Analysis of Operational Efficiency of Listed Companies in the Internet Financial Sector-based on Data Envelopment Analysis

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ABSTRACT

The emergence of the Internet financial model has enabled financial services to benefit thousands of civilians, and has also given rise to a large number of Internet financial enterprises with low operating costs, high efficiency and rapid development. As the supply-side structural reforms continue to advance in depth, the Internet financial industry will carry more reform missions, and will also have excellent development opportunities. The Internet financial enterprises developed under different backgrounds have great differences in their business models and operating methods. Therefore, their operating performance will be very different. It is of great significance to conduct comparative studies on the operational efficiency of different types of Internet finance companies. This paper uses Data Envelopment Analysis (DEA) to analyze the operational efficiency of listed companies in the Internet financial sector, in order to provide the basis for them to optimize the resource allocation, enhance the operation efficiency and explore profitability. The results show that the overall operational efficiency of the Internet financial enterprises is relatively high, but the efficiency gaps between different companies are obvious. Inefficient scale is the main reason leading to low operational efficiency. The Internet financial enterprises should focus on exploring strategies for improving operational efficiency from the perspective of economies of scale management. 1

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INTRODUCTION

With the outbreak of the information technology revolution, the Internet has entered a period of rapid development. A large number of complex scientific and technological information penetrated into the traditional financial industry, forming a new financial innovation model: Internet finance. Internet finance refers to a new type of financial business model in which traditional financial institutions and Internet companies use the Internet technology and information and communication technologies to realize financing services, payment, investment and information intermediary services. The emergence of the Internet financial model has provided a trading environment with low barriers to entry, convenient payment and low information asymmetry for both sides of the transaction, which greatly reduces the transaction cost and improves the efficiency of the allocation of resources. The existing Internet financial models mainly include: Crowd funding, P2P online lending, third-party payment platform, digital currency and so on.

The emergence of Internet financial mode has made financial services more popular among the civilian population, and has also produced a large number of Internet financial enterprises. These enterprises have common points of low operating cost, high efficiency, wide coverage and rapid development, but due to the different development modes, the profitability methods are also different. How to effectively adjust the income structure, enhance their own capital management capabilities, and develop suitable operating methods are all worthy of consideration for Internet finance enterprises.

This paper uses data envelopment analysis (DEA) to analyze the operating efficiency of the listed companies of the Internet financial sector, in order to provide a basis for them to optimize the allocation of resources, improve the operation efficiency and exploit the way of profit making.

LITERATURE REVIEW

At present, few domestic scholars have studied the operational efficiency of Internet financial enterprises, and the related research on Internet finance mainly focuses on two aspects: the development trend of Internet Finance and the impact on the traditional financial models. Among them, Xie Ping and Zou Chuanwei [1] put forward the concept of "Internet financial model" for the first time. They believe that the Internet financial model is a direct financing way of large information, low cost and high efficiency compared to indirect financing of commercial banks and direct financing of capital markets. Li Yuanbo, Zhu Shunlin [4] pointed out that the integration of the development of tasks on the offline line has brought a greater impact on the traditional financial industry. Wang Guogang and Zhang Yang [2] believe that Internet finance cannot replace the traditional financial industry. Its development only utilizes the defects of China's financial system. Short-term arbitrage cannot become the mainstream mode of operation of finance. Cao Fengyi
[3] believes that commercial banks should use their existing resource advantages, such as customers, networks, and sound credit systems, to actively change existing business models. Promote the marketization of traditional financial companies. Therefore, commercial banks should actively introduce Internet technology, develop and update their own systems in a timely manner, and continue to innovate their own service methods in order to face the enormous impact of Internet finance.

**METHODOLOGY**

**Data Sources**

In the Internet financial sector, 15 representative listed companies are selected as the research samples of this article. These 15 companies are Su Ningyun business, Oriental Wealth, ufu network, Hengsheng electronics, gold certificate stock, love construction group, Tong Shun, Shenzhen Huaqiang, win win, Huijin shares, security information and long software. China branch gold, 365 net, 2345. The accounting node is December 31, 2017.

On the basis of the previous related research and the requirements of data envelopment analysis for input-output data, this paper selects operating costs, current assets, fixed assets, payment to workers and cash paid for workers as input indicators, basic earnings per share, net profit, operating income and net operating cash flow. As an indicator of output.

**Model**

Data Envelopment Analysis (DEA) is an emerging theory developed by Farrel in 1957 and then subsequently studied and developed by operational research scientists A. Charenes, W.W. Cooper and E. Rhodes (1978). It is suitable for evaluating the relative efficiency of multiple decision making units (DMUs) with multiple inputs and multiple outputs.

| category       | Index name                                                                 |
|----------------|-----------------------------------------------------------------------------|
| Input index    | Operating costs, current assets, fixed assets, Cash paid to employees and for employees |
| Output index   | Basic earnings per share, net profit, Net operating income and operating cash flow |

**CCR model**

A. Chames, W.W. Cooper, and E. Rhodes three scholars (1978) proposed the first DEA model, CCR model, which assumed the same scale return (Constant
Returns to Scale, for short, CRS). In the CCR model, there are \( n \) decision units with similar production conditions. Each decision unit makes use of \( M \) input elements to produce \( s \) products, so the input and output vectors of the \( K \) decision unit are respectively:

Input vector:

\[
X_k = (x_{1k}, x_{2k}, ..., x_{mk})^T > 0 \quad (k = 1, 2, ..., n)
\]

Output vector:

\[
Y_k = (y_{1k}, y_{2k}, ..., y_{sk})^T > 0 \quad (k = 1, 2, ..., n)
\]

The DEA method constructs a production frontier based on the best performing DMU, which envelopes all DMU observations on or in the production front. When evaluating different decision units, they are regarded as a production process with only one overall input vector and one overall output vector, giving each input-output indicator a certain weight.

\[
W = (w_1, w_2, ..., w_m)^T
\]

The weight vector of the output is:

\[
Q = (q_1, q_2, ..., q_s)^T
\]

Then the best weight vector is obtained by solving linear programming, which makes the evaluation efficiency the highest. evaluation efficiency the highest.

\[
\begin{align*}
\max & \quad \frac{\sum_{r=1}^{s} q_r y_{rk}}{\sum_{i=1}^{m} w_i x_{ik}} \\
\text{s. t.} & \quad \frac{\sum_{r=1}^{s} q_r y_{rk}}{\sum_{i=1}^{m} w_i x_{ik}} \leq 1 \\
& \quad q_r \geq 0 \quad r = 1, 2, ..., s \\
& \quad w_i \geq 0 \quad i = 1, 2, ..., m
\end{align*}
\]

Using Charnes & Cooper (1962) for Charnes & Cooper transformation of fractional programming, this fractional programming problem can be transformed into a linear programming problem.
\[
g = \frac{1}{W^T X}
\]
\[
\alpha = gW
\]
\[
\beta = gQ
\]

We get the following linear programming model:

\[
\begin{align*}
\text{max} & \quad \beta^T Y_k \\
\text{s.t.} & \quad \alpha^T X_j - \beta^T Y_j \geq 0, j = 1,2, \ldots, n \\
& \quad \alpha^T X_k = 1
\end{align*}
\] (2)

Its dual plan is as follows:

\[
\begin{align*}
\text{min} & \quad \theta \\
\text{s.t.} & \quad \sum_{j=1}^{n} x_{ij} \lambda_j \leq \theta x_{ik}, \quad i = 1, \ldots, m, \\
& \quad \sum_{j=1}^{n} y_{rj} \lambda_j \geq y_{rk}, \quad r = 1, \ldots, s, \\
& \quad \lambda_j \geq 0, j = 1,2, \ldots, n
\end{align*}
\] (3)

Among them: the linear programming coefficient; the best obtained optimum theta is the technical efficiency value of the decision unit K, and 0 < theta < 1, and if theta =1, it means that the decision unit is located on the frontal surface and becomes a valid unit of DEA. If theta <1, it indicates that the decision unit is relatively in the DEA invalid state, and the input source has a waste phenomenon, or at the present time. Under input conditions, output can be increased by increasing the efficiency of input elements.

(1) Decomposition of BCC model and efficiency

The CCR model is based on the scale reward invariance hypothesis and does not consider the impact of scale factors.

If we want to eliminate the scale factor and measure the pure technical efficiency, we can add the constraint coefficient of linear programming coefficient on the technology of CCR model.

\[
\sum_{j=1}^{n} \lambda_j = 1,
\]

The variable model BCC is established. Its plan is as follows:

\[
\gamma^* = \text{min} \theta
\]
\[
\begin{align*}
\text{s. t.} \quad & \sum_{j=1}^{n} x_{ij} \lambda_j \leq \theta x_{ik}, \quad i = 1, \ldots, m, \\
& \sum_{j=1}^{n} y_{rj} \lambda_j \geq y_{rk}, \quad r = 1, \ldots, s, \\
& \sum_{j=1}^{n} \lambda_j = 1, \\
& \lambda_j \geq 0
\end{align*}
\]

Since technical efficiency (TE) includes pure technical efficiency (PTE) and scale efficiency (SE), the scale efficiency can be obtained through the ratio of the two, that is, after calculating the pure technical efficiency, the efficiency of technical efficiency can be obtained.

\[SE = \frac{TE}{PTE}\] (5)

The pure technical efficiency is to measure the management, innovation ability and the efficiency of the system design and execution. The scale efficiency can reflect whether the current production is at the optimal scale and how far from the optimal size. By combining the CCR model with the BCC model to decompose the efficiency, it is more accurate to find out the efficiency of the decision unit in the process of efficiency evaluation.

**ANALYSIS AND DISCUSSION**

Using deap2.1 software and selecting two models of CCR and BCC, the comprehensive efficiency (TE), pure technical efficiency (PTE) and scale efficiency (SE) of the listed companies of 15 Internet Financial plates are obtained respectively, and the scale reward state of each decision unit. The following will be discussed in detail.

**Comprehensive Efficiency (TE) Analysis**

Through the empirical test, it is found that 9 out of the 15 companies are effective in DEA. Relatively speaking, these 9 companies have high overall business performance. They are in the leading position in both industry management and scale economies. The remaining 6 companies failed to achieve DEA effectiveness, varying degrees of efficiency loss. The score of Shenzhen Huaqiang comprehensive efficiency is 0.993, indicating that the relative strength of benchmarking companies
in Shenzhen Huaqiang has 0.7% of the operational efficiency. We have noticed that the three companies of annux information, long software and UFIDA had low score of comprehensive efficiency, and there was room for efficiency improvement from 35% to 40%. Using the UF network as an example, the efficiency score is 0.592. The enterprise can improve the operation efficiency by raising the management level and the scale control ability by 41.8 percentage points, that is, it can save 41.8% of the cost under the condition of the same output, or increase the output of 41.8% in the case of the same input.

Through the analysis, it can be seen that the Internet financial enterprises have high overall operating performance because of their involvement in the Internet. However there is a big gap between the management performance of different companies because of management and industrial categories.

**Pure Technical Efficiency (PTE) Analysis**

The pure technical efficiency results of the sample companies show that 13 companies have a pure technical efficiency score of 1, which means they have achieved an effective scale. These companies have done a better job in enterprise management, innovation ability, and system design and execution, boosting the efficiency of business. In addition, the 2345 efficiency score is 0.978 and there is a slight loss of efficiency. The management efficiency can be improved by further optimizing the management model. For a long time, the software technical efficiency score is only 0.624, the loss of efficiency is close to 40%. Its managers need to find problems in management level, innovation power and system design in order to get rid of inefficient operation as soon as possible.

**Analysis of Scale Efficiency (SE)**

The results of the empirical test show that the scale efficiency results show that 9 scale efficiency scores of 15 companies are 1, and the scale efficiency is achieved, that is, at the present optimal production scale, the scale economy is the highest. The remaining 6 companies have lost scale efficiency. Compared with the industry benchmark, UFIDA has a gap of more than 40%. These 6 companies need to allocate resources rationally and optimize the allocation of resources so as to improve economies of scale.

**Analysis of Scale Reward**

After the empirical test of the scale efficiency of each company, it is found that the 9 companies such as Su Ning Yun business and other companies are in the same state of scale reward, that is, the proportion of output growth is equal to the proportion of investment. Shenzhen Huaqiang, long its software, Huijin shares and an information of 4 companies are in a state of increasing returns to scale, so we need to further expand the scale of investment and bring enterprises into the scale of
economies of scale. 2345 and UF network are in the stage of diminishing returns to scale, indicating that the current scale is more than the optimal production scale. Therefore, the reduction of low efficiency assets should be reduced so as to release the space for operational efficiency.

SUGGESTIONS

This paper selects 15 Internet financial sector listed companies' input and output data at the end of 2017 year, uses data envelopment analysis method to calculate the operating efficiency of Sample Firms, and makes a comparative analysis from four aspects of comprehensive efficiency, pure technical efficiency, scale efficiency and scale reward, and draws the following conclusions:

The efficiency of Internet financial enterprises is relatively high, but the efficiency gap between different companies is obvious, and the inefficiency of scale is the main reason leading to low operation efficiency.

Based on the above conclusions, the following suggestions are put forward for the development of Internet financial companies:

(1) Give full play to the advantages of the industry with low operating costs and high management efficiency, continue to expand service extensions, and realize deep value in cross-industry areas.

(2) Internet finance companies should strive to explore strategies for improving operational efficiency from the perspective of economies of scale management, find the optimal scale for their own operations, and achieve economies of scale.

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