

## Efficiency Analysis of Chinese Blockchain Concept Stock Listed Companies

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### Abstract

*With the continuous development and application of Internet technology, in recent years, new technologies such as cloud computing, big data, the Internet of Things, and AI are becoming more and more familiar to the general public. The development of a digital society has entered a new period of development. In this paper, we used on the 2018 annual data of 50 listed companies with blockchain concept stocks in China. Using data envelopment analysis (DEA) to study and analyze the input-output efficiency, it can be concluded that the input-output efficiency of 50 listed companies is very different. Inefficient companies are as high as 62%. Most companies have a large room for improvement in input-output efficiency due to uneconomical scale or inefficient technology. In order to better improve the company's input-output efficiency, one must improve the efficiency of resource utilization, optimize the company's research and development costs and the input and management of technical personnel; the second is to increase technological innovation and business innovation.*

**Keywords:** Blockchain Technology, Listed Company, DEA, Input-output Efficiency

### 1. Introduction

With the continuous development and application of Internet technology, in recent years, new technologies such as cloud computing, big data, the Internet of Things, AI, AR, and 5G are becoming more and more familiar to the general public. The development of the digital society has entered a brand-new Development period. Among them, blockchain technology has brought huge disruptive innovation and development opportunities to all walks of life, especially in the areas of supply chain, finance, anti-counterfeiting traceability, intellectual property, charity, games and other fields have been actively applied and developed. Then, with the continuous deep development of blockchain technology, various blockchain applications continue to run, various business models based on blockchain technology applications are constantly being explored and promoted.

The countries facing the blockchain industry Policies, industry standards, business models, government

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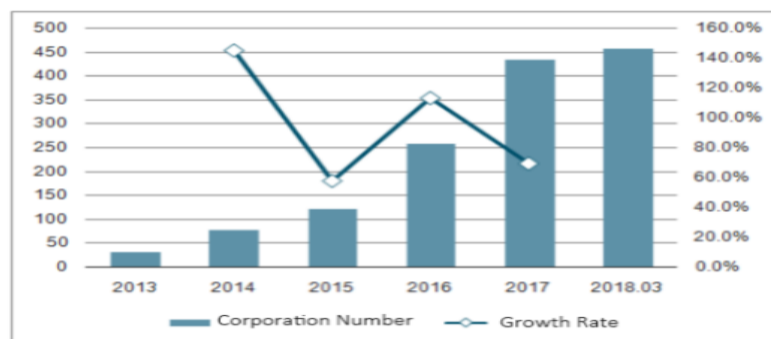
supervision, etc. all need to be constantly improved and adjusted. The input-output efficiency of listed companies with blockchain concept stocks is also greatly affected by the above factors. The official curtain on the development of blockchain technology started from "Bitcoin: A Peer-to-Peer Electronic Cash System" published by Satoshi Nakamoto in 2009 [1]. This paper describes in detail how to build a new, decentralized, point-to-point transaction system that does not require a trust foundation, and its feasibility has been proven by Bitcoin since 2009. The prominent advantage of blockchain technology lies in the decentralized design, It is a digital ledger system duplicated and distributed across the network of computer systems [2].

Through the use of encryption algorithms, time stamps, tree structures, consensus mechanisms, and reward mechanisms, the implementation of point-to-point based on decentralized credit in a distributed network where nodes do not need to trust Transaction [3]. The technology solves the problems of poor reliability, low security, high cost, and low efficiency in the current centralized model. With its own unique advantages, the blockchain has attracted a lot of attention, and related research and applications have a blowout trend for a while [4].

Blockchain technology is considered to be the fifth disruptive computing paradigm after mainframe computers, personal computers, the Internet, and mobile social networking. It is the fourth in the history of human credit evolution following blood relative credit, precious metal credit, and central bank note credit. Milestone [5]. The broad-based blockchain technology is expected to completely reshape human social activities and bring profound changes to the fields and industries of finance, technology, culture, politics, etc [6]. The blockchain technology would have a future impact on several industries including Banking, Healthcare, Real Estate, and Music [7].

Blockchain technology, as a decentralized, distributed, credible, immutable, and traceable public account book, has quickly become the underlying core technology in the fields of finance, anti-counterfeiting traceability, government affairs, privacy protection, etc. With the continuous popularization and application of chain technology, blockchain technology can form alliance chains between various industries in the future, so that the entire network data between various industries can be effectively and securely shared.

As the Chinese government holds a meeting at the highest level of the government on October 24, 2019, it emphasizes the need to use blockchain as an important breakthrough in independent innovation of core technologies, clarifies the main attack direction, increases investment, and strives to overcome a number of key core technologies. Accelerate the development of blockchain technology and industrial innovation [8]. Based on this more and more listed companies are increasing their efforts to develop their own company's blockchain technology, increasing the introduction and cultivation of blockchain technology talents, Continuously increase the company's technology research and development costs, constantly explore the application of blockchain technology in different industries, constantly research new technological achievements, and constantly explore business models that match the blockchain technology. As more and more companies continue to label the blockchain [9]. According to data, as of the end of March 2018, the number of my country's blockchain companies whose main business is blockchain has reached 456, the industry has initially formed a scale, and the number of newly established companies has reached 178, is shown in Figure 1.



**Figure 1. Number and growth rate of Chinese blockchain companies in 2013 ~ 2018.3**

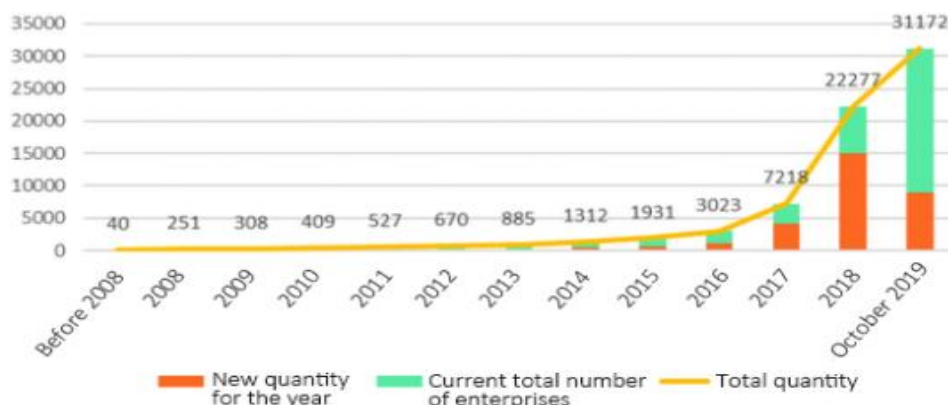
What are the input-output efficiencies, future development prospects, and how to improve the Chinese blockchain concept stock listed companies? And improvement, this is the content of the analysis and research focused in this article. This article selects the annual report data of 50 Chinese blockchain concept stock listed companies in 2018, uses the DEA method to analyze the input-output efficiency of 50 companies, objectively describes the actual input-output efficiency results of each company, and finally according to the empirical analysis results Put forward corresponding opinions and suggestions objectively.

## 2. Previous Research

As the underlying core technology of digital currencies such as Bitcoin and Ethereum, Bitcoin is the first application of blockchain technology. From the perspective of the application of blockchain technology, blockchain technology can be divided into three stages: the first stage is Bitcoin, which is a set of ledger system and currency issuance mechanism, and does not support other application development; the second stage is Ether Fang, Ethereum has added a smart contract mechanism on the basis of improving the Bitcoin block [10].

Everyone can develop applications on it, which is essentially a robust and secure distributed state machine. Typical technical components include Consensus algorithms, peer-to-peer communication, cryptography, database technology, and virtual machines. The five essential core capabilities are data storage, data sharing, distributed, anti-tampering and privacy protection, and digital contracts. The third phase is similar to the expansion phase of Ethereum, and the blockchain will complete the exchange of value.

According to incomplete statistics, as of the end of October 2019, there were a total of 31,172 companies across the country with the words "blockchain" in their names (including previous names), business scope or product information (names). However, after further statistical screening of the data, it was found that, as of October 2019, there were about 1,000 companies that actually conducted blockchain business or focused on blockchain in China, of which two batches of blockchain information services were conducted through the Internet letter There are nearly 400 companies on file, is shown in Figure 2.



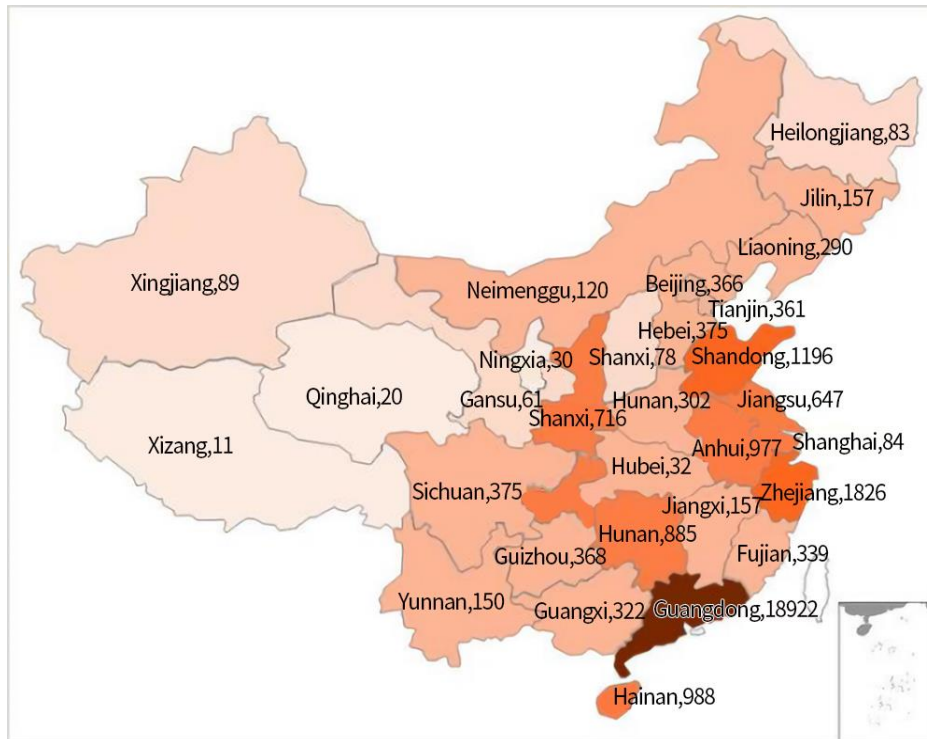
**Figure 2. Number of registered blockchain companies in 2008-2019**

The number of Chinese blockchain companies has been concentrated since 2017, and after analysis, it has basically benefited from: the blockchain technology has gradually improved and the market ecology has become increasingly mature; the fiery currency market has attracted many early participants; traditional Internet giants and the regular army have entered Market, deepening the social acceptance of the blockchain; and policy support for blockchain technology.

At present, Chinese blockchain companies are mainly small and medium-sized companies, with registered

capital generally in the millions and tens of millions. The number of companies with a registered capital of over 100 million is close to 1,000, accounting for only 3.27%.

The agglomeration effect of the blockchain industry has begun to appear. Guangdong Province has become the main location for the registration of Chinese blockchain-related companies, and the Yangtze River Delta, the Pearl River Delta, and Shaanxi, Hunan and Chongqing are becoming the main gathering areas for Chinese blockchain companies. is shown in Figure 3.

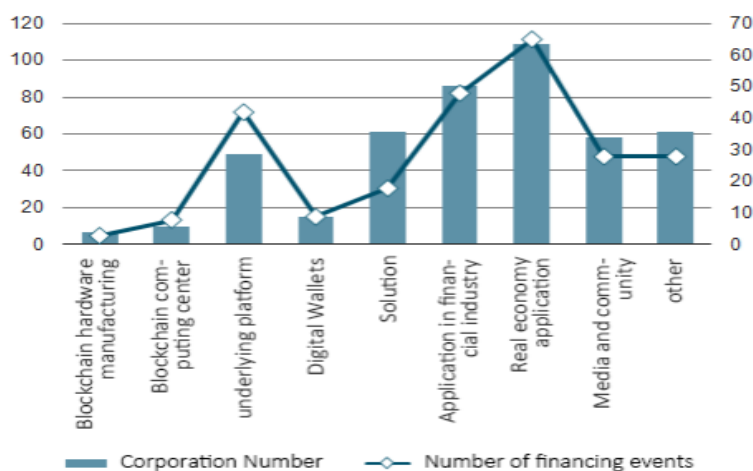


**Figure 3. Distribution of blockchain companies**

At present, China's blockchain companies are mainly engaged in the research and development of blockchain technology, and there are relatively few service companies such as research, consulting and investment. There are about 250 companies that directly mention "digital currency" in their business scope.

At the same time, the integration of blockchain with new technologies such as artificial intelligence and the Internet of Things continuously expands new space for technology applications, further releasing the vitality of innovation and entrepreneurship. The development of artificial intelligence must be based on massive big data, and the blockchain can ensure the security and credibility of the data. Once the two are deeply combined, more new applications can be created, a secure intelligent learning environment, an organization with a higher level of intelligent manufacturing and intelligent management, and a wider range of intelligent applications can be provided. The new companies in the blockchain industry cover multiple fields, reflecting the diversified application of blockchain technology.

In 2018, the number of industrial application companies in the blockchain field was the largest, of which 86 companies served the financial industry and 109 companies served the real economy. In addition, the number of related companies in the field of blockchain solutions, underlying platforms, blockchain media, and communities are all over 40, is shown in Figure 4.



**Figure 4. Number of companies and financing events in China's blockchain industry segment in 2018**

### 3. Research Method

#### 3.1 DEA Model

In this paper, data envelopment analysis (DEA) with variable returns to scale is used to analyze and study the sample data [11]. This method is a new field in the cross research of operations research, management science and mathematical economics [12]. It is a quantitative analysis method based on multiple input indicators and multiple output indicators, using linear programming to evaluate the relative effectiveness of comparable units of the same type [13]. DEA method and its model have been widely used in different industries and departments since 1978 by the famous American operations researcher A.Charnes and W.W.Cooper, and are used to deal with multi-indicator input and multi-indicator output.

The DEA analysis method uses mathematical programming (including linear programming, multi-objective programming, generalized optimization with a cone structure, semi-infinite programming, random programming, etc.) to evaluate research objects with multiple inputs and multiple outputs. It is called relative effectiveness among Decision Making Units [14]. Judging whether the DEA is valid according to the data observed on each DMU is essentially judging whether it is located on the "production frontier" of the production possible set.

The frontier of production is a generalization of the production function to multiple output situations in economics. The DEA method and model can be used to determine the structure, characteristics, and construction methods of the production frontier. Therefore, DEA can be regarded as a non-parametric statistical estimation method: Because DEA has a certain economic background, it is The theory can directly use input and output data to build non-parametric models for economic analysis [15].

When DEA is used to evaluate the efficiency of DMU, a lot of economic management information can be obtained. At present, the DEA method has become a commonly used analysis tool and method in the fields of management science, systems engineering, decision analysis, and evaluation technology at home and abroad. The regional economic system is a multi-input, multi-output production system. Therefore, to evaluate its operating efficiency, multiple outputs should be compared with multiple inputs, and its overall efficiency should be considered [16].

In addition, efficiency is a relative concept. Only through a horizontal comparison of several units can we really explain the level of efficiency. Assume that the model has  $m$  decision-making units (DMUs), each of which has  $n$  input elements and  $k$  output elements. The input-output efficiency is 50 listed companies, and the

input-output efficiency is 50. The comprehensive reflection of the company's technical efficiency  $O_n^*$ , pure technical efficiency  $T_n^*$ , and scale efficiency  $C_n^*$ , where technical efficiency is related to pure technical efficiency and scale efficiency, and the equation (1) for calculating technical efficiency is:

$$O_n^* = C_n^* \times T_n^* \tag{1}$$

For the same company, if the input-output efficiency values of CRS and VRS are different, it is said that the company has scale inefficiency. A case of single input and single output is used to illustrate the calculation process of scale inefficiency. The frontiers of DEA with constant returns to scale and variable returns to scale can be shown in Figure 5.

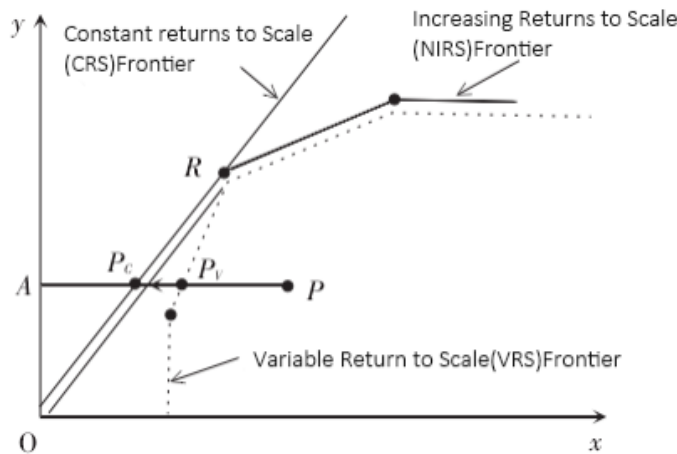


Figure 5. Principles of scale efficiency in DEA

In the case of constant return to scale, the technical inefficiency of point P for input is P; in the case of variable return to scale, the technical inefficiency is P. All measured values are in the range of 0 ~ 1, and Therefore, the measurement of technical efficiency with constant returns to scale is decomposed into two parts: pure technical efficiency and scale efficiency [17]. Scale efficiency can be roughly expressed by the ratio of the average output of the company at the PV point and the average output of the (technical) optimal scale point R. Assuming each blockchain concept stock company has n input indicators and k output indicators, the model is established as shown in equation (2):

$$\begin{aligned} & \text{Main} \theta \\ & s \cdot t \cdot \begin{cases} \sum_{j=1}^m \lambda_j x_{ij} + S_i^- = \theta x_{i0}, i = 1, 2, \dots, n \\ \sum_{j=1}^m \lambda_j x_{hj} + S_i^+ = y_{h0}, h = 1, 2, \dots, k \\ \sum_{j=1}^m \lambda_j = 1 \\ \lambda_j, S_i^-, S_i^+ \geq 0 \end{cases} \end{aligned} \tag{2}$$

In equation (2), x is the input variable, y is the output variable, m is the number of decision units,  $\lambda_j$  is the combination ratio of the jth blockchain concept stock listed company relative to DMU  $j_0$ ,  $S^-$  is the input relaxation variable, and  $S^+$  To produce the residual variable (radial variable),  $\theta$  is the effective value of decision unit DMU  $j_0$ .

The input-output efficiency of listed companies in the blockchain concept stocks is a multi-dimensional and complex system with multiple inputs and multiple outputs, including total assets of various types, main business costs, main business income, technical personnel, research and development costs, investment income, and more Comprehensive data indicators. There are various evaluation index systems constructed, and the selection of indicators needs to be combined with the purpose of efficiency analysis. In addition, the

availability of data must be considered. Is shown in Table 1. The decision unit of this article selects the company's annual statements and data of some of the listed blockchain concept stock companies in Sina Finance in 2018 (50).

**Table 1. Input and output indicators of listed companies with blockchain concept stocks**

	Index	Unit	Description	Remark
Input	Total assets	Yuan	Total assets refer to all assets owned or controlled by an economic entity that bring economic benefits	x1
	Technical staff	Number	The company's R & D personnel	x2
	R&D expenses	Yuan	Comprehensive R & D personnel	x3
	Main business cost	Yuan	The main business cost is the cost incurred by the company in selling regular goods and providing labor services.	x4
Output	Main business income	Yuan	Main business income refers to the operating income obtained by the company from its production and operation activities in the industry.	y1
	Investment income	Yuan	Investment income refers to the income from the company's external investment (the losses incurred are negative), such as the company's external investment to obtain dividend income, bond interest income and profits from joint ventures with other units.	y2
	ROE	%	Return on Equity (ROE), is the percentage of net profit to average shareholder equity and is the company's tax Percentage of net profit divided by net assets.	y3

#### 4. Empirical Analysis

The relevant input and output data in the annual statements of the 50 A-share listed blockchain concept stock companies in China used in this study in 2018 are shown in Table 2. The analysis results using the DEA method show that 31 companies had low input-output efficiency in 2018, accounting for 62% of the entire analysis data; 19 companies had input-output efficiency that met the standards, accounting for 38% of the entire analysis data. In 62% of companies with low efficiency, there are cases of excessive scale, inefficient technology, unreasonable staffing, and unreasonable use of research and development costs.

Among them, the efficiency of JIN YI KE JI([www.genvict.com](http://www.genvict.com)) is low, and the scale of the company is inefficient. It needs to be adjusted to reduce the scale by 18.396%. The technical staff of the company is too bloated, which results in low technical efficiency and low conversion rate of technical results. It is necessary to optimize the deployment of technical staff to reduce 18.396 % Technical staffing, the company's R & D expenses also need to be adjusted down 18.396%, etc. For the problems of the above JIN YI KE JI([www.genvict.com](http://www.genvict.com)), you can refer to SI FANG JING CHUANG([www.formssi.com](http://www.formssi.com)), HENG SHENG DIAN ZI([www.hundsun.com](http://www.hundsun.com)), JU REN WANG LUO([www.ga-me.com](http://www.ga-me.com)), XIN HUA WEN XUAN([www.winxuan.com](http://www.winxuan.com)), HAO YUN KE JI([www.haoyuntech.com](http://www.haoyuntech.com)) companies that meet the efficiency value standards learn other aspects of scale configuration, technical staffing, and R & D costs. Has reached to improve and optimize technical efficiency and scale efficiency.

Among them, the efficiency of HAN WEI KE JI([www.hanwei.cn](http://www.hanwei.cn)) is low, and the scale of the company is inefficient. It needs to be adjusted to reduce the scale by 26.406%. The technical staff of the company is very bloated, which causes severe technical inefficiency. It is necessary to optimize the configuration of technical staff to improve technical efficiency and reduce 34.73% Technical staffing, the company's R & D expenses also need to be adjusted down by 26.406%, etc. For the problems with the above HAN WEI KE JI([www.hanwei.cn](http://www.hanwei.cn)), you can refer to the efficiency values of REN MIN WANG([www.people.com.cn](http://www.people.com.cn)), YONG YOU WANG LUO([www.yonyou.com](http://www.yonyou.com)), XIN HUA WEN XUAN([www.winxuan.com](http://www.winxuan.com)), SHI JUE ZHONG

GUO(www.vcg.com). Companies to learn other aspects of scale, technical staffing, and R & D costs. Has reached to improve and optimize technical efficiency and scale efficiency.

**Table 2. Input-output effectiveness results**

Delimitation	Input				Output		
	Total assets	Technical staff	R&D expenses	Main business cost	Main business income	Investment income	Roe ( % )
Max	48559578286	14505	3322664182	36365157948	46579327313	812526935.3	19.83
Min	943820410.8	13	727422.96	76152585.29	295522213.4	533655.37	0.33
Average	6187836930	2114.18	255234611.4	2658705369	3707570640	64287728.84	7.779926
SD	8008113996	2697.385028	519541213.7	5813531680	7169133337	123328997.4	4.478912498
Correlation							
	Total assets	Technical staff	R&D expenses	Main business cost	Main business income	Investment income	Roe ( % )
Total assets	1	0.310258266	0.77059891	0.934897026	0.955525152	0.310146609	0.025668173
Technical staff	0.310258266	1	0.450868771	0.283391084	0.322237024	0.18502072	0.316946728
R&D expenses	0.77059891	0.450868771	1	0.727944164	0.802045008	0.341788557	0.204131233
Main business cost	0.934897026	0.283391084	0.727944164	1	0.990910564	0.254602266	-0.039701126
Main business income	0.955525152	0.322237024	0.802045008	0.990910564	1	0.277575095	0.013193742
Investment income	0.310146609	0.18502072	0.341788557	0.254602266	0.277575095	1	0.281997947
Roe(%)	0.025668173	0.316946728	0.204131233	-0.039701126	0.013193742	0.281997947	1

Among them, the efficiency of RUN HE RUAN JIAN(www.hoperun.com) is relatively low, and the scale of the company is inefficient, and the scale needs to be adjusted to reduce it by 26.014%; the technical staff of the company is very bloated, which causes severe technical inefficiency, and it is necessary to optimize the configuration of technical personnel to improve technical efficiency and reduce 90.859% Technical staffing, the company's R & D expenses also need to be adjusted down by 26.014%, etc. For problems with the above RUN HE RUAN JIAN(www.hoperun.com), you can refer to YONG YOU WANG LUO(www.yonyou.com), XIN HUA WEN XUAN(www.winxuan.com), SHI JUE ZHONG GUO(www.vcg.com), these companies with efficiency values that meet the standards, learn Other aspects of scale allocation, technical personnel allocation and R & D expenses. Has reached to improve and optimize technical efficiency and scale efficiency.

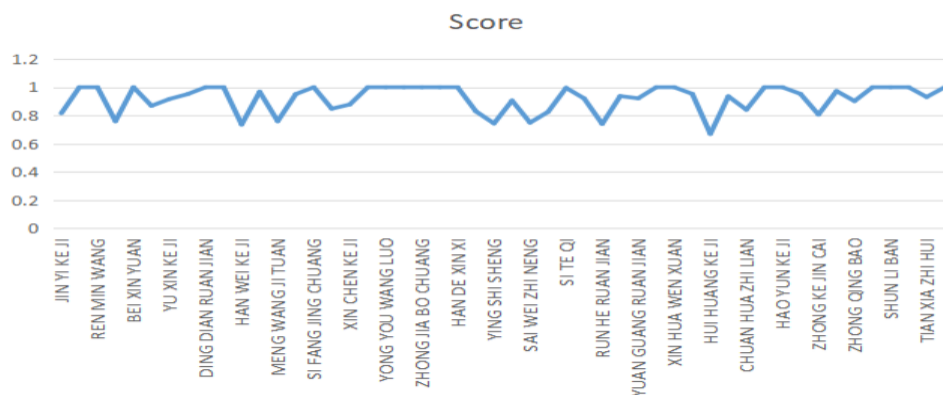
Among them, the efficiency of HUA YU RUAN JIAN(www.thunisoft.com) company is low, the company's scale efficiency is low, and the scale needs to be adjusted to reduce 13.173%; the company's technical staff is too bloated, resulting in low technical efficiency and low conversion rate of technical results. It is necessary to optimize the deployment of technical staff and reduce 67.267 % Technical staffing, company R & D expenses also need to be adjusted down by 13.173%, etc. For the problems of HUA YU RUAN JIAN(www.thunisoft.com) above, you can refer to BO SI RUAN JIAN(www.bosssoft.com.cn), YONG YOU WANG LUO(www.yonyou.com), SHI JUE ZHONG GUO(www.vcg.com), etc. Learn other aspects of scale configuration, technical staffing, and R & D costs. Has reached to improve and optimize technical efficiency and scale efficiency. Please refer to Table 3 for the above data.



**Table 3. Overview of Input-output efficiency**

DMU	Score	DMU	Score
JIN YI KE JI	0.816	HUA RUAN KE JI	0.9053
ZHONG GUO CHANG CHENG	1	SAI WEI ZHI NENG	0.7492
REN MIN WANG	1	GUANG HUAN XIN WANG	0.8253
MENG WANG JI TUAN	0.7592	SI TE QI	0.9955
BEI XIN YUAN	1	CHANG SHAN BEI MING	0.9202
HUA YU RUAN JIAN	0.8683	RUN HE RUAN JIAN	0.7399
YU XIN KE JI	0.9166	CHUANG WEI SHU ZI	0.937
BO YAN KE JI	0.9508	YUAN GUANG RUAN JIAN	0.9213
DING DIAN RUAN JIAN	1	AN NI GU FEN	1
BO SI RUAN JIAN	1	XIN HUA WEN XUAN	1
HAN WEI KE JI	0.7359	FEI TIAN CHENG XIN	0.9526
LANG XIN KE JI	0.9675	HUI HUANG KE JI	0.6695
MENG WANG JI TUAN	0.7592	XIN KAI PU	0.9353
XIN XI FA ZHAN	0.9509	CHUAN HUA ZHI LIAN	0.8407
SI FANG JING CHUANG	1	NAN WEI RUAN JIAN	1
WAN DA XIN XI	0.8477	HAO YUN KE JI	1
XIN CHEN KE JI	0.8777	FEI TIAN CHENG XIN	0.9526
XIN YA DA	1	ZHONG KE JIN CAI	0.8063
YONG YOU WANG LUO	1	ZI GUANG GU FEN	0.9727
HENG SHENG DIAN ZI	1	ZHONG QING BAO	0.9021
ZHONG JIA BO CHUANG	1	KE DA GU FEN	1
JU REN WANG LUO	1	SHUN LI BAN	1
HAN DE XIN XI	0.9967	SHI JUE ZHONG GUO	1
YI LIAN ZHONG	0.8284	TIAN XIA ZHI HUI	0.9306
YING SHI SHENG	0.7436	HE REN KE JI	1

Based on the above analysis of the sample data of 50 listed companies, 62% of the companies have failed to meet the technical efficiency requirements, and the technical efficiency is relatively low, indicating that their investment resources have not reached the optimal state. Inefficiency. However, 38% of the companies are efficient. The company's technical efficiency is relatively good, and the efficiency value reaches 1. is shown in Figure 6.



**Figure 6. Overview of input-output performance**

Among them, 62% of inefficient companies have too bloated technical staff and too high R & D costs, but the technical results are not obvious, resulting in lower output income. This is also related to the development and current status of blockchain technology because of the lack of National standards and industry standards, the entire application of blockchain technology is still in the initial development stage, and are constantly exploring and trying.

From the perspective of the Chinese government, we must attach great importance to policy integration and supervision. Blockchain technology, as the technology with the broadest current research, application and investment prospects in China, will definitely face various obstacles in the process of its development. Without the support of substantial policies and cooperation efforts in various aspects, the blockchain The leap from technology to the digital economy will be difficult to achieve, so it is necessary to strengthen the supervision of listed companies in the concept block section of the blockchain. If the definition of the concept block of the blockchain is more clear, the regulation of listed companies in this sector is more stringent, and the listed companies in the sector are more active in adjusting their own input-output efficiency. It is even more worth looking forward to, which can effectively promote the improvement of the company's input-output efficiency.

## 5. Conclusions and Discussions

In this paper, the empirical analysis of the above data shows, we know these company needs to improve the utilization efficiency of comprehensive resources, optimize the allocation of technical personnel, optimize the allocation of company assets, improve the company's technical efficiency, vigorously increase technological innovation, strengthen the transformation of technological achievements, and make more differences Explore and practice blockchain applications in the field, strengthen exchanges with governments and industries, and explore and practice different business models.

Blockchain technology and business innovation are the core strengths of future digital socio-economic development. Companies should effectively promote the application and development of blockchain technology in accordance with unified national standards, industry standards and their own business scope. The company grows in a multi-dimensional and complex environment system. It must improve its operating conditions from the scale of the company based on its grasp of market changes, analysis of future prospects, and judgment of its own conditions. The central focus is to reduce the investment in total assets to improve the efficiency of economies of scale; in technology research and development, increase technological innovation, strengthen the transformation of technological achievements, and optimize staffing to improve technological efficiency.

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