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On Technology Finance and Region Optimization of the Industrial Structure in Anhui based on the DEA model

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Abstract

Technology finance is a multi-party resource system that helps all technology companies and the development and innovation of technology achievements, providing a powerful impetus for industrial structural upgrades. However, compared to some developed regions, there are still non-negligible gaps in the development of Anhui's technology finance industry. Research on the development efficiency and regional industrial structure of technology finance has important practical significance for promoting sustainable and high-quality economic development in Anhui Province. Based on the statistical data from 2010 to 2020, it can be concluded that through the establishment of the DEA-BCC model, it is possible to study the differentiation of the development efficiency of technology finance in Anhui Province in recent years. However, overall efficiency levels are still on the rise. Coupling tuning analysis is used for service and technology development. Studies show that binding adjustments have increased in recent years. Finally, we summarize and propose proposals to further promote technology financing in Anhui Province and promote advanced development of industrial structure.

Keywords

Technology Financial Efficiency; Industrial Structure; DEA Model; Coupling Relations.

1. Introduction

The background to the new normalization of the economy plays an important role in promoting economic development such as productivity improvement. Technology and finance are two key elements of modern economic development. By tightly integrating the resources of both sides, it is possible to effectively promote the sophistication and economic restructuring of the region's industry and promote the high quality and stable development of the Chinese economy.

The development of China's technology finance began relatively late, and most academic research in this area found that resources were misallocated. Sun Zhongyan (2020) uses the DEA-BBC model to investigate dynamic and static changes in the efficiency of technology finance in eight states and cities, revealing the development of technology finance in the enterprise world. I found a difference [1]. From the DEA model and index analysis of Chen Tianwu (2020), it was found that the development efficiency of technology finance in the Midwest region of my country is low [2]. Based on data from 2009 to 2011, Chen Junmei (2014) concluded that the integration of finance and technology in the Ningxia Hui Autonomous Region is not ideal [3]. Cui Yi et al. In 2007, the efficiency of technology finance in Guangdong revealed the problem of coordination between inputs and outputs [4].

In addition, many scholars have conducted various studies on the relationship with the development of industrial structure. Zou Jianguo et al. (2021) established the SLM model and

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found that technological capital facilitated industrial structural upgrades and the spillover effect was more pronounced in the eastern region [5]. Chen Yanan et al. (2020) concluded that the development of technology financing can facilitate the improvement of the industrial structure using a two-step GMM approach [6]. He Tao(2020) established a PVAR model based on data from six central countries and found that the two had a positive impact on each other, but the impact on the rationalization of the industrial structure is not significant [7]. According to data from a group of experts, Xu Weihua is investigating whether current innovation infrastructures in different parts of China can help optimize the industrial structure of the region [8].

Looking back at related literature, few literature studies correlations by combining the efficiency of technology finance with the characteristics of industrial structure. Therefore, based on existing standards, we will use the DEA model to perform empirical data analysis on the development efficiency and advanced regional industrial structure of Anhui Province's technology finance from 2010 to 2020. This reflects the efficiency of Anhui's technological financial development. This paper analyzes the differences between Anhui and some developed regions, and puts forward some suggestions to promote the quality of sustainable economic development in Anhui.

2. Establishing an Indicator System and Data Source

2.1. Indicator Selection and System Definition

Select the number of R & D funds (10,000 yuan) and R & D personnel (persons) as input indicators. Select the total production value (100 million yuan) and the number of patent applications (items) of the high-tech industry as production indicators. The financial indicators of technology include the total annual investment in fixed assets (10,000 yuan) and the annual total planned investment (10,000 yuan).

Table 1. Input and output indicators

Indicator type	Contents of the indicator	Indicator code	Indicator type	Contents of the indicator	Indicator code
Input indicator	R&D expenses (10,000 yuan)	X_1	Output indicator	Total production value of high-tech industry (100 million yuan)	Y_1
	Full-time equivalent to R&D person in charge (person)	X_2		Number of patents granted (items)	Y_2

2.2. Data Source

The indicator data is from Anhui Statistical Yearbook (2010-2020) and Anhui High-Tech Industry Statistics Bulletin (2010-2020).

3. Development Efficiency of Technology Finance in Anhui Province

3.1. Research Ideas

Data Package Analysis was proposed by A. Charnes, WNCcopper, and E. Rhodes in 1978 to evaluate the inputs and outputs of multi-indexes and measure the effectiveness of the system [9-11]. This is a non-parametric evaluation method. DEA includes the assumption that a certain scale of economy CCR assumes that a certain scale of economy is a model fluctuation BCC model constant diminishing return CCR. The assumed premise of the model is constant yield with respect to scale. Many scholars have established DEA models for studying related problems by referring to relevant literature. Changes in investment size affect the efficiency of technology finance, so we will use the DEA-BBC method for analysis here [12].

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3.2. Establishment of Model

The DEA-BBC method is as follows:

Overall efficiency = pure technical efficiency × scale efficiency

$$min[\theta - \varepsilon(\hat{e}^T s^- + e^T S^+)] = V(DE)$$

$$s.t. \sum_{j=1}^{n} xj\,\lambda j + s^- = \theta xj0$$

$$\sum_{j=1}^{n} yj\,\lambda j - s^+ = yj0$$

$$\sum_{j=1}^{n} \lambda j = 1$$

Here, θ, λ, s^+, s^- ≥0.

Given n decision-making units (DMUs), each DMU has m input metrics and s output metrics. This x_{ij} is the i-th input Y_{rj} of the j-th DMU and the r-th output of the j-th DMU. $e_M^T = (1,1,\ldots,1) \in E_m, e_s^T + (1,1,\ldots,1) \in E_s$, θ is efficiency value of the decision unit, s^+ and s^- is slack variable.

3.3. Empirical Analysis

3.3.1. Measurement Results

Effective data measures total efficiency, pure technical efficiency, and scalability efficiency over a specific time period. As you can see from Table 2 , the overall efficiency of Anhui Province is improving. Overall efficiency in some areas declined for some time, but then improved rapidly. If the trend is about the same as the change in overall efficiency, the pure technological efficiency in some areas has been declining for a period of time, but the overall pure technological efficiency in Anhui is on the right track. This also shows the effectiveness of Anhui Province. As shown in Table 4, from 2016 to 2020, the trend of change in the scale efficiency of each city in Anhui is the same as the trend of change in overall efficiency and pure technological efficiency. Only Bozhou's development is effective, and other cities are clearly ineffective.

Table 2. Overall efficiency values of cities in Anhui Province from 2016 to 2020

Area	Years					Area	Years				
	2016	2017	2018	2019	2020		2016	2017	2018	2019	2020
Hefei	0.588	0.417	0.426	0.575	0.937	Huainan	1	0.259	0.347	1	0.754
Huaibei	0.505	0.709	0.677	0.644	0.659	Fuyang	0.485	0.532	0.5	0.779	0.971
Suzhou	0.618	1	1	0.881	0.658	Xuancheng	0.56	0.591	0.635	0.636	0.648
Chuzhou	0.797	0.734	0.756	0.88	0.95	Chizhou	0.995	0.858	0.897	0.954	0.989
Lu'an	1	0.633	0.875	0.892	1	Huangshan	0.753	0.564	0.503	0.694	0.635
Wuhu	0.996	0.679	0.78	1	1	Anqing	0.596	0.647	0.639	0.772	0.835
Tongling	0.687	0.559	0.538	0.564	0.68	Ma'anshan	0.674	0.395	0.353	0.446	0.743
Bengbu	0.46	0.485	0.491	0.644	0.766	Bozhou	0.618	1	1	0.881	0.658
Average value	0,732	0.629	0.651	0.773	0.827	Average value	0,732	0.629	0.651	0.773	0.827

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Table 3. Net Technology Efficiency Values of Cities in Anhui Province from 2016 to 2020

Area	Years					Area	Years				
	2016	2017	2018	2019	2020		2016	2017	2018	2019	2020
Hefei	1	1	1	1	1	Huainan	1	1	1	1	0.763
Huaibei	0.636	0.885	0.792	0.707	0.677	Fuyang	0.565	0.584	0.554	0.782	1
Suzhou	1	1	1	1	0.866	Xuancheng	0.74	0.749	0.77	0.773	0.802
Chuzhou	0.94	1	1	1	1	Chizhou	1	0.898	0.937	1	1
Lu'an	1	0.684	0.959	0.894	1	Huangshan	0.998	0.785	0.82	0.984	1
Wuhu	1	1	1	1	1	Anqing	0.733	0.777	0.75	0.847	0.866
Tongling	0.766	0.779	0.714	0.703	0.773	Ma'anshan	0.676	0.539	0.424	0.487	0.746
Bengbu	0.578	0.644	0.637	0.755	0.906	Bozhou	1	1	1	1	1
Average value	0.852	0.833	0.835	0.871	0.9	Average value	0.852	0.833	0.835	0.871	0.9

Table 4. Scale Efficiency of Cities in Anhui Province from 2016 to 2020

Area	Years					Area	Years				
	2016	2017	2018	2019	2020		2016	2017	2018	2019	2020
Hefei	0.588	0.417	0.426	0.575	0.937	Huainan	1	0.259	0.347	1	0.988
Huaibei	0.793	0.417	0.426	0.575	0.973	Fuyang	0.858	0.91	0.902	0.996	0.971
Suzhou	0.618	1	1	0.881	0.76	Xuancheng	0.756	0.79	0.825	0.823	0.808
Chuzhou	0.848	0.734	0.756	0.88	0.95	Chizhou	0.995	0.955	0.957	0.954	0.989
Lu'an	1	0.924	0.912	0.998	1	Huangshan	0.755	0.718	0.613	0.705	0.635
Wuhu	0.996	0.679	0.78	1	1	Anqing	0.813	0.832	0.852	0.912	0.964
Tongling	0.898	0.717	0.753	0.802	0.88	Ma'anshan	0.997	0.732	0.832	0.916	0.997
Bengbu	0.797	0.754	0.771	0.852	0.846	Bozhou	1	1	1	1	1
Average value	0.857	0.764	0.786	0.888	0.919	Average value	0.857	0.764	0.786	0.888	0.919

3.3.2. Analysis of Results

From the above calculation results, we can see that the change in Anhui's annual efficiency index is generally greater than 1. In recent years, the development of technology finance in Anhui Province has been accelerating. The efficiency of investment in technology has generally improved. However, there are clear regional differences between Anhui Province and Hefei City, Maanshan City, Anqing City, Xuancheng City, Huangshan City, Tongling Prefecture, etc., and the input / output efficiency of technology finance is not high.

4. Coordinated Development of Technology Finance and Industrial Structure in Anhui

4.1. Research Ideas

Analysis of coupling adjustment based on weight of indicators at all levels. This transforms the unique development relationship between Anhui's technology finance and advanced industrial structure [13-15]. You can check the trend. From 2010 to 2020, we will promote the development from two low debt to high debt.

4.2. Establishment of Model

The coefficient of variation method was used to evaluate the degree of coupling using the overall score. The formula is:

$$M = \left[N_i \times G_i / \left(\frac{N_i + G_i}{2} \right)^2 \right]^2$$

$$T = 0.5 \times N_i + 0.5 \times G_i$$

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$$Q = \sqrt{M \times T}$$

Among them, the degree of coupling is M, the efficiency of technology finance is N, the degree of coupling is Q, and the degree of industrial structure is G.

Due to the small combined value obtained from this calculation, there is actually a close relationship between technology finance and advanced industrial structures. Therefore, as shown in Table 5, the optimized Q-binding is reintroduced and subdivided according to the actual properties.

Table 5. Goodness-of-fit classification and goodness-of-fit adjustment

Coupling m	Coupling	Coupling Q adjustment	Coupling adjustment	Coupling M	Coupling	Coupling Q adjustment	Coupling adjustment
[0.0,0.3)	Low binding	[0.0,0.2)	terrible	[0.0,0.3)	Break-in stage	[0.6,0.7)	Primary director
		[0.2,0.3)	Severely disabled			[0.7,0.8)	Intermediate coordinator
[0.3,0.6)	Competition stage	[0.3,0.4)	Mild disability	[0.0,0.3)	Highly coupled	[0.8,0.9)	Good adjustment
		[0.4,0.6)	Small dislocations			[0.9,1.0)	Senior coordination

4.3. Search Results

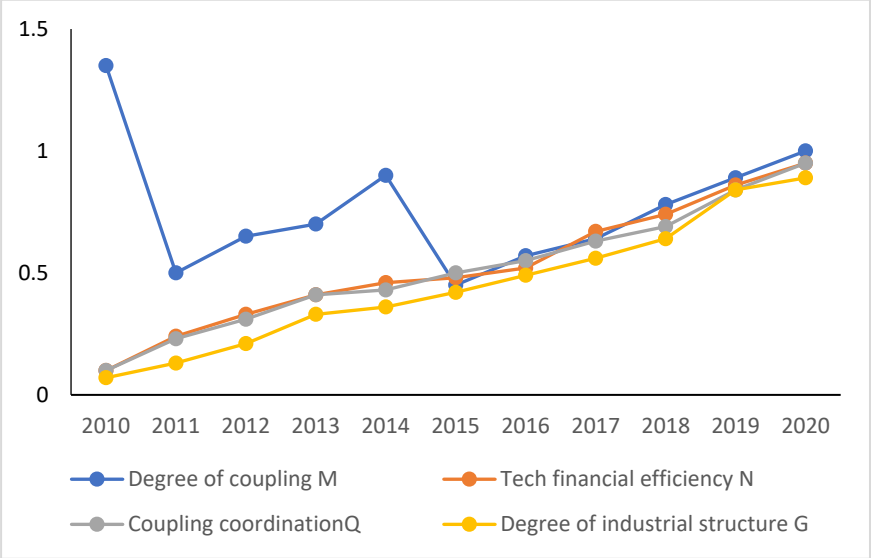

Figure 1. Coupling degree and adjustment tendency diagram of coupling degree

As shown in Figure 1, both the degree of coupling and the degree of adjustment of the degree of coupling increase. In contrast, the degree of coupling fluctuated significantly from 2010 to 2015 and dropped sharply in 2010. This shows that the development of technology finance and structural industry in Anhui was not optimistic at the time, and we will add reasons and changes. The sophisticated industrial structure is synergistic and reflects a clear understanding of the government and the public about the effectiveness of technology financing. Considering that the degree of coupling calculated by the coefficient of variation is unscientific, it is necessary to achieve a rational realization of the degree of coupling. If the development trend of technology finance is relatively stable, the connection between technology finance and industrial progress will be stronger. As you can see from Figure 1, from 2015 to 2020, the degree of integration and coordination between technology finance and industrial optimization continues to improve.

Anhui's technology finance still has room for further improvement, and the outlook has not yet been announced.

5. Conclusion and Suggestions

In recent years, investment in technology in Anhui has continued to increase. The DEA-BBC model was established for empirical analysis based on Anhui's statistical data from 2010 to 2020. The degree of coordination of inputs and outputs is good, but it is affected by various complex factors such as differences in economic development, differences in the distribution of universities, differences in development between regions, and efficiency problems in some regions. Being relatively serious, Anhui must work hard to resolve this phenomenon. It turns out that large investments do not necessarily improve the efficiency of technology finance. According to the coefficient of variation method, the degree of coupling and coordination between Anhui's technology finance and advanced industrial structures has generally improved in recent years.

Based on the findings above, make the following recommendations:

First, the government actively invests in the establishment of funds or parent funds to guide private capital to technology enterprises, actively supports the development of technology finance, and fully plays a leading role. Pay attention to the transformation efficiency of regional scientific and technological achievements. Second, employ a variety of equity financing methods for technology companies. These include government support, technology loans, technology guarantees, equity investments, multi-level capital markets, technology insurance and technology leasing. Allocate R & D funds reasonably, and continuously train, recommend and promote scientific research talents. The flow of talent between regions has narrowed the differences in the level of development of technology finance between regions. Third, strengthen the synergistic effect of finance and technology, promote the improvement of rational and balanced industrial structure between regions through the development of high-tech industry, and realize the cooperative development of the three major industries.

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