

# Investment Trend and Efficiency Evaluation of Manufacturing Industry under the Background of Epidemic Situation Taking Anhui Province as an Example

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## Abstract

Through the analysis of Anhui manufacturing investment, it is found that Anhui manufacturing investment has a good investment environment, especially the policy environment and scientific and technological innovation environment. The traditional manufacturing investment tends to be stable, the growth rate of high-tech manufacturing investment has accelerated, and the investment structure has been continuously optimized. However, due to the impact of COVID-19 and the downward trend of domestic economy, the overall investment in Anhui's manufacturing industry has been declining. The growth rate of manufacturing investment has also declined. At the same time, it is also found that investment in manufacturing industry mainly comes from self-raising funds and domestic loans, and the sources of funds are relatively single. The investment in high-tech manufacturing industry still needs to be strengthened, the investment in manufacturing industry in the province is unbalanced and the investment recovery in manufacturing industry is slow. In view of the above problems in manufacturing investment, we should expand financial support to broaden manufacturing investment and financing channels, strengthen policy guidance to deepen advanced manufacturing investment, and actively plan to promote the balance of regional manufacturing investment.

## Keywords

Manufacturing investment; Regional differences; Investment efficiency.

## 1. Introduction

From the perspective of investment hard environment, Anhui Province has many advantages. The first is the geographical location. It is located in the lower reaches of the Yangtze River Basin and the middle reaches of the Huaihe River. It is adjacent to Jiangsu, Hubei and Zhejiang in the southeast. Northern Anhui is connected to Shandong. The level of transportation is superior and the level of interconnection continues to improve. Human resources are sufficient and the cultural quality of the population is continuously improved. In recent years, Anhui Province has made great efforts to build an innovative Province, with steady progress in major scientific and technological innovation indicators and strong breakthroughs in scientific and technological innovation. In addition, the soft investment environment in Anhui Province has also been continuously optimized. According to the report of the 2020 white paper on China's regional manufacturing business environment issued by CCID Research Institute of the Ministry of industry and information technology, Anhui's manufacturing business environment ranks eighth in China, including the policy environment. Under the impact of the epidemic, changes in the global economic development pattern have begun to take shape, and major changes are taking place in the world manufacturing industry under this background. There are

both opportunities and challenges for Anhui manufacturing investment, which is very worthy of attention.

## 2. Analysis of Manufacturing Investment in Anhui

This paper analyzes the overall situation of manufacturing investment in Anhui Province from three aspects: overall manufacturing investment, manufacturing investment in various cities and sub industry investment, and compares and analyzes the development of manufacturing investment in time dimension.

### 2.1. The overall situation of manufacturing investment

Through the analysis of the relevant data such as the total investment and growth rate of Anhui Province from 2012 to 2021, the main characteristics of Anhui manufacturing investment are obtained:

#### 2.1.1. Manufacturing investment shows an upward trend as a whole

According to the data of manufacturing investment from 2012 to 2021, Anhui's manufacturing investment generally shows an upward trend. From 2012 to 2016, manufacturing investment increased steadily. In 2016, the amount of manufacturing investment crossed the trillion level for the first time, reaching 1038.831 billion yuan. From 2016 to 2018, the growth rate of manufacturing investment increased significantly, and the growth rate of Anhui manufacturing investment in 2018 was as high as 33.33%. From 2018 to 2019, the growth rate of manufacturing investment decreased, and the growth rate slowed down. The amount of manufacturing investment increased from 1524.5 billion yuan to 1684.5 billion yuan. In 2020, affected by factors such as the spread of the epidemic at home and abroad and the price fluctuation of raw materials in the manufacturing industry, the production and operation of the manufacturing industry also fluctuated greatly [1]. The investment growth rate showed a negative value for the first time in a decade, and the investment also decreased to 1584.504 billion yuan.

Facing the complex and severe external environment in 2021, under the background of multi-point spread of domestic epidemic, Anhui province is based on reality, focusing on high-quality coordinated development. Thanks to the effective implementation of various preferential enterprise support policies, the investment in manufacturing industry increased by nearly 140 billion yuan compared with 2019. The effect of the policy of "double recruitment and double introduction" is obvious. In 2021, our province organized the centralized commencement of 9 batches of major investment projects, and the number of industrial projects in treasury in the province increased by 1549, including 863 industrial projects with more than 100 million yuan. Manufacturing investment gradually rebounded, with an annual growth of 14.6%, 5.2 percentage points higher than the overall investment growth, which provided strong support for the rapid development and growth of manufacturing industry in the province.

#### 2.1.2. The growth rate of manufacturing investment has dropped

From 2012 to 2021, the growth rate of manufacturing investment in Anhui alternate. From 2012 to 2016, the growth rate of manufacturing investment alternately increased and decreased, all the way down to 9.4% in 2016; After that, due to the de capacity in the early stage, the supply of industrial products fell short of demand, and the capacity utilization rate increased significantly, causing the growth rate of manufacturing investment to stop falling and pick up, significantly rising from the historical lowest point of 9.4% in 2016 to the maximum value of 33.3% in 2018 in a decade; In 2019, due to the dual pressure of domestic and international economic downturn, the growth rate of manufacturing investment was down sharply, reaching 33.33% in 2018, and then dropping to 10.1% in 2019. The impact of COVID-19 in 2020 made the manufacturing industry one disaster after another, and the first time it appeared negative growth in 2020, the growth rate was -5.6%. In 2021, Anhui's manufacturing

investment achieved good results and resumed positive growth, with a growth rate of 14.6%. It can be seen that manufacturing investment shows different differences in different stages. Comparing the growth rate of Anhui manufacturing investment with that of the national manufacturing investment, it can be seen that Anhui manufacturing investment has been higher than the national level except that it was lower than the national growth rate in 2012 and 2020. In 2012, the growth rate of Anhui's manufacturing investment was 1.6 percentage points lower than that of the national manufacturing investment. From 2013, the growth rate of Anhui's manufacturing investment was significantly higher than that of the national manufacturing investment, and the gap was gradually widening. At the end of 2018, the gap reached 26.83 percentage points, the largest in the decade from 2011 to 2020. Even after a sharp decline in 2019, it was still 7 percentage points higher than the national average growth rate. The trend relationship between Anhui manufacturing investment and national manufacturing investment shows that, on the one hand, despite the steady improvement of the efficiency level of China's manufacturing industry, the operation pressure of downstream industries, especially small and micro enterprises, is still great in the process of capacity removal, the vitality of market players needs to be stimulated, and the manufacturing industry still needs to operate steadily to improve quality and efficiency [2]. On the other hand, it shows that the strategy of building a strong manufacturing province in Anhui has formed a joint force of the whole province to promote the high-quality development of manufacturing industry, and provides a solid guarantee for the investment and development of manufacturing industry.

Affected by the low base of the epidemic in 2020, the investment growth rate of Anhui manufacturing industry showed a trend of "high before low" in 2021, falling from 21.2 in the first quarter to 14.6% in the whole year. However, excluding the impact of the low base in 2020, the two-year average growth rate of Anhui manufacturing investment decreased from 10.6% in the first quarter to 7.05% in the first half of the year, then gradually decreased to 6.75% in the first three quarters, and finally achieved an annual growth of 7.3%. Due to the low base of the previous year, the investment growth rate in the first quarter of 2021 was as high as 21.2%. At the end of the second quarter and the beginning of the third quarter, the industrial production was affected by the flood, and the growth rate of fixed asset investment was also greatly impacted, which decreased by 7.1% compared with the high investment in the first quarter. In the second half of 2021, the two-year average growth rate of manufacturing investment increased, but there was little room for Anhui manufacturing investment to recover due to the rise in the price of raw materials and other reasons. Finally, the annual growth rate reached 14.6% and the two-year average growth rate reached 7.3%.

### 2.1.3. Capital sources of manufacturing investment

This part mainly makes a detailed comparative analysis on the sources of investment funds of Anhui manufacturing industry from 2012 to 2020. From 2012 to 2020, the largest source of Anhui manufacturing investment funds is self-raising funds, and the main sources of self-raised manufacturing funds are various special funds and special loans. The total investment of self-raising funds has increased from 560.807 billion yuan in 2012 to 1479.643 billion yuan in 2020, and the total investment has nearly tripled. The investment proportion of self-raising funds shows an alternating trend of increase and decrease, but it is always the part with the largest proportion. From 2012 to 2020, Anhui's manufacturing investment self-raising funds accounted for about 90% of the total manufacturing investment funds. It can be seen that Anhui's overall manufacturing investment funds are still highly dependent on self-raising funds. Domestic loans are the second largest source of investment funds for Anhui's manufacturing industry, and the total amount of funds shows a downward trend first and then upward trend. From 55.759 billion yuan in 2012 to 23.481 billion yuan in 2015, a decrease of nearly double. From 2016 to 2020, there was an overall upward trend, from 30.338 billion yuan to 85.069 billion yuan. Mainly due to the widening of investment channels in manufacturing industry, the

state continues to pay attention to the development of manufacturing industry. Among them, it decreased to 59.908 billion yuan in 2019, mainly due to the global economic downturn and the Sino US trade war, which led to the decline of domestic loan investment in manufacturing industry. Anhui is also actively expanding the development path of manufacturing investment. In the future, the proportion of domestic loans and bonds is expected to increase, so as to promote the healthy development of Anhui manufacturing investment sources.

## 2.2. Manufacturing investment in various cities

Compared with the overall stable trend of manufacturing investment in Anhui Province, the manufacturing investment situation of 16 prefectures and cities in Anhui Province is obviously different. This part mainly makes a detailed analysis on the completion of manufacturing investment and the growth rate of manufacturing investment in 16 cities in Anhui in recent years. At the same time, it compares and analyzes the overall situation of manufacturing investment in the three regions of Northern Anhui, central Anhui and southern Anhui.

### 2.2.1. Manufacturing investment in various cities

There are few changes in the ranking of manufacturing investment in 16 cities in Anhui, and the completed amount and growth rate of manufacturing investment in some cities are increasing year by year.

From the perspective of the total investment in manufacturing industry in various cities, the completed amount and proportion of manufacturing investment in Hefei ranked first among all cities in the three years from 2019 to 2021. The investment in manufacturing industry in 2019 was 297.3 billion yuan, the investment in manufacturing industry in 2020 was 290.7 billion yuan, and the investment in manufacturing industry in 2021 was 319.7 billion yuan, all of which exceeded 290 billion yuan. Wuhu followed closely, with its manufacturing investment exceeding 230 billion yuan. The manufacturing investment in 2019 was 251.7 billion yuan, which fell slightly to 232.1 billion yuan in 2020 and rebounded to 278.2 billion yuan in 2021. In addition, there are six prefectures and cities with more than 100 billion yuan in three years, including Bengbu, Chuzhou, Xuancheng, Ma'anshan, Anqing and Suzhou. The manufacturing investment of Chuzhou and Ma'anshan slightly exceeds that of the other three prefectures and cities. In 2019, the manufacturing investment of Chuzhou and Ma'anshan was 151.1 billion yuan and 190.2 billion yuan. In 2020, Chuzhou surpassed Ma'anshan in the third place, with a manufacturing investment of 145.3 billion yuan and 128.3 billion yuan, In 2021, the manufacturing investment of Chuzhou and Ma'anshan was 171.3 billion yuan and 144.4 billion yuan,. In the past three years, Huainan and Huangshan were the last two cities. Huainan's manufacturing investment in the past three years was 24.1 billion yuan, 21.9 billion yuan and 25.5 billion yuan. The investment decreased in 2020, but rebounded again in 2021. Although the total investment in manufacturing industry in Huangshan is the lowest among all cities, it shows an increasing trend year by year. The investment in manufacturing industry in the three years is 11.4 billion yuan, 11.6 billion yuan and 14.1 billion yuan respectively.

From the three-year growth rate of manufacturing investment in various cities, the first growth rate of manufacturing investment in recent three years is Chizhou, Tongling and Fuyang, with growth rates of 30.3%, 34.42% and 31.8% respectively. The growth rate of manufacturing investment ranked first every year is far higher than that of manufacturing investment in the whole province in that year. It is worth noting that in 2021, the growth rate of manufacturing investment in Fuyang, Suzhou, Tongling and Huangshan exceeded 20%, which injected a strong impetus into the development of manufacturing industry after the epidemic. In recent three years, Huangshan, Maanshan and Bengbu ranked last, with negative growth rates of - 25%, - 48.7% and - 1.1% respectively. There will be steady growth in 2019, only Huainan has negative growth, and other cities show positive growth trend; In 2020, affected by the epidemic, the manufacturing industry at home and abroad was hit to varying degrees. Among the 16 prefectures and cities, 11 prefectures and cities showed a negative growth trend, and only 5

prefectures and cities showed a positive growth trend. In 2021, thanks to the holding of the world manufacturing conference in our province, the manufacturing investment in various places was booming. Only Bengbu had a negative growth in manufacturing investment, while the manufacturing investment in other cities increased to varying degrees, and the growth rate of manufacturing investment in Fuyang, Suzhou, Tongling and Huangshan exceeded 20%.

In terms of the proportion of manufacturing investment in various cities, Hefei still ranks first in the proportion of manufacturing investment in the whole province, with more than 17%, 17.4%, 17.4% and 17.61% respectively in three years. Wuhu ranked second, with a growth rate of more than 10%, accounting for 14.8%, 13.9% and 15.33% respectively. Ma'anshan and Chuzhou are slightly inferior, ranking third and fourth. In the last two places are Huainan and Huangshan. Huainan accounted for 1.4%, 2.1% and 1.41% of the province's manufacturing investment in the past three years, while Huangshan accounted for 0.7%, 0.7% and 0.78% respectively.

### 2.2.2. Manufacturing investment in three regions

In terms of subregions, manufacturing investment in central Anhui accounts for a large proportion of manufacturing investment in the whole province, while that in Northern Anhui is relatively small, and there is a large difference between central Anhui and Northern Anhui.

From 2019 to 2021, the ranking of the proportion of manufacturing investment in the three regions has not changed, ranking first in central Anhui, second in southern Anhui and third in Northern Anhui. The investment in manufacturing industry in central Anhui has always been far ahead of the investment in manufacturing industry in the other two regions. Hefei is the political and economic center of Anhui, focusing on the transformation from "Hefei manufacturing" to "Hefei intelligent manufacturing". The manufacturing industry presents a trend of rapid, quality, competitiveness and sustainable development. BOE, Weilai and other high-tech enterprises have settled in Hefei, driving the rapid development of Hefei's manufacturing industry. In recent three years, Hefei's manufacturing investment has exceeded 290 billion yuan and 310 billion yuan in 2021. The manufacturing investment of Chuzhou and anqing exceeded 100 billion yuan. The manufacturing investment of Lu'an was slightly lower than that of the other three cities in the region, but increased every year. The manufacturing investment increased to 72.7 billion yuan in 2021. Northern Anhui has a vast territory and abundant resources. Bengbu and Suzhou rank high, leading the development of manufacturing industry in Northern Anhui. Fuyang and Huaibei are the largest grain industry bases in North China. They are mainly food processing industries. They are not driven by large high-tech enterprises and intelligent manufacturing enterprises. Their manufacturing investment is slightly lower than that of other cities. However, in 2021, the growth rate of Fuyang manufacturing investment ranked first in the province with excellent results. The polarization of Southern Anhui is serious. Huangshan and Chizhou cities are mainly because with the five development concepts and the construction of Southern Anhui international cultural tourism demonstration area, Southern Anhui pays more and more attention to ecological environment protection and vigorously develops tourism and service industry. However, Ma'anshan, Wuhu and Xuancheng are driven by large manufacturing enterprises such as Maanshan Iron and steel, Chery Automobile and rice paper, Therefore, the overall manufacturing investment in southern Anhui is higher than that in Northern Anhui, but lower than that in central Anhui.

## 2.3. Manufacturing investment by industry

By comparing and analyzing the investment amount and investment source of Anhui manufacturing industry in 2020, it is concluded that the investment characteristics of Anhui manufacturing industry are as follows:

### 2.3.1. Investment amount of manufacturing industry by industry

From the perspective of the overall change trend, the investment growth rate of various industries in the manufacturing industry shows a downward trend, and the change range of

investment in various industries is different. In 2020, the growth rate of Anhui's manufacturing industry was - 5.6%, a year-on-year decrease of 15.7%. Among the 31 industries, in addition to food manufacturing, petroleum processing, coking and nuclear fuel processing, chemical raw materials and chemical manufacturing, pharmaceutical manufacturing, non-ferrous metal smelting and rolling processing, iron, shipbuilding, aerospace and other transportation equipment manufacturing and comprehensive utilization of waste resources, the investment volume of these eight industries increased and the growth rate increased compared with the past, and the growth rate of the other 23 industries showed a downward trend and decreased significantly. It can be seen from the table that most of the manufacturing industries whose investment can maintain positive growth in 2020 are heavy industries with high growth rate, such as petroleum processing, coking and nuclear fuel processing industry 59.5%, ferrous metal smelting and rolling processing industry 43.9%, and nonferrous metal smelting and rolling processing industry 15.2%; The proportion of light industry is relatively small and the growth rate is low, such as 9% in textile industry and 0.4% in food manufacturing industry. The top three industries with the highest growth rate were petroleum processing, coking and nuclear fuel processing, comprehensive utilization of waste resources, ferrous metal smelting and rolling processing, with a year-on-year increase of 59.5%, 57.7% and 43.9%; The top three industries with the largest decline were tobacco products, chemical fiber manufacturing and general equipment manufacturing, with a year-on-year decrease of 122.5%, 94.6% and 60.2%. It is worth noting that the special equipment manufacturing industry is the only manufacturing industry that has maintained positive growth for ten consecutive years under the background of the epidemic, which is mainly due to Anhui's high attention to high-end equipment manufacturing in recent years. Anhui adheres to the investment attraction of the industrial chain, vigorously supports high-end equipment manufacturing through the implementation of the "double recruitment and double introduction" scheme, and actively introduces and implements new manufacturing enterprises with strong driving ability. Although the investment development of Anhui's manufacturing industry is optimistic on the whole, objectively speaking, in terms of professional equipment manufacturing, Anhui's manufacturing foundation is weak, the industrial scale is small, and the number of leading enterprises still needs to be solved. Next, the direction of Anhui manufacturing investment should focus on solving the problems of few categories, small scale and talent shortage.

### 2.3.2. Investment sources of manufacturing industry by industry

At present, the sources of investment funds in Anhui's manufacturing industry mainly include national budget funds, domestic loans, bonds, utilization of foreign capital, self-raising funds and other funds (including social fund-raising, individual fund-raising, free donation, etc.), and the investment proportion of various funds is different. This part mainly makes a detailed comparative analysis on the sources of investment funds of manufacturing industry in Anhui in 2020.

It can be seen from the total investment sources of manufacturing industry in 2020 that there are three industries with more than 150 billion yuan, namely: general equipment manufacturing industry (184.980 billion yuan), special equipment manufacturing industry (181.190 billion yuan) and non-metallic mineral products industry (167.401 billion yuan); More than 100 billion yuan also includes electrical machinery and equipment manufacturing (127.362 billion yuan), automobile manufacturing (112.1 billion yuan) and computer, communication and other electronic equipment manufacturing (110.779 billion yuan).

From the distribution of capital sources, it can be seen that the largest source of Anhui manufacturing investment funds is self-raising funds, and the main sources of self raised capital construction funds are various special funds and special loans. Among the self-raising funds, the special equipment manufacturing industry, general equipment manufacturing industry, non-metallic mineral products industry, electrical machinery and equipment manufacturing

industry and automobile manufacturing industry with an investment of 100 billion yuan, with an investment of 173.519 billion yuan, 164.890 billion yuan, 159.826 billion yuan, 118.325 billion yuan and 106.657 billion yuan respectively. The investment in tobacco products industry, metal products and mechanical equipment repair industry is far lower than that in other industries, both of which are less than 200 million yuan. From the above comparison, it can be concluded that self-raising funds are the main source of investment by industry, accounting for more than 90%, followed by domestic loans and other funds. However, there are few investment funds from the state budget, foreign capital and bonds, less than 1%.

### 3. Investment Efficiency of Manufacturing Industry in Anhui

Manufacturing investment efficiency is the comparative relationship between the input and output of manufacturing capital in various fields. This section uses data envelopment analysis (DEA) to analyze the overall efficiency of manufacturing investment in Anhui, the overall efficiency of manufacturing industry in various cities and the investment efficiency of manufacturing industry in various industries.

#### 3.1. Overall efficiency analysis of manufacturing investment

##### 3.1.1. Model selection

In this part, the data envelopment analysis (DEA) method is used to analyze the investment efficiency of Anhui manufacturing industry. For any decision-making unit DMU, the dual BCC model under input guidance can be expressed as:

$$\begin{aligned} \min &= (\theta - \varepsilon (e^t s^- + e^s s^+)) \\ s.t. & \sum_{i=1}^n \lambda_i y_{ir} - s^+ = y_{0r} \\ & \sum_{i=1}^n \lambda_i x_{ij} + s^- = \theta x_{0j} \end{aligned} \tag{1}$$

$\lambda_j \geq 0, S^+ \geq 0, S^- \geq 0, \theta$  free. For this model, slack variable  $S^+$  and  $S^-$  are introduced,  $x_{ij}$  is the input factor,  $y_{ir}$  is the output factor,  $\theta$  denotes the effective value of the decision unit DMU,  $\lambda$  denotes the coefficient of linear combination of decision units, and band \* denotes the optimal solution [3].

If  $\theta^* = 1, S^{-*} = S^{+*} = 0$ , the DMU decision unit is said to be DEA valid; if  $\theta^* = 1, S^{-*}, S^{+*}$  there exists a non-zero value, the DMU decision unit is said to be DEA weakly valid; if  $\theta^* \leq 1$ , the DMU decision unit is said to be DEA invalid. Since DEA has significant advantages in analyzing multiple inputs and multiple outputs, this part uses DEA to evaluate the efficiency of Anhui manufacturing investment.

##### 3.1.2. Establishment of evaluation index system and data selection

Considering that in the selection of DEA indicators, the input indicators are as small as possible and the output indicators are as large as possible. Therefore, the selection of investment efficiency evaluation indicators of manufacturing industry is as follows: first, investment indicators. It is the fixed asset investment completed amount of Anhui manufacturing industry from 2011 to 2020; Second, output indicators. Manufacturing industry has gradually become an important growth point of Anhui's industrial economy. Therefore, the added value of industries above Designated Size in Anhui in recent ten years is selected as the output index. With reference to relevant research, the two indexes of GDP per capita and GDP are selected. Therefore, the output index of manufacturing investment efficiency is the added value of industries above Designated Size, which reflects the economic value of products or services provided by manufacturing investment activities in various regions.

##### 3.1.3. Analysis of empirical results

Due to the use of DEA, the data does not need standardized processing. The research directly uses the software deap2 1. According to the selected input and output indicators, the technical

efficiency, pure technical efficiency, scale efficiency and scale return of Anhui manufacturing investment from 2012 to 2021 are calculated. Because the value of technical efficiency is equal to the product of pure technical efficiency and scale efficiency, its value range is between 0 and 1.000. The closer the result is to 1.000, the higher the efficiency is. When the efficiency is equal to 1.000, it indicates that its manufacturing investment efficiency is the most effective.

According to the DEA calculation results, the following analyzes the manufacturing investment efficiency of Anhui from 2012 to 2021 from the average value, trend and 2021:

From the average value of investment efficiency of Anhui manufacturing industry in recent ten years, without considering other factors such as external environment, the average value of technical efficiency is 0.785, the average value of pure technical efficiency is 0.951 and the average value of scale efficiency is 0.824. Pure technical efficiency is higher than scale efficiency, close to 1, indicating that pure technical efficiency is in the dominant position and scale efficiency is in the secondary position. On the whole, except that the manufacturing investment reached DEA effective in 2012, it did not reach full scale effective in other years, but most of them were at a high level. From 2012 to 2021, the investment efficiency of manufacturing industry first showed a constant scale, and then began to decline in scale. The scale remained unchanged in 2012, which means that the manufacturing investment reached DEA efficiency in 2012, and the input and output of the manufacturing industry matched, which shows that the use of input resources of various elements of the manufacturing industry in this year is effective, there is no redundancy of input, and the regional resource allocation is more reasonable. From 2013 to 2021, the scale showed a decreasing trend, indicating that the investment of various factors in the manufacturing industry in these nine years was unreasonable. The pure technical efficiency in 2020 and 2021 was 1, but the technical efficiency and scale efficiency were 0.693 and 0.659, indicating that the pure technical efficiency was effective and DEA was weakly effective in this year. From the above analysis, it can be concluded that the above changes in Anhui manufacturing investment are closely related to the government's macro-control and the economic situation at home and abroad. In recent years, Anhui has deeply implemented the innovation driven development strategy and promoted the strategy of building a strong manufacturing province. With the continuous increase of manufacturing investment, the scale will remain unchanged in 2012, and the input and output of manufacturing industry match. However, with the continuous increase of investment, the regional resource allocation is unreasonable, resulting in a lot of ineffective investment; From 2013 to 2021, the investment efficiency of manufacturing industry decreased in scale, indicating that the faster the investment speed and the larger the investment scale, the higher the efficiency. According to the data of Anhui manufacturing investment efficiency in 2021, the comprehensive technical efficiency is 0.659, which shows that the comprehensive measurement results of Anhui manufacturing investment allocation, capital use efficiency and other capabilities are low. Among them, the pure technical efficiency is 1, which shows that the investment of Anhui manufacturing investment resources is efficient at the current technical level. The reason why it fails to achieve comprehensive effectiveness lies in the ineffective scale. Therefore, the focus of Anhui manufacturing investment reform lies in how to give better play to its scale efficiency.

### **3.2. The overall efficiency of manufacturing investment in various cities**

The analysis ideas and methods of manufacturing investment efficiency in various cities are consistent with the overall investment efficiency of manufacturing industry. In this section, DEA method and statistical regression model are used to calculate the manufacturing investment efficiency of 16 cities in Anhui in 2021, and relevant indicators and data are selected for efficiency measurement and evaluation.

#### **3.2.1. Model construction and indicator options**

This section is basically consistent with the method used in the previous section. Data envelopment analysis (DEA) is used to analyze the investment efficiency of Anhui manufacturing industry.

The evaluation indicators of manufacturing investment efficiency include input indicators and output indicators. Considering the accuracy, operability and suitability of the data, four indicators are selected to quantitatively measure the level of manufacturing investment efficiency, of which the specific indicators are as follows:

Input indicators. In 2021, the fixed asset investment of manufacturing industry in various cities of Anhui Province is taken as the capital investment index.

Output indicators. The output indicators in this section are the gross national product of 16 prefectures and cities to reflect the specific situation of manufacturing investment efficiency in various cities. The data of input and output indicators of 16 cities in Anhui in 2021 are brought into deap2 1. Through the calculation and analysis of the software, we can get the technical efficiency, pure technical efficiency, scale efficiency and scale return of manufacturing investment in various cities, so as to analyze the manufacturing investment efficiency of various cities in 2020.

### 3.2.2. Empirical results and analysis

The input-oriented BCC model is adopted to bring the input and output index data of Anhui cities in 2021 into the model, and the sorted data can be directly brought into deap2. The investment efficiency results of each city are obtained through DEA calculation and analysis, including technical efficiency, pure technical efficiency, scale efficiency and the state of scale return. Among them, technical efficiency, also known as comprehensive technical efficiency, is equal to the product of scale efficiency and pure technical efficiency, which reflects the allocation capacity and use efficiency level of investment resources of manufacturing industry in each city; Pure technical efficiency reflects the change of manufacturing investment efficiency caused by factors such as system and management level under the condition of constant return to scale; Scale efficiency reflects the production efficiency affected by factors such as the size of manufacturing industry in each city, and reflects the gap between the actual scale and the optimal production scale [4]. Returns to scale reflect the stage of manufacturing investment and can help cities determine the next manufacturing investment plan.

In 2021, the average technological efficiency of manufacturing investment in all cities of Anhui Province was 0.419, the average pure technical efficiency was 0.543, and the average scale efficiency was 0.779. The average value of scale efficiency is greater than the average value of pure technical efficiency, which shows that the investment scale efficiency of manufacturing industry in Anhui has a great impact on technical efficiency.

From the analysis of technical efficiency and scale efficiency of various cities: the value of pure technical efficiency index of Hefei, Fuyang and Huainan is 1, but the value of technical efficiency and scale efficiency is less than 1, the value of technical efficiency and scale efficiency of Hefei is 0.526, the value of technical efficiency and scale efficiency of Fuyang is 0.708, and the value of technical efficiency and scale efficiency of Huainan is 0.841. Pure technical efficiency refers to the efficiency brought by the system and management level. The value of pure technical efficiency in Hefei, Fuyang and Huainan is 1, indicating that the operation efficiency and management level of capital investment of manufacturing enterprises are relatively high, and the investment structure and scale of manufacturing industry are relatively reasonable, indicating that the use of investment is efficient at the current technical level. Only the technical efficiency, scale efficiency and pure technical efficiency of Huangshan are 1, indicating that the technical investment of Huangshan manufacturing enterprises is relatively effective compared with other cities, and the manufacturing investment is relatively reasonable. The technical efficiency and pure technical efficiency of Huaibei, Xuancheng, Tongling and Chizhou are lower than the average, while the scale efficiency is higher, indicating that the higher the scale, the

closer it is to the optimal production scale. The scale efficiency, technical efficiency and pure technical efficiency of other cities are less than the average value, indicating that there is a big gap in scale, investment and efficiency.

From the scale benefit analysis of manufacturing investment in various cities: the calculation results of returns to scale, it can be seen that 15 of the 16 cities in Anhui are in the stage of diminishing returns to scale, and Huangshan is in the stage of constant scale.

It can be seen that in 2021, due to the increasing pressure of the global economy and the impact of factors such as the epidemic of globalization, slow industrial transformation and upgrading, unbalanced and insufficient development, most cities in Anhui show the technical characteristics of diminishing returns to scale. Therefore, it is necessary to reasonably allocate resources among northern, central and southern Anhui, and ensure that the investment and construction of manufacturing industry in each region is consistent with the economic development of the region in terms of scale and speed, Give full play to the regional advantages of each region and reasonably adjust the investment structure in the province; Reasonably grasp the strategic opportunities such as the development of regional integration in the Yangtze River Delta, give play to the regional advantages, and firmly and unremittingly invest in scientific and technological innovation for a long time, so as to promote the strategy of building a strong manufacturing province.

### 3.3. The overall efficiency of manufacturing investment by industry

The analysis ideas and methods on the investment efficiency of manufacturing industry are consistent with the previous analysis of the investment efficiency of manufacturing industry in various cities. This section uses DEA method and statistical regression model to calculate the investment efficiency of manufacturing industry in 31 manufacturing industries in Anhui in 2020, and selects relevant indicators and data for efficiency calculation and evaluation.

#### 3.3.1. Model construction and indicator options

This section is basically consistent with the method used in the previous section. Data envelopment analysis (DEA) is used to analyze the investment efficiency of Anhui manufacturing industry.

The evaluation indicators of manufacturing investment efficiency include input indicators and output indicators. Considering the accuracy, operability and suitability of the data, four indicators are selected to quantitatively measure the level of manufacturing investment efficiency, of which the specific indicators are as follows:

(1) Input indicators. This section selects indicators from two aspects: labor input and capital input. The number of employees in Anhui manufacturing industry in 2020 is selected as the labor input index, and the fixed asset investment in Anhui manufacturing industry in 2020 is selected as the capital input index.

(2) Output indicators. The output indicators selected in this section are the total industrial fixed assets and total profits of Anhui manufacturing industries (Enterprises above Designated Size) in 2020.

#### 3.3.2. Empirical results and analysis

This section uses DEA model to calculate the manufacturing investment efficiency of 31 manufacturing industries in Anhui in 2020, and selects relevant indicators and data to calculate and evaluate the efficiency.

From the average efficiency of various industries in the manufacturing industry, without considering the external environment and other factors, the average technical efficiency is 0.375, the average pure technical efficiency is 0.445, and the average scale efficiency is 0.858, which is close to 1. The scale efficiency is higher than the pure technical efficiency, indicating that the scale efficiency is in the dominant position and the pure technical efficiency is in the secondary position. The manufacturing industry has not reached full scale efficiency, but it is at a high level. In terms of technical efficiency and scale efficiency, the scale efficiency of computer,

communication and other electronic equipment manufacturing industry is 1. Agricultural and sideline food processing industry, wine, beverage and refined tea manufacturing industry, textile industry, chemical raw materials and chemical products manufacturing industry, pharmaceutical manufacturing industry, rubber and plastic products industry, non-metallic mineral products industry, ferrous metal smelting and rolling processing industry, non-ferrous metal smelting and rolling processing industry, metal products industry The scale efficiency of general equipment manufacturing, special equipment manufacturing, automobile manufacturing and electrical machinery and equipment manufacturing exceeds 0.9, close to 1, indicating that the investment efficiency of manufacturing industry is at the cutting-edge level. The current scale and technology are effective and conducive to the development of this industry. The pure technical efficiency of chemical fiber manufacturing industry is 1, which shows that the capital operation efficiency and management level of this industry are relatively high, but the scale efficiency is low, which shows that the control of investment scale is relatively unreasonable, and the investment scale has not reached the optimal level. The level of pure technical efficiency and scale efficiency of other manufacturing industries is very low, resulting in low overall efficiency and lower than the average level, indicating that there are major problems in investment scale and investment management of other manufacturing industries. From the perspective of economies of scale, in 2020, 29 of the 31 industries are in the stage of increasing scale, indicating that most manufacturing industries in Anhui are in the stage of increasing scale. The manufacturing industry should be encouraged to pay attention to continuously adjusting the investment structure and promoting the increase of marginal income. Industries with decreasing returns of scale need to increase capital and labor investment and speed up the transformation and upgrading of the industry.

#### 4. Policy Recommendations

To sum up, the current problems faced by Anhui manufacturing investment mainly include the following aspects: reduced investment scale, slow investment recovery, single source of funds, large regional gap and low investment efficiency. Based on this, this paper puts forward several policy suggestions to promote the healthy development of Anhui manufacturing investment: first, strengthen financial support, improve the scale of investment by improving financing channels and strengthening credit support; Second, grasp the construction of industrial transfer agglomeration areas in Northern Anhui, improve the investment level of manufacturing industry in Northern Anhui, and narrow the gap between central Anhui and southern Anhui [5]. Third, take innovation as the guide, increase investment in innovation and R&D of manufacturing industry. By expanding effective investment in manufacturing industry, it can not only help the recovery of investment in Anhui manufacturing industry, but also improve the efficiency of investment in Anhui manufacturing industry.

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