment, drew the famous share picture of China's regional investment effectiveness.[1] Duan Hengchao, Wen Xiaozheng (2013) also used the same idea to evaluate the classification effectiveness of China's regional investment, and then make regression analysis for the factors which influence the classification efficiency. [2]Shang Yuxin, Hong Huizhu (2010) carried on the comparative study on the classification effectiveness and the investment philosophy effectiveness of fifteen cities in Xinjiang from 2002 to 2007, from two aspects of input redundancy and output deficiency, they analyzed the problems existing in the non DEA effective unit.[3]With reference to the above documents, DEA can make grading evaluation in different regions, the investment efficiency can be excluded from the priority order, so this paper adopts the DEA method.

## 2. RESEARCH METHODS

### 2.1. Data Envelopment Analysis (DEA)

Data envelopment analysis (DEA) is a system analysis method based on the concept of "relative efficiency", which is known by the famous American researchers A .Charnes and W.W.Cooper. The basic idea is every evaluation unit or department is a decision making unit (DMU), they make up

evaluation group. Each DMU has the same input indexes and output indexes. The method uses mathematical programming model, makes comparison of relative efficiency between the different DMUs and makes comprehensive analysis of the input-output ratio.[4]

$C^2R$ model is the most widely used model in DEA method, and the model is adopted in this paper. $C^2R$ is a model to determine the total efficiency of decision making units, which is the product of technical efficiency and scale efficiency. There exist n decision making units: $DMU_i$ , i=1,2,3..... n, each decision making unit has the corresponding efficiency evaluation index: $h_j$,

$$h_j = \frac{u^T y_j}{v^T x_j} = \frac{\sum_{r=1}^{n} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}}, j = 1, 2, \cdots, t \quad xj=(x_{1j},\ldots,x_{mj})T, \quad yj=(y_{1j},\ldots y_{rj})T$$

Among them: $v_i$ ( i=1,2,... m) represents a measure of the input; $u_r$ (r=1,2,... n) represents a measure of the output.

Now evaluate the efficiency of the $j_0$ ($1 \le j_0 \le t$)DMU, make "v", "u" as the variable vectors, make the efficiency index of the DMU($j_0$) as the goal, the efficiency index of all the DMUs as the constraint, and finally do the Charnes - Cooper transformation, we can get the C2R model. The model is as follow:

$$(D^1_{C^2R}) \begin{cases} \min \theta \\ s.t. \sum_{j=1}^{t} \lambda_j x_j + S^- = \theta x_0 \\ \sum_{j=1}^{t} \lambda_j y_j - S^+ = y_0 \\ \lambda_j \ge 0, j = 1, \cdots, t \\ S^-, S^+ \ge 0 \end{cases}$$

The t represents the number of the same kind of decision making units(DMU); X represents the input index, Y represents the output index; λis the input variable coefficient, S- processes for the remaining variables, S + for the slack variables; θ（$0 \le \theta \le 1$）for the evaluation of the effectiveness of DMU values: When θ=1, the DMU is DEA efficient; When θ<1, the DMU is DEA non-effective.

### 2.2. Grading Evaluation of the Effectiveness of the Decision Making Unit

When making effectiveness evaluation analysis, the most difficult problem is unable to compare the merits of DEA invalid decision making units. [5]To overcome this defect, we put forward the following improvement plan: First of all, make the first evaluation for all the DMUs. The DMU which its evaluation value equal 1 can be called level-1 effective; Then, eliminate the effective DMU, make the second evaluation for the rest invalid DMUs which do not meet the production frontier, find the DMU which its evaluation value equal 1, and call them level-2 effective…… The rest can be done in the same manner. When the remaining DMUs are all invalid or valid, we can get a result of the DEA classification effective evaluation.

## 3. EMPIRICAL ANALYSIS

### 3.1. The Establishment of the Index System and Data Sources

For the macroeconomic system, according to the Cobb-Douglas production function $Y=AK\alpha L\beta$, we choose indicators which reveal relationship between input and output. [6]Input indicators are the whole society fixed assets investment (100 million yuan) (X1) which reflects the level of regional

investment, and the electricity consumption (kwh) (X2) which reflects the energy consumption; Output indicators are the per capita GDP(yuan/person) (Y1) and the residents' consumption level (yuan) (Y2). Decision making unit are the 11 provinces in western areas, including Ningxia, Xinjiang, Qinghai, Gansu, Shanxi, Tibet, Yunnan, Guizhou, Sichuan, Chongqing, and Guangxi. According to the consistency, comparability and availability of the data, we select a total of 10 years of data (from 2006 to 2015) of the 11 provinces and calculate the average value for analysis. All the data are from China National Bureau of statistics.

**Table3.1.** *Average value of every index in the western provinces of 2006-2015*

| provinces | Y1: per capita GDP | Y2: residents' consumption level | X1: whole society fixed assets investment | X2: electricity consumption |
|---|---|---|---|---|
| Xingjiang | 19492.8 | 5784.8 | 2607.7 | 519.9 |
| Ningxia | 19220.6 | 6951.8 | 932.7 | 452.1 |
| Qinghai | 17717.3 | 5833.3 | 748.3 | 337.3 |
| Gansu | 12240.7 | 4989.4 | 2089.6 | 659.7 |
| Shanxi | 19556.3 | 6548.8 | 5078.8 | 698.9 |
| Tibet | 13598.8 | 3696.3 | 331.7 | 19.1 |
| Yunnan | 12355.0 | 5488.8 | 3655.0 | 807.8 |
| Guizhou | 9766.3 | 4885.6 | 2263.3 | 712.8 |
| Sichuan | 15691.1 | 6304.9 | 8167.2 | 1246.1 |
| Chongqing | 20733.5 | 7556.5 | 4225.9 | 489.0 |
| Guangxi | 14881.2 | 6034.8 | 4280.8 | 751.1 |

### 3.2. The First Evaluation on the Western Provinces Investment Efficiency

By using the C2R model of DEA, with the aid of DEAP2.1 software calculation, we obtained the analysis result of the investment situation in the western region, and the result is shown in the table below:

**Table3.2.** *Investment effectiveness analysis results of western provinces*

| provinces | evaluation value | | | return to Scale | output slack variable value | | input slack variable | |
|---|---|---|---|---|---|---|---|---|
| | crste | vrste | scale | | S1+ | S2+ | S1- | S2- |
| Xinjiang | 0.199 | 0.849 | 0.235 | drs | 0.000 | 1216.178 | 0.000 | 0.000 |
| Ningxia | 0.669 | 1.000 | 0.669 | drs | 0.000 | 0.000 | 0.000 | 0.000 |
| Qinghai | 0.699 | 1.000 | 0.699 | drs | 0.000 | 0.000 | 0.000 | 0.000 |
| Gansu | 0.214 | 0.289 | 0.741 | drs | 3596.032 | 0.000 | 0.000 | 0.000 |
| Shanxi | 0.116 | 0.607 | 0.191 | drs | 0.000 | 414.183 | 0.000 | 0.000 |
| Tibet | 1.000 | 1.000 | 1.000 | - | 0.000 | 0.000 | 0.000 | 0.000 |
| Yunnan | 0.135 | 0.311 | 0.434 | drs | 4408.914 | 0.000 | 0.000 | 0.000 |
| Guizhou | 0.194 | 0.248 | 0.780 | drs | 5887.903 | 0.000 | 0.000 | 0.000 |
| Xichuan | 0.069 | 0.278 | 0.249 | drs | 2626.781 | 0.000 | 0.000 | 0.000 |
| Chongqing | 0.160 | 1.000 | 0.160 | drs | 0.000 | 0.000 | 0.000 | 0.000 |
| Guangxi | 0.127 | 0.421 | 0.301 | drs | 2908.659 | 0.000 | 0.000 | 0.000 |

In the above table, crste represents the technical efficiency without taking into account of the return to scale; vrste represents the technical efficiency with considering the return to scale; scale represents scale efficiency with considering the return to scale. Crste= vrste×scale. S+ represents the output slack variable value, S- represents the value of the input slack variable.

1. For the comprehensive efficiency (crste), it is a comprehensive measurement and evaluation of the decision making unit which are about the resource allocation ability, resource use efficiency and other aspects. The image above indicates that only the Tibet area has achieved investment efficiency.
2. For pure technical efficiency (vrste), it is due to factors such as management and technical efficiency. Pure technical efficiency = 1, means in the current technical level, the use of its resources is effective.

3. The scale efficiency (scale) is the scale factor which influences the production efficiency, reflects the gap between the actual size and the optimal production scale.

The table reflects most of the western regions are in decreasing return to scale. For these provinces, their comprehensive technical efficiency values are less than 1, most of which are not located in the production frontier. In Xinjiang, the scale factors mainly influences the overall efficiency. The main influencing factors of Gansu are management and technology, Shanxi is the scale factor. Guizhou is mainly influenced by management and technological factors. Both the scale efficiency and technical efficiency of Yunnan, Sichuan and Guangxi are not high.

For Ningxia, Qinghai and Chongqing, their comprehensive technical performance is invalid, pure technical efficiency is effective, and the scale efficiency is invalid. But slack variable is 0, indicating that the three regions in terms of their own technical efficiency have no need to reduce the input, and no need to increase the output. The comprehensive efficiency of the sample is not effective, it can be attributed to the imbalance between its size and the input-output structure. In addition, the three regions are in the stage of decreasing return to scale, so the focus of the reform lies in how to better play to their economies of scale.

### 3.3. The Grading Evaluation on the Western Provinces Investment Efficiency

Using the above data, we continue to evaluate the effectiveness of investment in the western region in a classified way, and the results are shown below:

**Table3.3.** *Investment effectiveness grading analysis results of western provinces*

| provinces | First time | Second time | Third time | Fourth time | Fifth time |
|---|---|---|---|---|---|
| Xinjiang | 0.235 | 0.841 | 1.000 | — | — |
| Ningxia | 0.669 | 0.956 | 1.000 | — | — |
| Qinghai | 0.699 | 1.000 | — | — | — |
| Gansu | 0.741 | 0.855 | 0.717 | 1.000 | — |
| Shanxi | 0.191 | 0.881 | 1.000 | — | — |
| Tibet | 1.000 | — | — | — | — |
| Yunnan | 0.434 | 0.941 | 0.788 | 0.998 | 1.000 |
| Guizhou | 0.780 | 0.838 | 0.702 | 0.979 | 1.000 |
| Sichuan | 0.249 | 0.962 | 0.904 | 0.636 | 1.000 |
| Chongqing | 0.160 | 0.894 | 1.000 | — | — |
| Guangxi | 0.301 | 0.983 | 0.866 | 1.000 | — |

In the initial evaluation, only the investment in Tibet is effective. Do the second evaluation of the remaining 10 provinces excluding Tibet, and then eliminate the level-2 effective provinces , do the third evaluation, and so on until the fifth evaluation, all decision making units are effective, and classification process is over. The chart shows that the level-1 effective DMU is Tibet; Level-2 effective province is Qinghai; Level-3 are Xinjiang, Ningxia, Shanxi and Chongqing. The fourth grade effective is Gansu Province and Guangxi; The fifth level effective is Yunnan, Guizhou and Sichuan.

## 4. Conclusions and Suggestions

### 4.1. Conclusions

At present, the western regions have entered the peak period of investment, but high investment is often associated with low efficiency, mainly because the industry structure of investment and capital source structure is unreasonable. The phenomena of duplication investment and inefficient investment are more serious. So in the western region, in order to effectively promote the economic and social sustainable development, we can no longer blindly pursue a high amount of investment, the government should adopt more long-term policy rather than a short-term policy, and the investment mechanism must be structurally adjusted. [7]

### 4.2. Suggestions

First, we should coordinate the relationship between human and capital investment proportion. Like Gansu, Yunnan, Guizhou, Sichuan and Guangxi, their pure technical efficiency are all lower than formation of regional economic growth pole, 0.5, the education resources in these areas is relatively backward, human resources is lack of advantage, the country can increase human capital, and coordinate human capital and investment capital proportion to promote their development, improve the economic benefits of investment.

Second, the government should actively guide the optimization of investment structure. At the same time of expanding investment increment, we should do a good job of optimizing the allocation of investment, to avoid duplication investment and inefficient investment, fundamentally improve the overall benefit of investment. The western regions should carefully analyze their own industrial advantages, resource advantages, make the best use of the circumstances, form the regional economic growth pole, and concentrate on the economic growth pole, in order to achieve economies of scale. For Ningxia, Qinghai and Chongqing, their pure technical efficiency has been achieved effectively, but the scale efficiency is invalid, so it's more important to adjust the investment structure, rather than blindly in pursuit of the amount of investment.

Third, we should coordinate the relationship between the economic development and investment. We should not blindly rely on investment, but focus on improving the utilization rate of capital.[8]Especially for the provinces whose investment efficiency is invalid, they should focus on improving investment efficiency, not the expansion of investment scale.

## REFERENCE

[1] Feng Zhenhuan, Zhao Guojie. Use DEA to evaluate the effectiveness of the classification of regional investment in China [J]. Modern Finance and Economics - Journal of Tianjin Institute of Finance and economics, 2004, 01:18-21.

[2] Duan Hengchao, Wen Xiaozheng. Grading evaluation of the regional investment effectiveness in China [J]. DEA era finance, 2013, 14:40-41.

[3] Shang Yuxin, Zhu Honghui. The effectiveness of Xinjiang regional investment based on DEA model analysis [J]. Journal of Shanghai Business School, 2010,02:68-70.

[4] Yu Dengke, Deng Qunzhao. Thinking of DEA method application [J]. modern management science, 2012,10:20-23.

[5] Li Xueyu, Chu Jinxia. Classification based on DEA to study the impacts of the fund size and fund performance [J]. Journal of financial times, 2013:242-243.

[6] Ye Shiqi Yan Caiping, Mo Jianfang. B - D method of the DEA index system [J]. Journal of jinan university (natural science and medicine edition), 2004 01:249-255.

[7] Zhang Xiaoyan, Qi Yue. The study on investment efficiency, investment structure and mechanism in the western region [J]. Journal of investment research, 2011, 10:30-41.

[8] Xu Hongmei. Shortage of funds in the large-scale development in west China and improve the soft environment of investment in western [D]. Xian building university of science and technology, 2003