# Competitiveness Comparative Research on Jiaozuo Service Industry Based on Synchronic and Diachronic Data

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***Abstract***

*Service industry plays a more and more important role in economic development, it had become an important symbol for the enhancement of one region competitiveness. The paper constructed the Jiaozuo service competitive evaluation model, which used 2004-2011 years sequence data of Jiaozuo and synchronic data of Zhengzhou, Kaifeng, Luoyang, Xinxiang, Jiaozuo five cities, based on the DEA method, designed input index including employees and fixed assets, designed output index including service industry output value and growth rate, then it solved the answer with LINGO8.0 linear programming software. Model could not only evaluate sequence change on development of service industry competitiveness for eight years in Jiaozuo, but also did a horizontal section comparison with Zhengzhou, Kaifeng, Luoyang, Xinxiang four Cities. Model operation results showed that Jiaozuo service industry appeared to be on the mend but unstable situation on the overall effectiveness according to the longitudinal input and output, the horizontal section comparing showed that it had slightly shortage than Zhengzhou, Kaifeng city, it was in a horizontal line with Xinxiang, Luoyang, but the total amount was insufficient, it was totally in accord with the actual situation in Jiaozuo service industry development. Finally, it proposed the countermeasure and suggestion from Jiaozuo important development industries, service industry development policy and talent training.*

***Keywords****: Service industry; Synchronic data; Diachronic data; Competitiveness; Jiaozuo*

## 1. Introduction

In the big background of economic globalization, with computer technology as the core and the information as the foundation, all kinds of service industry had become the backbone of economic growth. Through service function, Service industry organically connected social production, distribution with consumption links, accelerated the operation of human resources, material resources and information resources, played an important role in promoting the industrialization and modernization. And it promoted the development of the other service industries on the basis of this information, finance, insurance, business service was the most obvious. Then in the background of China's reform and opening up today, the service industry would open as a matter of course, and the competition pattern formatted initially, the foreign capital of main industry also speeded up the step [1-2]. Therefore, described the advantages and disadvantages of Jiaozuo service industry quantitatively, would help evaluate Jiaozuo service industry competitiveness correctly, in order to provide objective basis for improving its economic development.

Service industry competitiveness was a comprehensive system which covered service industry itself, the relevant elements, relationships and behavior, and other aspects. As a result of each region's economic environment, economic base had too many differences and the same area also had many differences in different periods [3-4]. Therefore, only using absolute indicators such as the value-added proportion of service industry or service industry value-added in economic growth to measure the competitiveness of service industry was not comprehensive, it should carry on investigation comprehensively from the point of view of system. From this requirement, this paper based on the Synchronic data and time-series data, used DEA model, reflected the competitiveness level and the situation of Jiaozuo service industry from different aspects comprehensively [5]. Mainly focused on the input and output, if it

could use less investment to bring larger output, then competitiveness was stronger, on the other hand, competitiveness was weak.

## 2. Research Method
### 2.1. Specification of Model

DEA (Data Envelopment Analysis) developed on the basis of "relative efficiency evaluation" concept by American famous operations researcher A.C ham. and W.W. Cooperi301 in 1978, it was a kind of the input and output of the nonparametric system analysis method [6-8], with keeping input or output of DMU (Decision Making Unit) unchanged, with the help of mathematical programming, putting DMU projection to DEA front surface, and through the comparison on degreed from Decision Making Unit to the front of DEA, it evaluated their relative effectiveness, so, it not only could obtain the comprehensive efficiency quantitative index of each DMU, it but also made evaluation and sorting according to each DMU validity and effectiveness technology, it could make further analysis on non DEA efficient reasons and improvement direction  for each DMU, to provide a basis for Decision makers [9]. But concerning research service industry in the paper, the basic principles of evaluation of DEA model was shown in figure 1.
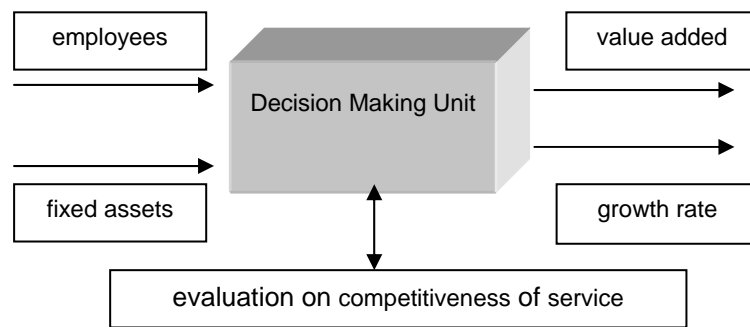


Figure 1. DEA model of the service industry competitiveness evaluation

Due to that development environment and investment conditions on service industry in different areas tended to have larger homogeneity, and service industry was one complex system with many inputs and outputs [10-11]. Therefore, this paper selected the $C^2R$ model including scale effective and technology effective. Suppose the number of DMU was n, each DMU had m kinds of inputs and s kinds of outputs, the mutual relationship diagram as was shown in table 1. In the table: $X_{ij}$ was the i input of the j DMU; $Y_{ij}$ was the r output of the j DMU. i=1, 2... m; j= 1, 2,..... , n; r= 1, 2... s.

All the input and output of DMU could be expressed as with vector:

$$X_i = ( X_{1j}, X_{2j},..., X_{mj} )^T , Y_i = (Y_{1j}, Y_{2j},..., Y_{sj} )^T$$

Basing on evaluation thought of DEA method and evaluation purpose of DEA model, it established the DEA evaluation model, through introducing slack variable $s^+$、 $s^-$ and the Archimedes infinite small $\varepsilon$, it could coke structure the linear programming model (D).

$$\min [\theta + \varepsilon ( \hat{e}^T s^- + e^T s^+ )]$$
$$s.t. \sum_{j=1}^{n} \lambda_j X_j - \theta X_{j0} + s^- = 0 \tag{1}$$
$$\sum_{j=1}^{n} \lambda_j Y_j - Y_{j0} - s^+ = 0$$
$$\lambda_j \geq 0, s^- \geq 0, s^+ \geq 0$$

Table 1. Relationship diagram of input and output index on service industry competitiveness evaluation

| Input weight | Input | DMU（1,2,…,j,…,n） | | | | | Output | Output weight |
|---|---|---|---|---|---|---|---|---|
| $V_1$ | 1 | $X_{11}$ | …………… | $X_{1j}$ | …………… | $X_{1n}$ | | |
| $V_2$ | 2 | $X_{21}$ | …………… | $X_{2j}$ | …………… | $X_{2n}$ | | |
| ⋮ | ⋮ | ⋮ | | ⋮ | | ⋮ | | |
| $V_m$ | m | $X_{m1}$ | …………… | $X_{mj}$ | …………… | $X_{mn}$ | | |
| | | $Y_{11}$ | …………… | $Y_{1j}$ | …………… | $Y_{1n}$ | 1 | $U_1$ |
| | | $Y_{21}$ | …………… | $Y_{2j}$ | …………… | $Y_{2n}$ | 2 | $U_2$ |
| | | ⋮ | | ⋮ | | ⋮ | ⋮ | ⋮ |
| | | $Y_{s1}$ | …………… | $Y_{sj}$ | …………… | $Y_{sn}$ | s | $U_s$ |

In the formula: $\hat{e}^T = (1,\cdots,1)^T_{1\times m}$, $e^T = (1,\cdots,1)^T_{1\times m}$,

$S^- = (s^-_1, s^-_2, \cdots, s^-_m)^T$, $S^+ = (s^+_1, s^+_2, \cdots, s^+_s)^T$ $s^-_i$ and $s^+_r$ $(i=1,2,\cdots,m; r=1,2,\cdots s)$ were slack variable, $\varepsilon$ took $10^{-5}$.

It must be noted that using the model needed to meet two assumptions: first, the number of evaluation area should be twice greater than or equal to the number of input and output of the project to avoid efficiency overvalued; Second, the input variable and output variable must satisfy the correlation requirements [12-15].

## 2.2. Variable Selection

In the variable index selection process, can accurate reaction area the present situation of the service industry, but also take account of economic indicators of comparability. According to the DEA evaluation principle, input indicators should be as little as possible, the output indicators should be the bigger the better [16-17]. From the point of view of economic significance, the number of employees, assets as input indicators, service industry output value, growth rate as the output index, as seen table 2.

Table 2. Service industry competitiveness of the DEA evaluation index system table

| Input index | Employees<br>fixed assets |
|---|---|
| Output index | service industry output value<br>service industry growth rate |

The paper intended to solve the problem with linear programming software LINGO8.0, the selection of indexes had different dimensions, it could not be directly solved, it used the averaging method to deal with original data on dimensional change process. Processing method was as follows:

$$X_{ij} = \frac{X'_{ij}}{\frac{1}{m}\sum_{i=1}^{m} X'_{ij}} \tag{2}$$

$X_{ij}$ -the data with dimensionless processing; $X'_{ij}$ -first I index of the first j decision unit; m-the number of evaluation index.

### 2.3. Model Test

For linear programming (D), used LINGO optimization software programming to solve type (1), the answer could evaluate the overall efficiency on service industry technology and scale [18].

Supposed the optimal solutions as $\theta$、 $\lambda^*$, $S^{*-}$, $S^{*+}$, $s_r^+$, Worked out the following several ways:

（i）if the （D） had optimal solution $\theta^* = 1$, the first $j_0$ DMU was called DEA weak efficient, if not, it was too.

（ii）if the （D） had optimal solution $\theta^* = 1$, and for each of its optimal solutions $\lambda^*$, $S^{*-}$, $S^{*+}$, $s^{*+} = s^{*-} = 0$ ( Each component was zero), the first $j_0$ DMU was called DEA efficient, if not, it was too.

（iii）If $\lambda_j$ existed, it made $\sum_{j=1}^{n} \lambda_j = 1$, the scale benefits was unchanged; If $\lambda_j$ did not exist, when $\sum_{j=1}^{n} \lambda_j < 1$, the scale was diminished, when $\sum_{j=1}^{n} \lambda_j > 1$, the scale was increasing.

DEA method was used to evaluate the relative efficiency on type department, in this study, decision making unit contained the development on Jiaozuo service industry for nearly eight years, and it did a longitudinal comparison on Jiaozuo service industry. Also including five cities in Henan province, Zhengzhou, Kaifeng, Luoyang, Xinxiang, it also did a transverse comparison on Jiaozuo service industry, in order to know accurately the position of Jiaozuo service industry Henan province. In this paper, it selected 2004-2011 years data on Jiaozuo service industry to do a longitudinal comparison, and recognized the competitiveness of service industry of Jiaozuo itself, then it did a horizontal comparative analysis by selecting the development status on Zhengzhou, Kaifeng, Luoyang, Xinxiang four cities in 2011 service industry and comparing with Jiaozuo, it could obtained the position of Jiaozuo service industry in Henan province objectively. So, it evaluated the comprehensive competitiveness of Jiaozuo service industry from two aspects of longitudinal and horizontal, provided an objective basis to improve the competitiveness of Jiaozuo service industry [19-21].


### 3. Longitudinal Diachronic Comparison on Competitiveness of Jiaozuo Service Industry

The service industry referred to was a generalized concept, including 15 industries, which were transportation, warehousing and postal service, information transmission of computer services and software, wholesale and retail trade, accommodation and catering industry, the financial sector, real estate, leasing and business services, scientific research technology services and geological exploring , water conservancy environment and public facilities management, residents service and other management, education, public health social security and social welfare, culture, sports and entertainment, public management and social organizations, international organizations, which were the third industry from the traditional said [22-24].

Since the reform and opening up, with the industrial structure of Jiaozuo optimization constantly, service industry of Jiaozuo developed rapidly. Especially in recent years, Jiaozuo tourism was as a representative service industry, it was developing rapidly and the scale was growing all the time. But from the Jiaozuo whole, development of service industry still lagged behind, all of these had a direct impact on the improvement of Jiaozuo services competitiveness. According to the selection of index system, it used the data of Jiaozuo service industry from 2004-2011 years to do a longitudinal evaluation of competitiveness, and recognized competitive status of 2004-2011 years on service industry as a decision making unit, in order to provide an objective basis for further understand the situation of Jiaozuo service industry. The specific results were seen in table 3.

Table 3 showed that evaluation result of Jiaozuo in 2011, 2005, 2004 years were DEA efficient, which was that input and output of Jiaozuo service industry achieved relatively superior status, its technical and scale were effective. In 2004, input and output of Jiaozuo service

industry achieved relatively reasonable, but in 2005, employees decreased, and fixed assets increased, its service industry output value increased comparing with 2004, on the whole, input and output could achieve the relative excellent. With the economic structure and related services policy of Jiaozuo adjusting continuously, Jiaozuo service industry appearing DEA invalid state was inevitable. From table 3, in 2006, 2008, 2009, 2010 years, k < 1, they were in DEA invalid state, the scale was increasing, and these suggested that increasing the investment would have some space for development in these years. In 2007, k > 1, although it was in DEA invalid state, but scale was in decreasing state. This showed that the two years in 2006-2007, industry structure adjustment and industrial policy change of Jiaozuo adapt to the current economic development form, service policies and structural adjustment was correct. It's only that Jiaozuo put too much into service in 2007. But it was relatively insufficient in 2008. This state continued until 2010, and Jiaozuo service industry returned to the DEA efficient state in 2011, which should benefit from Jiaozuo the policy of the government, promoting the rise of the service industry. Table 3 showed that fixed investment of Jiaozuo service industry had increased but the output value had a larger rise in 2011, this fully illustrated that Jiaozuo gave full play to the role of macroeconomic regulation and control in the development these years. From the whole of Jiaozuo in these eight years, the investment of Jiaozuo had added from 7.172 billion Yuan in 2004 to 20.044 billion Yuan in 2011, it illustrated that Jiaozuo government gave service industry a value degree, created more jobs for Jiaozuo employment and had played a very good role in driving economic development. But only 3 years of input and output efficiency on Jiaozuo service industry achieved optimal in this eight years, it illustrated that the Jiaozuo service industry had not paid full attention to the modicum of configuration on various inputs, so as not to make Jiaozuo service industry investment have no more reasonable [25]. But looked from the overall, Jiaozuo services growth was bigger, it mainly displayed on the added value of service industry. The added value of service industry was not efficient from an industrial longitudinal comparison, and couldn't fully explain the strength or weakness on industry competitive. Therefore, from different areas in the same industry development level, doing a horizontal comparison was very necessary for measuring the state of the industry to determine whether competitiveness was strength or weakness.

Table 3. Longitudinal diachronic comparison on competitiveness of Jiaozuo service industry
Units: employees (ten thousand people), fixed assets (one hundred million Yuan),
added value (one hundred million Yuan), growth rate (%)

| Years | Input index | | Out index | | $\theta$ | K | $S^{*-} \; S^{*+}$ | Relative effective | Scale effective | Technology effective |
|---|---|---|---|---|---|---|---|---|---|---|
| | employees | fixed assets | added value | growth rate | | | | | | |
| 2011 | 51.40 | 200.44 | 300.51 | 13.50 | 1.00 | 1 | 0, 0 | DEA efficient | Scale invariant | Technology effective |
| 2010 | 49.57 | 189.60 | 269.96 | 12.80 | 0.88 | <1 | 0.17, 0.29 | DEA invalid | Scale increasing | Technology invalid |
| 2009 | 49.05 | 165.70 | 241.40 | 11.80 | 0.86 | <1 | 0, 0.73 | DEA invalid | Scale increasing | Technology invalid |
| 2008 | 47.61 | 158.44 | 230.22 | 10.30 | 0.95 | <1 | 0.11, 0 | DEA invalid | Scale increasing | Technology invalid |
| 2007 | 45.16 | 149.30 | 219.76 | 12.50 | 0.96 | >1 | 0, 0.45 | DEA invalid | Scale decline | Technology invalid |
| 2006 | 42.48 | 144.35 | 188.16 | 11.00 | 0.99 | <1 | 0.13, 0 | DEA invalid | Scale increasing | Technology invalid |
| 2005 | 39.45 | 111.02 | 158.40 | 10.80 | 1.00 | 1 | 0, 0 | DEA efficient | Scale invariant | Technology effective |
| 2004 | 40.55 | 71.72 | 130.90 | 12.50 | 1.00 | 1 | 0, 0 | DEA efficient | Scale invariant | Technology effective |

(In the table: k=$\sum_{j=1}^{n} \lambda_j$ , Data sources [28-29]: Jiaozuo statistics network and Jiaozuo statistics bulletin of 2011; Use software Lingo8.0 to solve DEA model)

## 4. Horizontal Synchronic Comparison on Competitiveness of Jiaozuo Service Industry

In order to further explain the competitiveness status of service industry in Jiaozuo, it needed to measure from different areas in the same industry development level. But because of the limitation of data collection, the paper selected service industry development situation of the five cities including Zhengzhou, Kaifeng, Luoyang, Xinxiang, Jiaozuo in 2011 to do a horizontal comparative analysis [26, 29], as seen in table 4.

Horizontal comparison on competitiveness of Jiaozuo service industry in the table 4 showed that Zhengzhou and Kaifeng service industry were in the DEA efficient state in 2011, which was that two urban service industry competitiveness of Zhengzhou and Kaifeng were in a relatively strong, of course, these were inseparable from the two cities natural advantages. Zhengzhou was as the capital city Henan province, and it was in the Beijing-Guangzhou railway and the Longhai railway junctions, it not only had the superior geographical conditions, but also had many science and technology, information and talent resources, all of those made it easier to carry out extensive exchanges and cooperation, better to absorb the advanced science and technology, information and talent, and made it have more advantages comparing with other cities, which could provide strong support for improving service. And Kaifeng was as the seven dynasties, the munificent history culture promote the tourism development greatly. From table 4 we can see, Kaifeng put not the most investment into service industry in the five cities, but the service industry output value was not the least, comparing with Jiaozuo, Jiaozuo service investment was three times than Kaifeng, but output but only one times more than Kaifeng, and growth rate was 5.4% less than Kaifeng. These explained that the adjustment of economic structure on input and output of in Kaifeng service industry was reasonable. Comparing with the two cities, competitiveness of Jiaozuo service industry was weaker. And comparing with Luoyang, Xinxiang, the three cities were almost in the same level, input and output differed little, and they had non their own advantages comparing with Zhengzhou and Kaifeng, there were in DEA invalid state. Though Luoyang was the nine dynasties, but she did not play out their own historical and cultural background comparing to Kaifeng, tourism had less development than Kaifeng. From this point of view, Luoyang should adjust its own economic structure and gave full play to its advantages, developed the service industry vigorously.

Table 4. Horizontal synchronic comparison on competitiveness of Jiaozuo service industry
Units: employees (ten thousand people) fixed assets (one hundred million Yuan)
service value (one hundred million Yuan) growth rate (%)

| Years | Input index | | Output index | | $\theta$ | k | $S^{*-} \ S^{*+}$ | Relative effective | Scale effective | Technology effective |
|---|---|---|---|---|---|---|---|---|---|---|
| | employees | Fixed assets | Added value | growth rate | | | | | | |
| Zheng zhou | 169.2 | 1000.7 | 1524.1 | 13.8 | 1 | 1 | 0,0 | DEA efficient | Scale invariant | Technology effective |
| Kai feng | 39.4 | 63.9 | 258.7 | 17.9 | 1 | 1 | 0,0 | DEA efficient | Scale invariant | Technology effective |
| Luo yang | 117.1 | 372.5 | 601.7 | 12.8 | 0.79 | <1 | 0,0.63 | DEA invalid | Scale increasing | Technology invalid |
| Xin xiang | 92.07 | 207.8 | 321.11 | 13.8 | 0.57 | <1 | 0,0.41 | DEA invalid | Scale increasing | Technology invalid |
| Jiao zuo | 51.4 | 149.35 | 219.76 | 12.5 | 0.86 | <1 | 0.29,0 | DEA invalid | Scale increasing | Technology invalid |

(In the table: k=$\sum_{j=1}^{n} \lambda_j$ , Data sources [28-29]: national economic and social development statistics bulletin of every city in 2007; Use software Lingo8.0 to solve DEA model)

## 5. Countermeasures and Suggestions on Improving Competitiveness of Jiaozuo Service Industry

First, develop tourism culture industry of Jiaozuo positively, promote to adjust the industrial structure. The tourism culture industry said by the paper included cultural and sports entertainment, tourism, printing, news media, education, etc, it was a kind of generalized

tourism culture industry. Because tourism culture industry had characteristic such as wide coverage, much employment personnel, huge economic and social benefit, the high added value and so on, it was the bridge between the social each industry [8]. So, in the long run, tourism and cultural industry was the most potential and power industries. And specific to Jiaozuo, tourism was the first considered, consider Yuntai Mountain, Studio and other tourist attractions as the foundation of Jiaozuo propaganda, to promote the tourism development of Jiaozuo. Use tourism to promote the development of Jiaozuo service industry, we can say that focusing on the development of tourism and cultural industry was to promote the integration and restructuring on existing Jiaozuo advantage industry, to spin the industry chain and to enhance its radiation and leading role.

Second, the government should strengthen the policy support, optimize the development environment of Jiaozuo. In the fairness of creating industry, it should eliminate the policy differences between services in the water, electricity, land, blowdown and taxation, clean up the current limit not suitable and regulations and policies on restricting the development of Jiaozuo, and research support policies and measures which had advantage to the development, make a classification guidance, support the key industry for. At the same time, strengthen the investment demonstration guidance on key areas, weak links and emerging industry of service industry to attract more capital flowing to the service industry. Strengthen the evaluation of service performance; decompose the goal, task, major projects implementation of service industry development to the relevant departments and units, and promote stably to feed mechanism coordination and to guide the development of Jiaozuo modern service industry. It also holds top BBS or professional lectures on the development of service industry, transform the development idea, broaden the channels of development, and improve the understanding level [26].

Third, implement talent strategy to provide intellectual support for the development of service industry. Talent was the core of the development strategy of the service industry, it was also the key to the development of service industry. However, many service industry of Jiaozuo lacked talented persons, it had little success in the training and the introduction of high technology, high level talent service industry. Therefore, Jiaozuo should increase service talents and use, wide open channels, and organize the various aspects of the service personnel, especially create conditions to attract and hire talents for the development of the service industry actively, and provide intellectual resources. At the same time, it should consolidate their own strength, strengthen enterprise post vocational training and professional universities training, and gradually build high quality talent team, inject new vitality for the development of the service industry and the improvement of service level continuously.

## 6. Conclusion

Used $C^2R$ model of DEA to do a longitudinal evaluation on Jiaozuo service industry firstly, described nearly eight years service industry development of Jiaozuo, it illustrated that the economic structure adjustment policy on development of service industry in Jiaozuo was effective on the whole. But in the eight years, only three years of service industry was in DEA effective state, which illustrated that the policy adjustment on development of service industry in Jiaozuo remained to be further improved. On the horizontal comparison between Jiaozuo service industry and parts of Henan province cities, Jiaozuo lacked competitiveness comparing with the two cities Zhengzhou and Kaifeng, because the two cities had the unique historical conditions. And comparing with the two cities Luoyang and Xinxiang, their urban service industries were in the same level from the input and output. But according to output value and employment singly, Jiaozuo service industry was still relatively low in the position of Henan province; it still needed to be further improved. In the end, puts forward some suggestions from focusing on the development of industry, service industry development policy and talent training.

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