Analysis of the Operating Efficiency of China's Securities Companies based on DEA Method

Wei Huang [a], Qiancheng Guan [b], Hui Zhao [a]*

[a] School of Economics and Management Beijing Jiaotong University, China
[b] School of Marxism Minzu University of China, China
[c] School of Economics and Management Beijing Jiaotong University, China
[*] Corresponding author: Wei Huang, Master, huangweiuu@126.com

Abstract

Based on 20 listed securities companies between 2013 and 2015, this paper takes Data Envelopment Analysis (DEA) as foundation to study the technical efficiency (TE) and pure technical efficiency (PTE) by using CCR and BCC model. The research shows that the value of TE and PTE of securities companies have been rising, and the differences between operating efficiency of securities companies are narrowing as time goes on. CITIC and SDIC have the highest level of PTE, whose returns to scale remain stable in recent three years.

Keywords: securities company; DEA method; operating efficiency; technical efficiency; pure technical efficiency

1 Introduction

Securities market has played an important role in optimizing the allocation of resources. The level of operating efficiency of Securities companies directly affects the quality servicing clients. Therefore, by studying its level of operating efficiency, we can analyze factors which determine it, and it's significant to help China's securities companies to develop healthily.

In the context of the current literature, there are lots of researches using data envelopment analysis (DEA) method to analyze financial institutions. Many researchers used the BCC and CCR model to calculate the value of TE and PTE. Wang Hong-li, Bai Bin, Li Huai-yu (2013)[1] used the CCR model to evaluate them, then ordered them based on their numerical value. Chen Fang-pin, Xi Bin (2011)[2] calculated NIRS efficiency and super efficiency besides calculating the value of PTE, TE and SE.

In addition to using CCR and BCC model, some scholars also used Malmquist index of total factor productivity to analyze panel data. While Wang Xiaofang, Cheng Kesheng (2009)[3] used the data of 32 major securities companies to calculate the value of TE of China's securities industry between 2004 and 2006. And they drew the conclusion although the overall efficiency level of China's securities industry was relatively low, the operating efficiency increased constantly. Li Lan-bing, Hu Jun-li, Huang Guo-zhang (2011)[4] used Tobit model to compare the

operating efficiency of Chinese Mainland's securities companies with those of Taiwan's. They concluded the key factor of influencing PTE were total assets liabilities ratio and GDP.

Besides calculating the value of TE and PTE, some researchers also used empirical approach to study the relationship between them. Huang Jian-huan, Wang Liang-jian (2011)[5] used empirical approach to research the relationship between efficiency of securities company and its influencing factor. Zhang Xue-tao, Liu Xi-hua, Li Min (2011)[6] not only researched the production efficiency, but also used clustering analysis methods to study it further. They concluded that production efficiency of the whole China securities industry was not high. The main factor which affected it was technology, and the condition had been improved.

To sum up, whether the operating efficiency of securities companies has been changed is unknown. Therefore, this article uses the BCC and CCR model to calculate the value of TE and PTE with the DEA method. After popularizing advanced experience, we hope China's securities companies can perform better, and securities market would improve its competitiveness.

2. DEA theory and its model

In 1978, Charnes, Cooper and Rhodes[7] put forward the first DEA model—CCR model which is based on the principle of constant returns to scale (CRS), then DEA method was developed rapidly. The initial research application was not perfect. After Banker et al.[8] built the CCR model in 1984, basing on the size of the variable remuneration, DEA model was used in all walks of life.

Using the DEA method to analyze production efficiency has several advantages. The DEA method can be used in the multiple-input and multiple-output context without the need of estimating the weights. And the relating weights is generated by mathematical programming without assigning them, free from the influence of subjective factors.

2.1 Input-oriented or output-oriented mode

In the measurement of operating efficiency, DEA model is mainly divided into input-oriented model and output-oriented model. From the perspective of input-oriented model, it is concerned that how much input we can reduce to make technology effective under the circumstances of keeping the output same. On the contrary, the output-oriented model pays attention to increasing how much output with keeping the input same.

What determines the choice not only depends on the purpose of the research, but also the ability to control input or output. Most researchers tend to choose input-oriented model, because it's easier to control the input variables than output variables. So this paper follows the trend.

2.2 CCR and BCC model

Supposing there are several decision making units (DMUs), each DMU has several kinds of inputs which are denoted x_i(i=1,2, …,m), and its weight is expressed as v_i(i=1,2, …,m).

Similarly, the DMUs also have several kinds of inputs which are denoted y_r (r=1,2, …,q), and its weight is expressed as u_r （r=1,2, …,q）. In the measurement of operating efficiency, by using a ratio to build the model is an intuitive form, we can calculate the ratio of output to input. In the case of CRS，we can get the technical efficiency through the following optimizing model.

$$\text{Max} \quad \frac{\sum_{r=1}^{q} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \tag{1}$$

$$\text{s.t.} \quad \frac{\sum_{r=1}^{q} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1$$

$$v \geq 0, u \geq 0$$

$$i=1,2 …, m; r=1, 2, …, q; j=1, 2, …n$$

The hypothesis of CCR model is the CRS. But in fact, the returns to scale may also be variable. So in 1984, Banker, Charnes and Cooper calculate the value of PTE, excluding the impact of scale efficiency (SE). The PTE is represented as efficiency due to technical factors. We can turn CCR model into BCC model by increasing the convexity assumptions.

$$\text{Max} \ \varphi \tag{2}$$

$$\text{s.t.} \quad \sum_{j=1}^{n} \lambda_j x_{ij} \leq x_{ik}$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq \varphi y_{rk}$$

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

$$\lambda \geq 0$$

$$i=1, 2, …, m; r=1, 2, …, q; j=1, 2, …n$$

3 Empirical research

3.1 Data

Compared with non-listed securities companies, financial statements of listed securities companies are audited, which are more objective and credible. So this paper chooses the 20 listed securities companies, between 2013 and 2015, of CSMAR Solution as study samples, and the securities companies are as follows in table 1.

Table 1–The name of choosing securities companies

Northeast	GF	CITIC	Haitong	Soochow
Golden Dragon	Changjiang	SDIC	China Merchants	Huatai
Guoyuan	Shanxi	Sinolink	Pacific	Everbright
Sealand	Western	Southwest	Industrial	Founder

3.2 Variables selection

This paper draws on the experience of production function, namely, $Q = f(L, K)$, Q is the quantity, L is labour, K is capital. The production function indicates that labor and capital are the two main input factors in the economical production. The table 2 lists out the input and output variables which Chinese researchers choose for analyzing the operating efficiency.

Table 2 – The input and output variables by Chinese researchers

Researchers	Input variables	Output variables
Wang Xiaofang, Cheng Kesheng (2009)	total value of fixed assets, payroll payable	operation revenue
Li Lan-bing, Hu Jun-li, Huang Guo-zhang (2011)	stockholders' equity, operating expenses	brokerage revenue, underwriting revenue, underwriting revenue
Zhang Xue-tao, Liu Xi-hua, Li Min (2011)	operating expenses, gross payroll	operation revenue, trading volume
Chen Fang-pin, Xi Bin (2011)	registered capital, numbers of business department, operating expenses	net brokerage revenue, underwriting revenue, net revenue, income from investment
Wang Hong-li, Bai Bin, Li Huai-yu (2009)	number of employees,registered capital, total assets, trust assets	operation revenue net income

So this paper chooses the accounting item—accrued payroll and owner's equity to be input variables. Different from manufacturing industry, the securities industry is a service industry, it doesn't have the tangible product. So it's difficult to work out the output. Meanwhile, gross revenue is the economic interests which is formed from the daily operative activity, and it is the representation of operating results. Therefore, this article chooses the gross revenue as output elements.

3.3 The descriptive statistical analysis

Table 3 – Descriptive statistics of the 20 securities companies from 2013–2015

Year	TE			PTE		
	Mean	Standard deviation	Minimum	Mean	Standard deviation	Minimum
2013	0.09	0.21	0.02	0.34	0.37	0.04
2014	0.74	0.19	0.43	0.84	0.20	0.44
2015	0.77	0.15	0.54	0.89	0.13	0.60

According to the data in the table 3, in 2013 the mean and minimum were 0.09 and 0.34

respectively, and its standard deviation was the most maximal in the three years. This showed that in this year the managerial and administrative expertise of securities companies was not high, and the difference among the securities companies was particularly large. In 2013, the mean of PTE was lower than 0.4, indicating it's possible that cost reduction can be achieved by decreasing the unnecessary inputs. In addition, from 2013 to 2014, the reason why the mean and minimum of the two indicators increased greatly was that securities companies in 2014 achieved significant progress by building comprehensive network services platform, reducing artificial cost, optimizing the structure of revenue, under the background of great development in the mobile Internet.
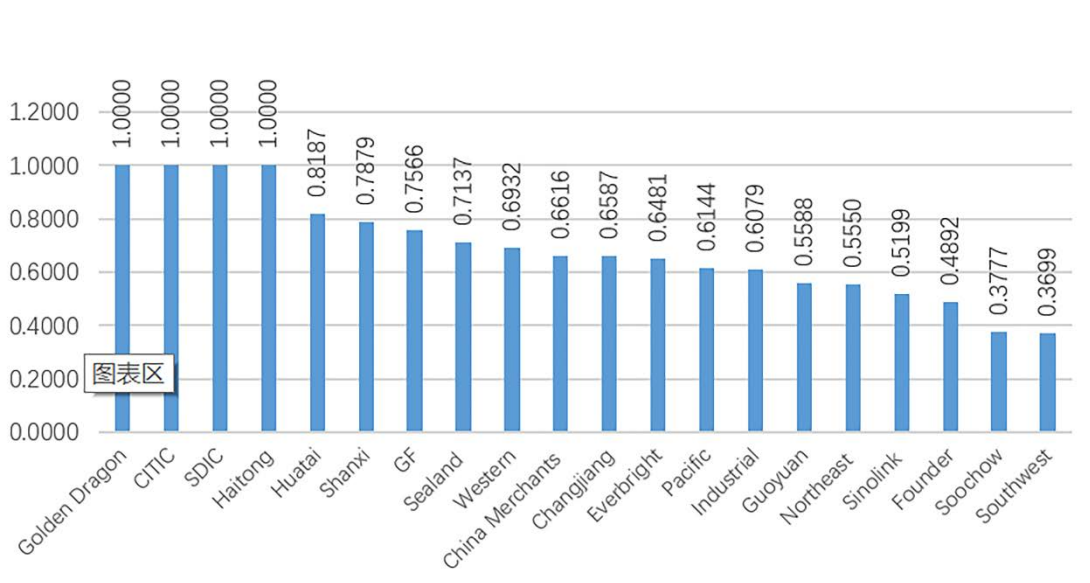

Fig. 1 – The average value of PTE of 20 securities companies between 2013 and 2015

As shown in the figure 1, the mean of PTE of CITIC, Haitong, Golden Dragon and SDIC were both 1, in a fully active state, having obvious advantages. This showed that the four brokerages had strict risk management mechanism and effective resource allocation mechanism in business activities, which made the human capital investment and investment function effectively. The mean of PTE of Huatai was in the range of 0.8 to 1.0. And there were 9 securities companies whose mean of PTE were in the range of 0.6 to 0.8, such as Shanxi, Industrial and so on. The mean of Southwest's PTE was the lowest–0.3699 in the 20 companies. The mean of PTE reflected the level of company's management, and it's also a measurement of the ability for operating continuously. The low value of PTE of Southwest reflected the management ability could be improved by strengthening its marketing ability and internal management.

4 Conclusions

Using the DEA approach, we investigate the operating efficiency of the China's securities companies between 2013 and 2015. The results show that Chinese securities is generally inefficient. But the value of PTE is increasing year by year. The overall level of TE is increased

by leaps and bounds with the difference in the respective securities companies reducing. Finally, there are 4 securities companies whose value of PTE is the highest.

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