

# Research on the Current Situation and Efficiency of Information Service Investment in Anhui Province

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## Abstract

The development of information service industry can not only provide necessary support for the enhancement of scientific and technological strength and the release of development dividends, but also provide a digital power engine for economic development and social governance. In recent years, Anhui provincial Party committee and government have always attached importance to the development of information technology and adhered to the guidance of innovation. The digital economy has become increasingly active and the scale of information service industry has been expanding. Firstly, this paper analyzes the basic situation of information service industry investment in Anhui Province from the aspects of the overall situation of information service industry investment and the comparison of information service industry investment in different cities. Secondly, the data envelopment analysis method and stochastic frontier analysis method are used to compare the investment efficiency of information service industry in Anhui, and the investment efficiency of information service industry in six provinces in Central China. Finally, in view of the problems of Anhui information service industry investment in recent years, this paper puts forward policy suggestions.

## Keywords

Information Service Industry; Investment Efficiency; Data Envelopment Analysis; Stochastic Frontier Analysis.

## 1. Introduction

Informatization represents new productivity and new development direction, and it is an important part of China's long-term goal of the 2035 plan. Accelerating the expansion of the new generation of information technology is a necessary link to accelerate the development of the modern industrial system. Expanding and strengthening the information industry can not only help agriculture, rural areas and farmers, but also improve the quality and efficiency of the manufacturing industry. The development of information service industry can not only provide necessary support for the enhancement of China's scientific and technological strength and the release of development dividends, but also provide a digital power engine for economic development and social governance. Anhui provincial Party committee and government have always attached importance to the development of information technology and adhered to the guidance of innovation. The digital economy is becoming more and more active, and the scale of information service industry is expanding.

*The Proposal of the CPC Anhui Provincial Committee on Formulating the 14th Five Year Plan for National Economic and Social Development and the Long-term Goal for 2035* emphasizes the need to vigorously develop strategic emerging industries. The process of promoting the deep integration of Internet, Internet of things, big data, artificial intelligence, cloud computing and

blockchain with various industries is also the process of expanding information services to various industries and production links. In March 2018, the general office of Anhui Provincial People's government issued *Several Opinions of the CPC Anhui Provincial Committee and Anhui Provincial People's Government on Promoting High-quality Economic Development*, which proposed to deepen the innovation driven development strategy and vigorously cultivate digital economy industrial clusters such as e-commerce, cloud computing, digital creativity and mobile communication. In September 2018, Anhui provincial Party committee and Anhui provincial government issued the guidance on accelerating the construction of "digital Jianghuai", proposing to strive to build a data led development model of "digital economy, digital government and digital society", and strive to make the digital economy the leading economy of the whole province. In October 2020, Anhui Provincial People's government issued *the notice of Anhui Provincial People's Government on Printing and Distributing the Construction Plan of "Digital Government" in Anhui Province (2020-2025)*, which proposed to improve the government's governance ability in many aspects with the support of new generation information technology, to form a modern governance model of "data decision-making, data service and data innovation".

This paper explores the current situation, investment efficiency and existing problems of Anhui information service industry investment, and puts forward feasible policy suggestions.

## 2. Investment Status of Information Service Industry in Anhui

### 2.1. Overall Situation of Anhui Information Service Industry Investment

From 2010 to 2020, the total investment in information service industry in Anhui increased significantly. In 2010, Anhui's fixed asset investment in information service industry was 19 billion, which increased to 25.9 billion in 2020, an increase of 36%. From 2010 to 2012, the investment in information service industry continued to decline, including 7.2 billion yuan in 2012, a decrease of 9.3 billion yuan compared with the previous year. After that, the development conditions of information service industry became more and more mature, the market gradually developed and improved, and the industry entered the expansion period. From 2013 to 2016, the industry investment increased by an average of 5 billion yuan per year, and the annual investment increased from 11.5 billion yuan in 2013 to 29.9 billion yuan in 2016. Since 2017, the investment in information service industry has gradually slowed down, showing a downward trend for three consecutive years, with an investment of 27 billion in 2017, and 2018 to 23 billion. In 2019, Anhui's investment in information service industry decreased to 21.3 billion. In 2020, the completed investment in fixed assets of Anhui information service industry increased by more than 4 billion to 25.9 billion, with an annual investment growth rate of more than 20%. In 2020, the development of Anhui information service industry has played an important role in both epidemic prevention and control and maintaining economic stability in the next three quarters.

### 2.2. Investment Status of Information Service Industry in Different Cities of Anhui Province

#### 2.2.1. The Investment Differentiation of Information Service Industry in Various Cities is Obvious

From 2013 to 2020, like the investment in information service industry in the province, the investment in information service industry in most cities in the province peaked around 2016. Since then, the investment in information service industry in various cities has been differentiated. The total investment in some cities has reached a new high, and the investment in information service industry in most cities has fluctuated at a low level. From 2013 to 2020, Hefei's investment in information service industry accounted for more than 50% of the

industrial investment in all cities in the province, ranking first in the province. From 2013 to 2015, Hefei's investment in information service industry grew rapidly, with an annual growth rate of about 50%. In 2015, Hefei's investment in information service industry was 13.2 billion yuan, the peak before 2020. From 2016 to 2017, after a short and slight decline in industrial investment in Hefei, it entered the growth range again from 2018, and the growth was stable. In 2020, Hefei's investment in information service industry reached 14.2 billion yuan, an increase of 15% over the previous year, accounting for 55% of Anhui's investment in information service industry that year.

The completed amount of fixed asset investment in information service industry in other cities in the province is significantly lower than that in Hefei. In addition to Hefei, Wuhu, Huainan, Ma'anshan, Huaibei and Tongling are cities in the province with a total investment of more than 5 billion in information service industry from 2013 to 2020. From 2013 to 2020, the total investment in information service industry of the five cities was 72 billion, accounting for more than 39% of the total investment of the whole province; by adding the industrial investment of the above five cities and the investment in Hefei from 2013 to 2020, the total amount is 159.3 billion. The investment of these six cities in the information service industry accounted for more than 88% of the investment in the information service industry of Anhui Province in the past eight years, which shows that the investment in the information service industry of Anhui Province has been significantly differentiated among cities.

In 2020, Anhui invested 25.919 billion in information service industry, including 14.2 billion in Hefei, accounting for 55.2% of the provincial investment. The investment in information service industry in the top six cities accounted for nearly 90% of the provincial industrial investment. Moreover, the ranking of investment in information service industry in 2020 is not completely consistent with the economic development of Anhui cities. For example, Tongling industry investment ranks fifth in the province, and its GDP ranks 15th in the province in 2020; in 2020, the GDP of Fuyang ranked 4th in the province, while its investment in information service industry ranked 13th.

### **2.2.2. Comparative Analysis of Investment by Region**

In order to further compare and analyze the investment in information service industry in various cities in Anhui, the cities are divided into three regions: Northern Anhui, Southern Anhui and central Anhui. Hefei is excluded from this comparison. Therefore, there are 6 cities in northern and southern Anhui and 3 cities in central Anhui.

Compared with the three regions, the investment in information service industry in southern Anhui is the highest, exceeding 11 billion yuan for two consecutive years from 2016 to 2017. From 2018 to 2019, after the investment in information service industry fell by different ranges, the investment in information service industry in southern Anhui reached 8.2 billion yuan in 2020, an increase of 26% over the previous year, the growth rate is the same as that in central Anhui, but the amount is much higher than that in central Anhui and Northern Anhui. From 2013 to 2019, the absolute amount of investment in information service industry in the three cities of central Anhui remained around 1 billion yuan, which fell respectively after reaching the level of 1.1 billion yuan in 2013 and 2016. In 2020, the industrial investment in central Anhui was 933 million yuan, with a growth rate of 26%, higher than that in Northern Anhui. Northern Anhui has maintained a certain scale of investment in information service industry in the past eight years. Since the scale of RMB 1.2 billion in 2013, the investment in the six cities has increased continuously, reaching the highest value of RMB 4.687 billion in 2017. From 2018 to 2020, the investment in information service industry in Northern Anhui has been in a downward range. In 2020, the investment in information service industry in Northern Anhui was 2.474 billion yuan, a decrease of more than 17% over the previous year.

### 3. Analysis on Investment Efficiency of Anhui Information Service Industry

#### 3.1. Model, Data and Index Selection

##### 3.1.1. Research Model

Data envelopment analysis is mainly used to evaluate the relative effectiveness of "departments" or "units" with multiple inputs, especially multiple outputs. It is a nonparametric statistical estimation method. This method transforms the original engineering efficiency concept of single input and single output into a similar multi input and multi output decision unit. Through the application of DEA model, the accuracy of infrastructure investment efficiency measurement is improved, and the evaluation results are more scientific and authoritative. The main data required by the data envelopment analysis method includes the infrastructure investment and output model, the data obtained through measurement, and the quantitative indicators. These indicators take the quantitative decision-making unit as a unit. At the same time, more accurate calculation results and evaluation results can also be reflected in the DEA model of each decision-making unit. DEA-BCC model examines the efficiency value of decision-making units under variable returns to scale, and can obtain the pure technical efficiency and scale efficiency of each decision-making unit, so as to more clearly investigate the change of efficiency [1]. Therefore, this paper uses the input oriented DEA-BCC model to measure the investment efficiency of Anhui information service industry.

Since the input oriented model is selected in the first stage, the regression analysis of the relaxation variables in the first stage can clearly see the impact of environmental factors on different relaxation inputs. The specific methods are as follows:

Taking the relaxation variable as the explanatory variable and the environmental variable as the explanatory variable, the regression equation of SFA return of each investment relaxation variable to redundancy and environmental variables is established as follows:

$$S_{ij} = f_i(Z_j \beta_i) + v_{ij} + \mu_{ij}$$

Among them,  $Z_j$  is the external environment variable corresponding to the j-th DMU,  $f_i(Z_j \beta_i)$  represents the determined relaxation front amount,  $v_{ij} + \mu_{ij}$  represents the error term, the parameter vector  $\beta_i$  is the estimated quantity,  $v_{ij}$  represents the random interference term, and  $\mu_{ij}$  represents the management inefficiency term,  $v_{ij}$  and  $\mu_{ij}$  are independent. It should be pointed out that when  $\gamma$  tends to 0, it means that random error is the main influencing factor; when  $\gamma$  approaching 1, management factor is the main influencing factor [2].

##### 3.1.2. Data Source and Index Selection

Based on the principles of the scientificity of evaluation indicators, availability and accuracy of data sources, the data comes from Anhui statistical yearbook. Due to the principle of appropriate selection of decision-making units in DEA model, the number of decision-making units is at least three times the sum of input-output indicators, and the input of information services is multifaceted. The input and output data of decision-making unit is an important element when using data envelopment analysis to measure efficiency. Therefore, whether the input-output indicators are appropriate or not is very important for the final efficiency measurement results. The government investment is divided into two parts: production line investment and non productive investment. According to the China Statistical Yearbook, the output indicators adopt the four indicators that can best represent the investment output of the government information service industry: infrastructure, education, health and economic growth. Based on the scientificity of evaluation indicators and the availability and accuracy of

data sources, 2017-2019 is selected as the research interval. The subjects were 16 prefecture level cities in Anhui Province.

### **3.2. Analysis on Investment Efficiency of Information Service Industry in Various Cities**

#### **3.2.1. Investment Efficiency based on Data Envelopment Analysis**

##### **(1) Comprehensive efficiency analysis**

Comprehensive efficiency is the technical efficiency without considering the return to scale, and pure technical efficiency and scale efficiency are the subdivisions of comprehensive efficiency. From 2017 to 2019, the comprehensive efficiency value of Anhui information service investment showed the characteristics of first increasing and then decreasing. From the average value of overall efficiency, the efficiency value is between 0.542 and 0.652, which does not reach DEA efficiency, and the input and output of information service investment are not ideal. There are great differences in the overall efficiency of information service investment in different cities. Huaibei, Tongling, Chizhou and Huangshan have maintained DEA valid for more than two years in three years, and only Huaibei and Huangshan have maintained DEA valid in three years. During this period, the effective proportion of non DEA cities is 75%. The investment efficiency of comprehensive information services in cities with strong resource endowment, infrastructure and economic strength such as Hefei, Wuhu and Ma'anshan is far lower than that of surrounding cities with low development level [3].

Compared with other provinces and cities in the province, Hefei, Wuhu and Ma'anshan basically take the lead in the scale of investment in information service industry. It can be seen from the foregoing that in 2020, the investment scale of Hefei will account for more than half of the investment scale of the whole province, with a total amount of more than 14 billion yuan. Although the investment scale of Wuhu and Ma'anshan is far behind that of Hefei, compared with other cities in the province, their investment scale is still much larger. The investment in information service industry in Ma'anshan and Wuhu accounted for more than 10% of the investment scale of the whole province, the former accounted for 14.7%, and the investment scale was 3.7 billion yuan; Wuhu City accounts for 11.6%, and the investment scale is close to the level of 3 billion yuan. In terms of urban economic development level, Wuhu will rank second in Anhui Province with a GDP of 361.8 billion yuan in 2020; the GDP of Ma'anshan ranking dropped to the sixth in 2020, but its total GDP ranking in the province has remained at the top 5 level since 2016, with rich investment resources. However, in contrast, relatively strong economic development can bring rich investment resources to the information service industry. At the same time, this is an important reason why the three cities ignore the input and output factors of the information service industry in the process of industry investment, resulting in a waste of resources. For Huaibei, Tongling, Chizhou and Huangshan with the highest comprehensive efficiency in 2019, the scarcity of investment resources makes them pay more attention to the effectiveness of resource allocation.

##### **(2) Pure technical efficiency analysis**

Pure technical efficiency is the technical efficiency when considering returns to scale. From the mean value of pure technical efficiency of information service investment, the pure technical efficiency of information service investment is significantly higher than the comprehensive efficiency, between 0.639-0.722, with a high mean level, but it is still in the DEA non effective state. In the past three years, the pure technical efficiency of information service investment has remained at or above two years. The effective cities are Hefei, Huaibei, Wuhu, Tongling, Chizhou and Huangshan; the pure technical efficiency of information service investment in Hefei, Huaibei, Tongling and Huangshan is more effective than the DEA of 2 years or more; Huaibei and Huangshan have long been at the forefront of Anhui information service investment efficiency. The pure technical efficiency of each city varies greatly. During this

period, the pure technical efficiency of information service investment is in non DEA effective cities: Suzhou, Bengbu, Fuyang, Chuzhou, Lu'an, Ma'anshan, Xuancheng and Anqing, accounting for 50% of all cities in Anhui. From the comparison of comprehensive efficiency and technical efficiency of information technology investment in Anhui cities from 2017 to 2019, pure technical efficiency is the main driving force to improve the comprehensive efficiency of information service investment in each city [4].

### (3) Scale efficiency analysis

Scale efficiency is the efficiency value when considering the return to scale. During the sample period, the scale efficiency of information service investment in Anhui is significantly higher than the comprehensive efficiency and pure technical efficiency, between 0.849-0.946, and the scale efficiency of information service investment in various cities is between 0.186 and 1, with great differences in scale efficiency. Taking 2017 as an example, cities with increasing returns to scale of information service investment include Bozhou, Suzhou, Fuyang, Huainan, Chuzhou, Lu'an, Ma'anshan, Xuancheng and Anqing; cities with diminishing returns to scale of information service investment include Hefei, Bengbu and Wuhu; cities with constant returns on investment in information services include Huaibei, Tongling, Chizhou and Huangshan. The cities with increasing returns to scale, decreasing returns to scale and constant returns to scale accounted for 56.25%, 18.75% and 25% respectively. A city with constant returns to scale shows that the output and input of the city's information service investment have increased in the same proportion; cities with diminishing returns to scale need to adjust the investment structure of information services to make information service investment more efficient and effective; cities with increasing returns to scale have good development space and potential, and need to further strengthen and optimize information service investment to continuously meet the practical needs of urban development.

In terms of specific cities, the investment scale of Hefei's information service industry ranks first in the province, but the investment scale of Hefei gradually decreased from 2017 to 2019, indicating that the efficiency of urban investment scale has experienced a process of first increasing and then decreasing. The relative ratio between Ma'anshan and Wuhu, the second echelon of investment scale in Anhui information service industry, shows that the efficiency improvement effect brought by the adjustment of investment scale in Ma'anshan is higher than that in Wuhu. From 2017 to 2019, the investment scale of the two cities tended to decrease first and then rise. In this process, the investment scale efficiency of Wuhu information service industry increased in 2018, and the return to scale decreased in other years; In Ma'anshan, although the return to scale decreased in 2018, the scale efficiency improved more strongly after the investment scale adjustment. In addition, the investment scale efficiency of Bengbu's information service industry in 2019 is only higher than that of Wuhu. Compared with the specific changes in investment scale, it is considered that the sharp reduction of information service investment is an important reason for the reduction of scale efficiency.

### 3.2.2. Investment Efficiency based on Stochastic Frontier Analysis Method

Because the input oriented BCC model is selected in the first stage of DEA empirical analysis, the input relaxation variables of the previous stage are selected as the explained variables, and the Frontier4.1 software is used to carry out SFA regression on the two input relaxation variables respectively.

There are many uncontrollable factors affecting the investment efficiency of government information service industry. Summarizing the factors investigated in the existing relevant literature, four common indicators such as per capita GDP, per capita loan balance, foreign investment and the number of patents is selected as the efficiency influencing factors of economy, finance, foreign investment and technical level. (1) Per capita GDP. It is used to measure the ratio of the realized GDP to the resident population of the region in a certain period

of time. As a standard to measure the overall level of regional economic development, per capita GDP is generally defined as: per capita GDP of each province = total output of each province (i.e. total GDP, total output of social products and services) / total population of each province. (2) Per capita loan balance. According to the definition, the per capita loan balance refers to the ratio of the total loan amount of a region to the population of the region by the end of the accounting period. This index reflects the distribution of financial resources. Per capita loan balance = total loans at the end of each province / total population of each province. (3) Foreign investment. According to the definition, foreign investment refers to the economic activities in which foreign companies, enterprises, other economic organizations or individuals conduct private direct investment in China in accordance with the laws of the People's Republic of China. Because the corresponding data of private investment is difficult to obtain and inaccurate, the foreign investment in China's Statistical Yearbook is used to reflect the investment status other than government investment. (4) Technical level. The number of three patent authorizations in each provincial region is used to reflect the technological level and technological innovation of the region. Generally speaking, the higher the technical level, the higher the production efficiency [5].

Through the adjustment of SFA regression results, the random disturbance and environmental factors in the management inefficiency of the original input index are separated, so as to calculate the adjusted input. The DEA efficiency of the adjusted input and output is calculated again to make the results more reasonable and accurate. Taking 2019 as an example, the adjusted results are shown in Table 1.

**Table 1.** Calculation results of efficiency of cities in Anhui Province in 2019

Region	Comprehensive technical efficiency	Pure technical efficiency	Scale efficiency
Hefei	0.821	1.000	0.741
Huaipei	1.000	0.876	1.000
Bozhou	0.873	0.741	0.924
Suzhou	0.918	0.762	0.941
Bengbu	0.625	0.864	0.541
Fuyang	0.884	0.823	0.25
Huainan	0.996	0.871	0.841
Chuzhou	0.988	0.824	0.876
Lu'an	0.921	0.861	0.724
Ma'anshan	0.980	0.434	0.951
Wuhu	0.304	0.961	0.441
Xuancheng	0.950	0.761	0.931
Tongling	1.000	1.000	1.000
Chizhou	0.999	0.414	1.000
Anqing	0.956	1.000	0.941
Huangshan	1.000	0.651	1.000
Mean value	0.888	0.802	0.818

### 3.2.3. Comparative Analysis of Investment Efficiency of Anhui Cities in 2019

Compare and analyze the investment efficiency calculation results of cities in Anhui Province in 2019 obtained from the previous research. From the mean value, the comprehensive technical efficiency has been greatly improved. Compared with the calculation results of pure technical efficiency and scale efficiency, the pure technical efficiency of each city has also been greatly improved in the adjusted results; the scale efficiency decreased slightly. Therefore, it can be considered that the improvement of comprehensive technical efficiency is mainly the contribution of pure technical efficiency.

From the perspective of comprehensive technical efficiency, the results show that the efficiency level of each city has improved. Among them, Huaibei and Tongling have maintained a high level of pure technical efficiency and scale efficiency; the adjusted pure technical efficiency of Huangshan has decreased, but the scale efficiency still maintains its best level among the cities in the province. The results of the two parts shows that the comprehensive technical efficiency of the three cities is the best in the province. The comprehensive technical efficiency of Bengbu and Wuhu is in a backward position among the cities in the province, but their pure technical efficiency level is in a leading position among the cities in the province; the efficiency level of the two cities is more backward. Due to the low scale efficiency, combined with the investment scale of the two cities, it is considered that the former is mostly because the investment scale is too small, while the latter is not consistent with the objective requirements of the development of information service industry in Wuhu City because of the fluctuation of investment scale.

Overall, among the efficiency results obtained by random frontier adjustment, the pure technical efficiency of each city is significantly improved, which is more than 30% higher than the comprehensive technical efficiency results obtained by DEA method; among them, Fuyang, Chuzhou, Lu'an and other cities increased from less than 0.4 to more than 0.8; obviously, random disturbance and stripping of environmental factors have a great impact on the calculation results of pure technical efficiency of each city. Although the scale efficiency level of cities has also improved, the range is small and the overall difference is small. The pure technical efficiency and scale efficiency are at a high level after adjustment, which shows that improving the technical level and scale efficiency is an important way to improve the investment efficiency of information services in various regions of Anhui Province.

### **3.3. Comparative Analysis of Investment Efficiency between Anhui Province and Other Provinces in Central China**

#### **3.3.1. Investment Efficiency based on Data Envelopment Analysis**

##### **(1) Comprehensive technical efficiency**

The comprehensive technical efficiency evaluation is the comprehensive operation efficiency of the government's investment projects in the information service industry, including the comprehensive measurement of management, resource allocation, fund use and other capabilities. It reflects the minimum factor input cost under the condition of maximum output, and can judge whether the input is wasted. If technical efficiency = 1, it shows that the input-output of investment in information service industry is comprehensive effective, that is, pure technical efficiency and scale efficiency at the same time; if the comprehensive technical efficiency is less than 1, it indicates that the comprehensive technology is invalid and the input is wasted, wasting (1-technical efficiency value) %.

From 2017 to 2019, the comprehensive technical efficiency of investment in information service industry in the six central provinces was above 0.5 except Shanxi Province. The average comprehensive technical efficiency of Shanxi in three years is 0.499, the efficiency level is low, and the investment waste exceeds 40%. Jiangxi's comprehensive technical efficiency ranks second among the central provinces, with an average value of 0.545, which is far from the leading provinces. The investment scale of information service industry in Hubei, Hunan and Henan provinces is ahead of that in central provinces, among which the investment scale of Hunan industry is the largest; In terms of comprehensive technical efficiency, there is little difference among the three provinces, which fluctuates around 0.7; The changes of comprehensive technical efficiency in the three provinces show a time trend of first increasing and then decreasing, but there is little difference between different years. From 2017 to 2019, Anhui's comprehensive technical efficiency was at the best level among the six provinces in Central China, with a minimum of 0.976 in 2017; in 2019, the comprehensive technical



efficiency of Anhui was 1, indicating that the comprehensive investment efficiency of Anhui was the best among the six provinces in Central China.

In addition, due to the relative efficiency obtained by DEA, compared with the average comprehensive efficiency of the six provinces from 2017 to 2019, even if the absolute value in 2018 is the highest, it cannot be considered that the overall investment efficiency of the six provinces in 2017 and 2019 is lower than that in 2018. On the other hand, the level of comprehensive technical efficiency in each province is low, which is mostly affected by factors such as unreasonable resource allocation and ineffective comprehensive operation; however, in order to truly judge the reasons for the invalidity of DEA, we should also analyze the pure technical efficiency and scale efficiency to judge whether there is invalid technical efficiency value or invalid scale efficiency.

### (2) Pure technical efficiency

Pure technical efficiency reflects the management level and support of government investment in information service industry. Pure technical efficiency is calculated by BCC model with variable return to scale. Under the input-output model, the efficiency value calculated by BCC can further clarify the impact of pure technical efficiency in the investment efficiency of information service industry.

From the pure technical efficiency measurement results of the six provinces in Central China from 2017 to 2019, it can be seen that the management level and support for investment in information service industry in the measured years are not much different, and they are basically at a better level; especially in 2019, the net technical efficiency level of all provinces is the same, and they are at the most efficient level. Connected with the comprehensive technical efficiency level of the six central provinces in 2017-2019 analyzed above, it can be explained to a certain extent that the low comprehensive technical efficiency level of each province is not caused by pure technical efficiency. The two parts jointly show that the government's management level and support for investment in information service industry are effective. In recent years, with the development of local economy, the investment scale of information service industry in all provinces has been expanding. As an important link of strategic emerging industry, information service industry is strongly supported by all provinces. Although the investment scale of information service industry fluctuates greatly, it is generally in an upward trend; in the rising stage of industry, all units still need to expand their scale. At the same time, resources are relatively scarce, and there are higher requirements for the effective use of investment.

### (3) Scale efficiency

Scale efficiency, also known as return on scale, examines whether provinces carry out public activities under the most appropriate investment scale under the condition of a certain technical level. Generally, there are three situations: increasing returns to scale, decreasing returns to scale and unchanged returns to scale. Constant return is the most ideal production state, and increasing and decreasing belong to scale efficiency. For increasing or decreasing decision-making units, they need to be improved to achieve the ideal state.

The scale efficiency of the six provinces in Central China is generally invalid, and the trend of scale efficiency is very similar to that of comprehensive technical efficiency, which shows that the invalidity of comprehensive technical efficiency is mainly caused by the invalidity of scale efficiency.

From 2017 to 2019, the comparison of scale efficiency among the six provinces in Central China shows that Jiangxi has the best scale efficiency; the investment scale of Shanxi is at the lowest level among the six provinces in Central China, and there is a large gap with other provinces, which matches the lowest scale efficiency; The scale efficiency of Hubei, Hunan and Henan, the six provinces with the largest investment scale in Central China, is basically similar, Hunan is

slightly lower than 0.7, while Henan and Hubei fluctuate around 7.5. In 2019, Anhui's scale efficiency reached the optimal level. In other years, it was not scale effective, but the efficiency value was at a high level. The three-year average scale efficiency was 0.976, second only to Jiangxi among the six provinces in Central China. Anhui Province is effective in scale in 2019, invalid in other years, and all the DUM are in the state of diminishing returns to scale, indicating that the decision-making unit has input redundancy. In order to achieve the optimal scale efficiency, we should reduce the input scale and save and intensively use resources.

#### (4) Comprehensive efficiency evaluation

In order to further analyze the influencing factors of investment efficiency of each province, the comprehensive technical efficiency, pure technical efficiency and scale efficiency of each province from 2017 to 2019 are averaged and summarized. The results are listed in Table 2 below.

**Table 2.** Average value of three types of investment efficiency of information service industry in six central provinces from 2017 to 2019

Province	Comprehensive technical efficiency	Pure technical efficiency	Scale efficiency
Jiangxi	0.7	1	0.7
Shanxi	0.637	0.98	0.685
Hubei	0.818	0.986	0.831
Hunan	0.788	0.986	0.795
Anhui	0.813	0.941	0.912
Henan	0.829	0.988	0.839
Mean value	0.785	0.989	0.793

Based on the comparative analysis of the comprehensive technical efficiency, pure technical efficiency and scale efficiency values of central provinces in 2017-2019, the following conclusions are drawn: the investment in information service industry in six provinces is DEA invalid, among which the comprehensive efficiency of investment in information service industry in Anhui is relatively good, followed by Henan, Hubei, Hunan, Jiangxi and Shanxi, and the lowest is Shanxi. The low comprehensive technical efficiency of the six provinces is mainly caused by their scale efficiency, because the pure technical efficiency of all provinces is greater than the scale efficiency, and the pure technical efficiency is close to 1. Especially in Jiangxi Province, pure technology is completely effective, and the investment in information service industry caused by scale efficiency is invalid.

#### 3.3.2. Investment Efficiency based on Stochastic Frontier Analysis Method

Using SFA investment efficiency, this paper compares and analyzes the investment efficiency of information service industry between Anhui Province and six provinces in Central China. Taking 2019 as an example, the comprehensive technical efficiency, pure technical efficiency and scale efficiency of the six provinces in Central China are listed in Table 3 below.

**Table 3.** Investment efficiency of information service industry in six central provinces in 2019

Province	Comprehensive technical efficiency	Pure technical efficiency	Scale efficiency
Jiangxi	0.713	1	0.8
Shanxi	0.675	0.951	0.684
Hubei	0.824	0.872	0.821
Hunan	0.794	0.921	0.821
Anhui	0.825	0.831	0.923
Henan	0.842	0.845	0.841

## 4. Suggestions

Since the 19th CPC National Congress, Anhui has continuously adhered to and implemented the new development concept and placed high-quality economic development in a key position. In 2020, COVID-19 had a wide and far-reaching impact on the social economy, and the demand for home segregation, online office and online teaching brought development opportunities to the information service industry. In 2020, Anhui's information service industry achieved remarkable results. Its market acceptance, service satisfaction and social acceptance were all significantly improved. It played an important supporting role in the COVID-19 epidemic prevention and control work, and provided a solid foundation for the realization of the five high-quality Anhui in the province's high-quality development and modernization. However, as an emerging business, there are still a series of problems to be solved in the development of information service industry. First, the growth rate of investment fluctuates greatly and the forerunner of investment is insufficient; second, the scale of investment needs to be optimized and the level of investment management needs to be improved; third, the investment efficiency of information service industry in each city is differentiated, and the investment scale is significantly different.

In view of the problems in Anhui information service industry investment, the following policy suggestions are put forward.

(1) Adjust the scale of investment and improve capital efficiency. The adjustment of investment scale is divided into two parts. First, continue to expand the overall investment scale of Anhui information service industry. Emerging business forms are still in the stage of rapid development, and more support is needed to prevent the industry from being in a disadvantageous position in future market competition. Second, adjust the investment scale of information service industry in each city. Expand the scale of industry investment in areas with imperfect development of information service industry. It is suggested that investment in information service industry should focus on cultivating local markets at this stage. Efforts should be made to prevent cities with small investment scale from continuing to reduce their scale, and make up for the shortcomings of relevant cities in information technology and services by expanding investment; government investment will drive private investment, consolidate the development foundation of industries in various cities, and constantly expand market space. For cities with redundant investment, appropriately maintain or reduce the investment scale, avoid excessive investment and maintain the benign development of the industry [6].

(2) Strengthen precision investment and refine investment management. To improve the investment efficiency of information service industry, we need to strengthen the ability of accurate investment. Therefore, we should learn from the advanced experience of developing and expanding emerging industries from surrounding provinces and cities, avoid detours in the investment process, make efficient use of funds and avoid idle and waste of resources. It is suggested that the government should pay more attention to the guarantee of basic information services, invest in and purchase information services, and appropriately improve the requirements for products and services without affecting the basic development of information services. According to their own development status and objectives, cities have more targeted to solve the "yes" and "good" problems of their information service industry in the investment process. For cities with excessive investment scale, it is suggested to consider reducing investment scale, avoiding redundant investment and striving to realize a virtuous circle; In fact, punishment measures can be established for cities that ignore the development of information service industry to avoid the situation that the development degree of information service is too low and insufficient to serve the real economy.

(3) Fully mobilize the market and allocate resources reasonably. Government investment can leverage social forces, to help the development and growth of information service industry. It is suggested that the government should pay more attention to investment projects that can consolidate the industry foundation, and need long-term capital investment in improving the construction of information infrastructure, absorbing and cultivating high-quality talents and other low-income fields. It is suggested to fully encourage private investment. The information service industry needs private investment participation, which is conducive to accelerating the absorption of high-quality talents through flexible salary. At the same time, the appropriate enterprise scale is more in line with the industry characteristics that the information service industry should have a detailed understanding of many fields. Through the rational allocation of various resources, we can realize a virtuous circle and better promote the development of the industry.

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